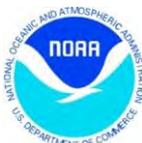


Tidal Wetlands Management Technical Support

Center for Coastal Resources Management
Virginia Institute of Marine Science
Grant #NA17NOS4190152, Task #6

Oct 30, 2018



Virginia Coastal Zone
MANAGEMENT PROGRAM

This project was funded, in part, by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant # NA17NOS4190152 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its subagencies

Table of Contents

Product 1: General Technical Guidance

Guidance Summary.....	4
Details of Advisory Requests – Advisory Database	5
Living Shoreline Requests	6
Details of Data Requests – Shoreline Permit Database	9
Database Data Requests	10
Preferred Shoreline Management Approach Reviews	11

Product 2: Education / Outreach

Tidal Wetlands Workshop Summary	13
Participants List	14
Agenda	17
Speaker Contact Information	19
Additional Resources Links.....	20
Presentation 1 – Workshop Objectives.....	21
Presentation 2 – Case Study Reviews.....	32
Presentation 3 – Living Shoreline Ecology.....	37
Presentation 4 – Residential-Scale Case Studies.....	56
Presentation 5 – Urban Estuary Restoration: Large Scale and Co-Located Projects	69
Presentation 6 – Nature-Based Features for Coastal Resilience.....	97
Presentation 7 – Shoreline Erosion Advisory Service.....	111
Presentation 8 – Legislative Updates	141
Presentation 9 – Shoreline Program Updates.....	146
Other Handouts.....	156
Additional Training Summary	161
Publications Summary	162
e-News, January 2018	163
e-News, April 2018	167
e-News, July 2018	171
e-News, September 2018.....	175
Rivers & Coast, Summer 2018.....	179

Product 1: General Technical Guidance

The Center for Coastal Resources Management (CCRM) continues to provide technical advice to the general public, regulatory and non-regulatory authorities. Advice on joint permit applications is coordinated through the VIMS Office of Research and Advisory Service and CCRM input is incorporated into a VIMS response for project review. We continue to provide general advice on shorelines and marine issues via phone, email, and/or when feasible on-site. In order to maximize the efficacy of site visit efforts, we focus on requests that involve living shoreline suitability assessments, proposed living shoreline projects and those from more rural localities. Advice draws from routinely used data and tools including on-line resources at CCRM/VIMS, from other coastal partners and agencies, aerial imagery, decision tools and decision models. All general technical guidance is tracked in the Advisory Database and all projects associated with a Joint Permit Application (JPA) are tracked in the Shoreline Permit Database.

Advisory Database: The Center continues to populate an advisory database to track our provision of technical advice outside of the joint permit process so that we can adapt CCRM's guidance development and outreach program to address issues identified through data analysis.

Technical Advisory and General Information – 74

Shoreline Permit Database: This database is continuously updated to track Virginia tidal shoreline erosion control projects. Permitted projects and decisions are compared with the preferred shoreline best management approach derived from the Comprehensive Coastal Resource Management Portals (CCRMPs). During this review, projects are categorized into CCRM-defined types; the location of the projects are geo-referenced; and project information is collected and entered into the database. This information is used to support various CCRM coastal resources management activities.

CCRMPs: www.vims.edu/ccrm/ccrmp/index

Preferred Shoreline Management Approach Reviews – 2,121

Historical Permit Records Database: The Center for Coastal Resources Management also serves the historical records for tidal wetland Joint Permit Applications (JPA) in a searchable database online. These records include 31,130 original JPAs and all associated photos, public hearing notices, additional information, and VIMS Reports. All records prior to January 1, 2010 as well as a link to current records can be found on CCRM's website here: www.vims.edu/ccrm/lwb_info/permits/index

Information concerning the data collected and extracted from these databases is provided in detail in the next section.

Details of Advisory Requests (extracted from the Advisory Database):

Type of Advice Requested:

• Erosion Control Advice (11 of these specific to living shorelines)	17
• Plant Recommendations/Plant Identification/Vendor Information (wetland, beach, dune, riparian buffer)	14
• Database Information (contractor info, number of living shorelines, etc.)	8
• Phragmites/Invasive Species Control	3
• Total Maximum Daily Load (TMDL)	3
• Stormwater Management	2
• Submerged Aquatic Vegetation (SAV)	2
• CCRMP/Decision Trees	2
• Miscellaneous (floating wetlands, dredge disposal, fish advisories, etc.)	23

Advice Requested From:

• Citizen/Property Owner	35
• Community/Non-Profit/NGO/Master Gardener/Naturalist	14
• Local Government/Wetland Board Staff or Member/Elected Officials	14
• State Agencies (including VIMS)	8
• Academic/Research	2
• Consultant	1

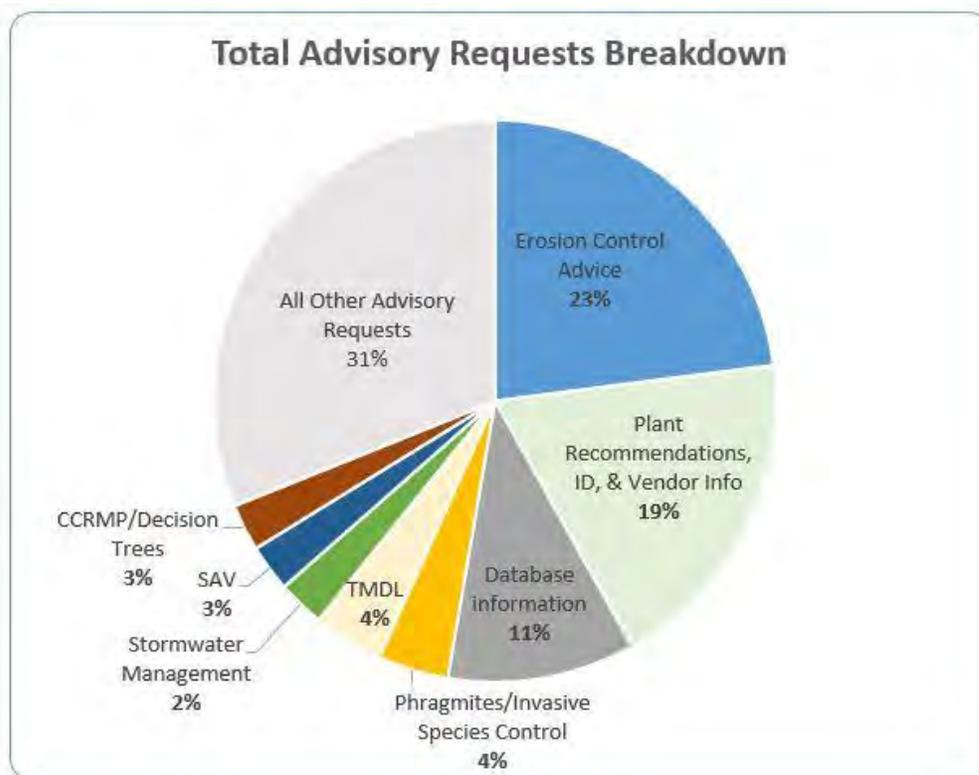


Figure 1.

As is illustrated in Figure 1, of **all categories** of advisory service requested this grant period, shoreline erosion control as a group topped the list, as it has in past grant periods.

Living Shoreline Requests:

Of the advisory requests associated with **shoreline erosion control**, 65% were related to the living shoreline management approach. (Figure 2)

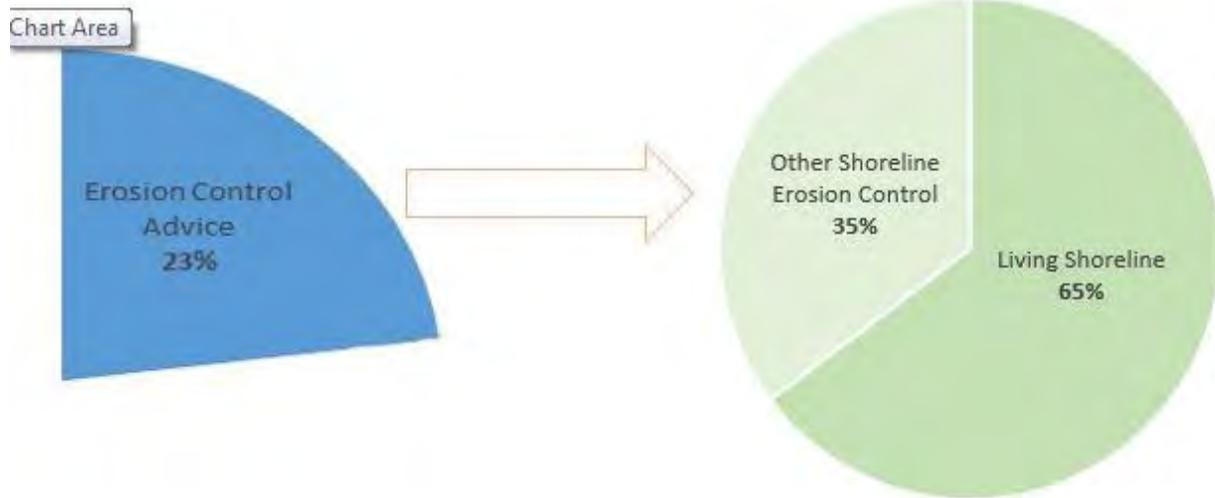


Figure 2.

Citizens and property owners were the largest group requesting information on living shorelines followed by community and non-profit groups. (Figure 3)

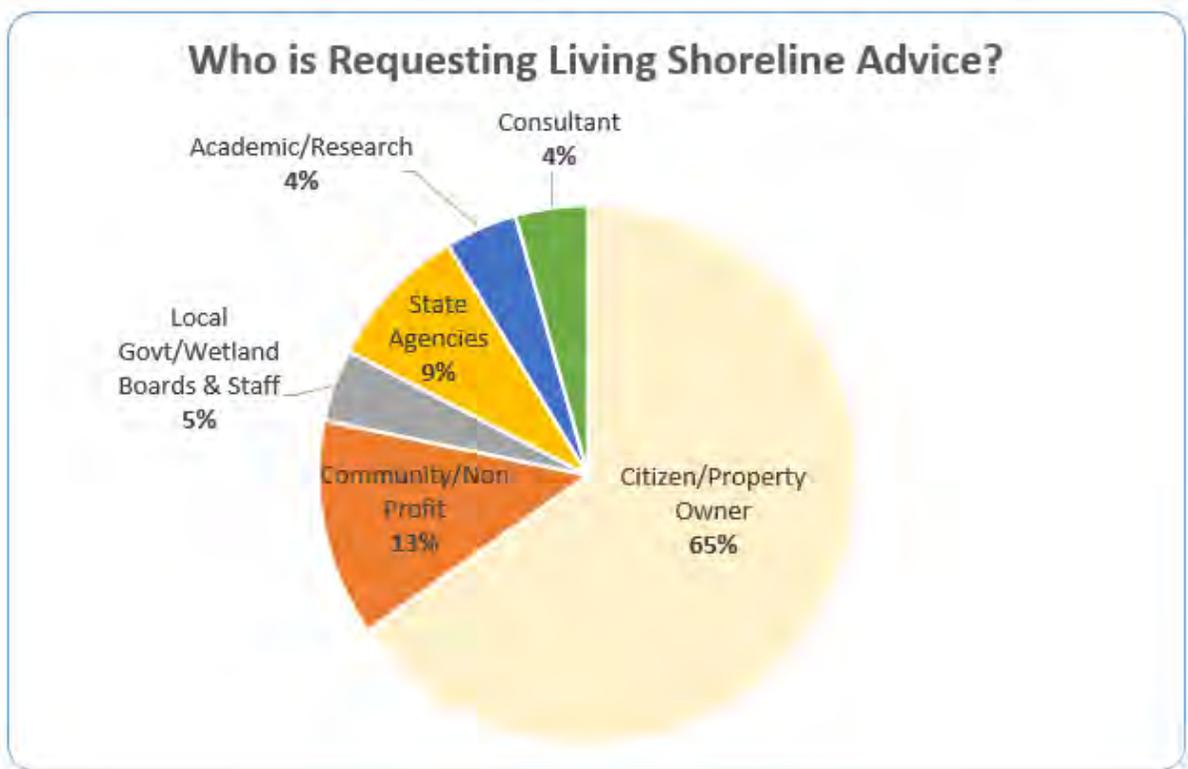


Figure 3.

Locality Type of Living Shoreline Advice Requested:

The percent of living shoreline requests from citizens/property owners living in rural localities this grant period decreased to 15%, down from 50%. Living shoreline advisory requests in suburban localities increased and requests in urban designated localities remained zero. Two local governments (represented by local government staff, wetlands board, and elected officials) requested living shoreline advice this grant period. One was a request from a suburban locality and the other was from out of state. (Figure 4)



Figure 4.

Living Shoreline Advisory Requests Summary:

31% of all advisory requests received during this grant period were in reference to living shorelines, similar to last grant period (30%) and up from 24% previous to that. Figure 5 illustrates the breakdown of topics related to living shoreline advisory requests. (Figure 5)

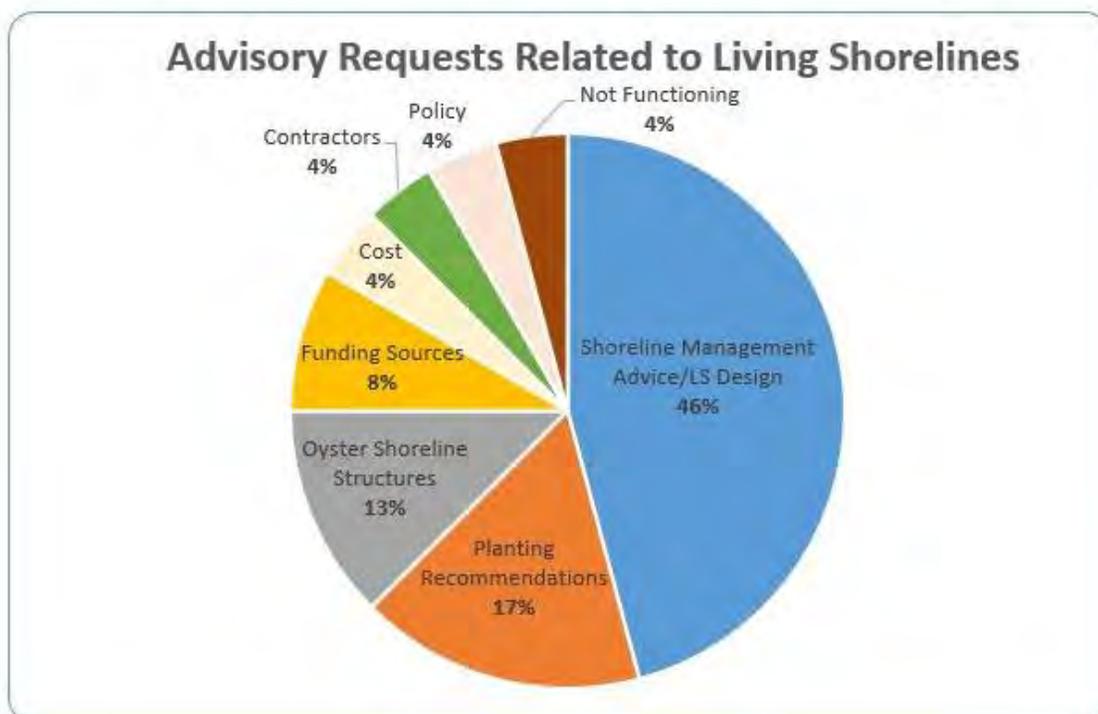


Figure 5.

Overall, the total number of living shoreline related requests from citizen/property owners and local governments remained similar, while there was a slight decrease in requests from state government and out of state government requests this grant period. Site visits were conducted for eight living shoreline advisory requests this grant period. Not all requests warrant a site visit. (Figure 6)

LOCALITY	CITIZEN	LOCAL GOV'T	OTHER	TOTAL	LOCALITY TYPE
Out of State - Tidewater		1	2	3	NA
Chesapeake			2	2	Suburban
Gloucester	4		1	5	Suburban
Hampton	1	1		2	Suburban
King and Queen	1			1	Rural
Lancaster			2		Rural
Mathews	5			5	Suburban
Middlesex	1			1	Rural
Northumberland			1	1	Rural
York	1			1	Suburban
TOTAL	13	2	8	23	

Figure 6. Living Shoreline Advice Requested

Details of Data Requests (extracted from the Shoreline Permit Database):

Using Microsoft Access, CCRM developed a comprehensive database utilizing fillable forms to house Virginia tidal shoreline erosion control permit and associated project information. The CCRM Shoreline Permit Database integrates Virginia project and permit information from a variety of existing sources into one master, searchable database. Center staff continues to populate the database with new information collected from Joint Permit Applications (JPAs) submitted to the Virginia Marine Resources Commission (VMRC); project shoreline site characteristics from local government websites, Google Earth and Bing maps; and preferred shoreline management recommendations from CCRM's Comprehensive Coastal Resource Management Portal (CCRMP).

Data has been collected on 16,040 shoreline erosion control projects to date. This includes basic information like the VMRC number; applicant name and contact information; property owner information; contractor; project type, length, impacts, wetlands board decision, board minutes, year built; project location (site address, locality, parcel ID, and lat., long.); fetch and waterway in addition to specific information that is required to support various aspects of CCRM projects, such as field site selection, comparative assessments, and a variety of surveys and analyses of social and natural systems.

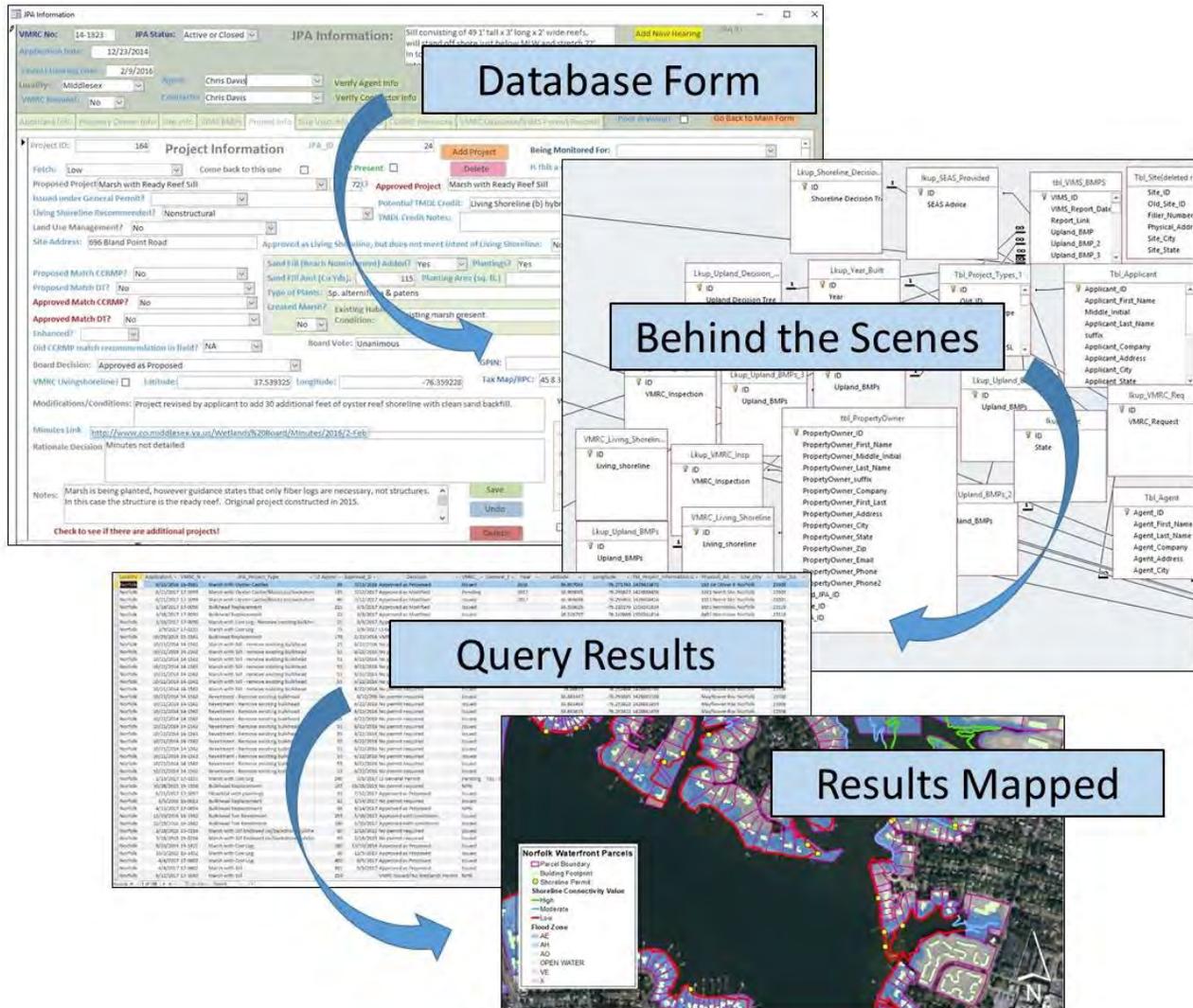


Figure 7. Database screens and output example.

Database Data Requests:

The following is a list of projects that benefited from data queries this grant year. (Figure 8)

AGENCY	PROJECT	DATA REQUEST
DCR Shoreline Erosion Advisory Service	Chesapeake Bay TMDL BMP Verification Project for Shorelines	Living shoreline projects categorized for structure type, fetch, length and geo-located
The National Oceanic and Atmospheric Administration (NOAA)	Project of Special Merit: Implementing Sustainable Shoreline Management in Virginia: Assessing the Need for an Enforceable Policy	Shoreline permit data and analyses of local government decisions, permit type, location, etc. before and after the living shoreline policy
The National Oceanic and Atmospheric Administration (NOAA)	Increasing Use of Natural and Nature-Based Features to Build Resilience to Storm-Driven Flooding	Living shoreline and oyster project locations and data
Chesapeake Bay Foundation/ VIMS	Living Shoreline Training Field Trip for Soil and Water Conservation District (SWCD) Staff	Mapped living shoreline and oyster projects in Lynnhaven Watershed and provided associated data
Chesapeake Bay Trust	Study on Influence of Shoreline Conditions on Fish	All shoreline project type structures in York River Watershed (2000-2016) locations and data
University of Melbourne Research Fellow, National Centre for Coasts and Climate	Conducting Comparative Assessments of Wave Attenuation of Oyster Structures, Stone Sills, and Control Shorelines	Oyster (shell, bag, and structure) shoreline project data (2000-2018) compiled
National Science Foundation (NSF)	Shorescapes Project	Identified sites meeting selected project criteria for field investigation of multiple ecosystem functions of living shorelines
National Science Foundation (NSF)	Waterfront Property Owner Social Survey	Gloucester, Norfolk, and Lancaster shoreline permit data, locations and property owner information for 2013-2018
National Science Foundation (NSF)	Shoreline Modification Decision Making Analyses	Gloucester and Norfolk shoreline permit data and locations

Figure 8.

Preferred Shoreline Management Approach Reviews:

CCRM routinely reviews all Joint Permit Applications (JPA) involving shoreline erosion control activities advertised for public hearings on local wetlands board agendas. Each approved project and permit decision is compared to the recommended preferred management approach derived from the CCRMP's to evaluate the agreement between wetlands board decisions and the VIMS comprehensive coastal resource management guidance. The goal of the recommended preferred approach is to foster the sustainability of shoreline resources using living shoreline designs where appropriate and applying traditional shoreline hardening only in areas where site conditions make them necessary. These recommendations reflect the Commonwealth's preferred approach for shoreline stabilization using living shoreline treatments whenever adequate erosion control can be achieved. See the table of the JPAs reviewed for agreement with the guidance this performance period. (Figure 9)

LOCALITY	TOTAL PROJECTS REVIEWED	YES	NO
Accomack	28	1	27
Alexandria	1	0	0
Cape Charles	1	1	0
Charles City	3	1	2
Chesapeake	9	1	8
Essex	4	0	4
Gloucester	27	10	17
Hampton	3	0	3
Isle of Wight	4	1	3
James City	4	1	3
King and Queen	4	0	0
King George	8	1	7
Lancaster	49	9	40
Mathews	35	13	22
Middlesex	42	7	35
New Kent	1	0	1
Newport News	2	0	2
Norfolk	26	7	19
Northampton	12	6	6
Northumberland	58	10	48
Poquoson	6	1	5
Portsmouth	3	0	3
Prince George	1	0	1
Prince William	2	0	2
Richmond County	20	4	16
Stafford	1	0	1
Suffolk	3	0	3
Virginia Beach	97	8	89
Westmoreland	30	5	25
York	17	5	12
TOTAL	496	92	404

Figure 9.

An additional 63 projects in “Areas of Special Concern” (e.g. marinas, canals, or industrial) and 19 projects assessed as “N/A” (where no CCRMP recommendation is available to compare to) were reviewed. These approved projects are included with the totals from Figure 9 on the map below (Figure 10).

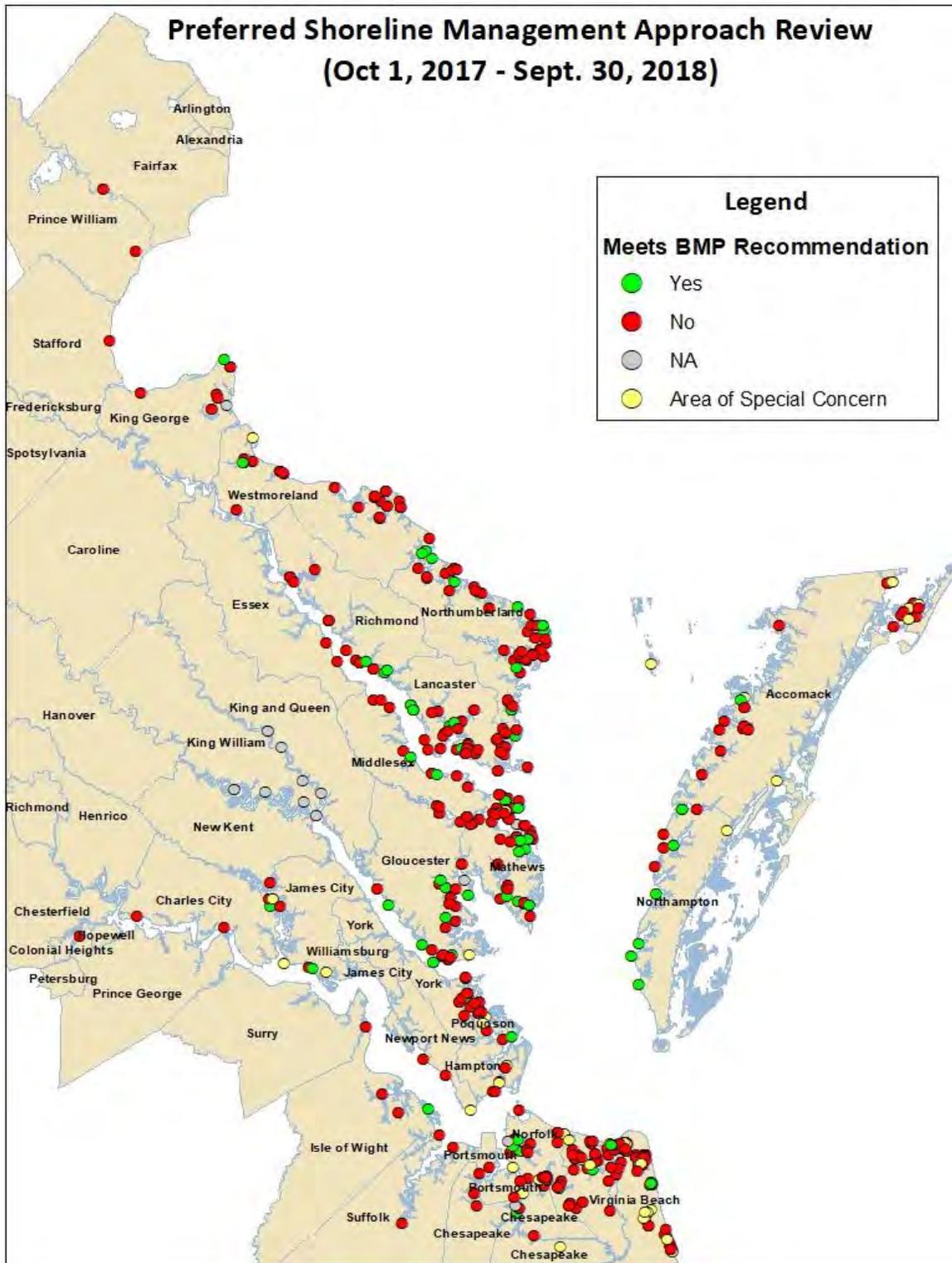


Figure 10.

Product 2: Education / Outreach

Tidal Wetlands Workshop

Shoreline Best Practice Case Studies: What Nature-Based Shorelines Look Like & How They Work

The Center for Coastal Resources Management staff planned, organized, and presented at our annual Tidal Wetlands Workshop on June 14, 2018. There were 109 registered workshop participants representing local governments (13), Wetlands Boards (7), state agencies (4), non-profit organizations (7), private consulting and engineering firms (6), and other private individuals.

The first half of the workshop included case study review presentations by Center personnel, the Department of Conservation and Recreation's Shoreline Erosion Advisory Service, the Elizabeth River Project, and an Old Dominion University researcher. The concurrent afternoon sessions included indoor and outdoor experiences meant to expound on the information gleaned in the presentations.

Listed below, all presentations and other workshop materials are available online:

<http://www.vims.edu/ccrm/outreach/workshops/2018/index.php>

Handouts

- Agenda
- Speaker Contacts and Program Information

Case Study Review Presentations

- Case Study Reviews
- Workshop Objectives & Logistics
- Living Shoreline Ecology
- Residential-Scale Case Studies: Examples from River Star Homes
- Urban Estuary Restoration: Large Scale & Co-Located Projects with Multiple Benefits
- Nature-Based Features for Coastal Resilience: Quantifying Wave Dissipation Shoreline Management BMP Verification for Chesapeake Bay TMDL Credits

Shoreline Program Updates

- 2018 Legislative Update
- Other Shoreline Program Updates

Concurrent Indoor & Outdoor Experiences

- VIMS Offshore Breakwaters & Beach Nourishment Case Study
- VIMS Teaching Marsh Case Study
- Drone Demonstration
- Hands-On Shoreline Management computer tools
- Wetlands Board e-Handbook

Participants List

Dan Adams	Stafford County – Wetlands Board	<i>adams.dan@verizon.net</i>
John Bateman	Northern Neck Planning District Commission	<i>jbateman@nnpdc17.state.va.us</i>
Emily Bazemore	City of Virginia Beach	<i>ebazemor@vbgov.com</i>
Margie Beane	NNMG Shoreline Evaluation Program	<i>margieb1121@gmail.com</i>
Clay Bernick	Clay Bernick Environment & Sustainability, LLC	<i>cbernickiii@gmail.com</i>
Pattie Bland	Hanover-Caroline SWCD	<i>ppbland@hanovercounty.gov</i>
Pam Boatwright	Elizabeth River Project	<i>pboatwright@elizabethriver.org</i>
Maura K. Boswell	Old Dominion University	<i>mbosw002@odu.edu</i>
Vicky Bowen	Northern Neck Master Gardeners	<i>bowenv@gmail.com</i>
Nathan Bowman	City of Norfolk – Wetlands Board	<i>nathan.bowman@norfolk.gov</i>
Barbara Brumbaugh	City of Chesapeake – Public Works	<i>bbrumba@cityofchesapeake.net</i>
Bobbie Burton	Northern Neck Master Naturalist	<i>burtonbs@longwood.edu</i>
Karla Carter	City Attorney's Office – Suffolk	<i>kdcarter@suffolkva.us</i>
Ian Cheyne	NNMG Shoreline Evaluation Program	<i>iancheyne@hotmail.com</i>
Bill Clarke	City of Poquoson – Wetlands Board	<i>theclarkee@gmail.com</i>
David K. Compton	City of Virginia Beach – Wetlands Staff	<i>dcompton@vbgov.com</i>
Sharon Conner	Hanover-Caroline SWCD	<i>sconner@hanovercounty.gov</i>
Darryl Cook	James City County	<i>darryl.cook@jamescitycountyva.gov</i>
Emily Cope	James River Association	<i>ecope@jrava.org</i>
Barbara Cummings	Waterfront Property Owner	<i>barbmcn@msn.com</i>
Karen Davis	Concerned Citizen	<i>ccbeachglass@gmail.com</i>
Larry DiRe	Town of Cape Charles	<i>planner@capecharles.org</i>
Anna Drake	York County	<i>drakea@yorkcounty.gov</i>
Louise Eichenlaub	Mathews-Middlesex Master Gardener	<i>lieichenlaub@gmail.com</i>
Brad Ellis	Moffatt & Nichol	<i>bellis@moffattnichol.com</i>
Mimi Faha	Stafford County	<i>mfaha@staffordcountyva.gov</i>
Sara Felker	City of Newport News	<i>sfelker@nnva.gov</i>
Karen Fetty	Hanover-Caroline SWCD	<i>kifetty@hanovercounty.gov</i>
Cole Fisher	City of Virginia Beach – Planning Department	<i>csfisher@vbgov.com</i>
Rich Foley	City of Hampton – Wetlands Board	<i>foleyr@verizon.net</i>
Ben Foster	Stafford County	<i>bfoster@staffordcountyva.gov</i>
Lynne France	City of Hampton – Wetlands Board	<i>francelj@cdmsmith.com</i>
Jeff Frye	York County – Wetlands Board	<i>jfff109@gmail.com</i>
Barbara Gavin	Elizabeth River Project	<i>bgavin@elizabethriver.org</i>
Bethany Gordon	University of Virginia – Civil Engineering	<i>bmg6bt@virginia.edu</i>
Andrew Griffey	City of Hampton	<i>apgriffey@hampton.gov</i>
Debbie Gwaltney	Northern Neck Master Gardeners	<i>dbgwaltney@gmail.com</i>
Cindy Hall	City Attorney's Office – Norfolk	<i>cynthia.hall@norfolk.gov</i>
Scott Hardaway	VIMS – Shoreline Studies Program	<i>hardaway@vims.edu</i>
Tracey Harmon	Virginia Department of Transportation	<i>tracey.harmon@vdot.virginia.gov</i>
Sue Henderson	Stafford County – Wetlands Board	<i>suehenderson@earthlink.net</i>
Kent Henkel	York County	<i>henkel@yorkcounty.gov</i>
Karen Holloway	City of Poquoson	<i>karen.holloway@poquoson-va.gov</i>
Wally Horton	City of Poquoson	<i>charles.horton@poquoson-va.gov</i>

Participants List

Yinting Hou	KCI Technologies, Inc.	<i>yinting.hou@kci.com</i>
Kim Hummel	Isle of Wight County	<i>khummel@isleofwightus.net</i>
David Imburgia	City of Hampton	<i>dimburgia@hampton.gov</i>
Mike Kelly	City of Suffolk – Parks & Recreation	<i>mkelly@suffolkva.us</i>
Susan Lindsey	NNMG Shoreline Evaluation Program	<i>kingdon@va.metrocast.net</i>
Eric Loescher	Timmons Group	<i>eric.loescher@timmons.com</i>
Marc Longest	Middlesex County	<i>m.longest@co.middlesex.va.us</i>
Laura Major	Timmons Group	<i>laura.major@timmons.com</i>
Deborah Marl	NNMG Shoreline Evaluation Program	<i>dmarl2398@gmail.com</i>
Ruth Martin	Lafayette Wetlands Partnership	<i>ruth_m_martin@hotmail.com</i>
Seamus McCarthy	City of Norfolk	<i>Paid - 6/14/18.mccarthy@norfolk.gov</i>
Wayne McCoy	Mid Atlantic Environmental LLC	<i>midatlanticenvironmental@yahoo.com</i>
Aqiylah McGill	City of Hampton	<i>amcgill@hampton.gov</i>
Charles McKenna	City of Virginia Beach – Wetlands Staff	<i>cmckenna@vbgov.com</i>
Whitney McNamara	City of Virginia Beach	<i>wmcmamar@vbgov.com</i>
Veronica Meade	City of Hampton	<i>vmeade@hampton.gov</i>
Jim Mershon	City of Hampton – Wetlands Board	<i>jmers101@gmail.com</i>
Kim Mikel	City of Hampton	<i>kdmikel@hampton.gov</i>
Betty Mill	Virginia Cooperative Extension	<i>bettymill@dymeroaks.net</i>
Jennifer Monument	City of Portsmouth – Wetlands Board	<i>jmonument1@gmail.com</i>
Shep Moon	Virginia CZM Program	<i>shep.moon@deq.virginia.gov</i>
Sharon Neal	City of Newport News	<i>sneal@nnva.gov</i>
Claire Neubert	City of Hampton – Wetlands Board	<i>dcneubert@hotmail.com</i>
Dave Newton	Oysters Forever	<i>mobjackman@gmail.com</i>
Arash Niroomandi	Moffatt & Nichol	<i>aniroomandi@moffatnichol.com</i>
Dannan O'Connell	City of Poquoson	<i>dannan.oconnell@poquoson-va.gov</i>
Tracy Outten	Town of Cape Charles	<i>tracy.outten@capecharles.org</i>
Cornell Owens	City of Poquoson – Wetlands Board	<i>hokie1456@cox.net</i>
Ron Owens	Gloucester County – Environmental Programs	<i>rowens@gloucesterva.info</i>
Joseph Parfitt	Virginia Department of Transportation	<i>joseph.parfitt@vdot.virginia.gov</i>
David Parks	City of Suffolk – Wetlands Board	<i>dparks@suffolkva.us</i>
Kenneth Paulson	City of Norfolk – Wetlands Board	<i>2eovbeach@gmail.com</i>
Chuck Payne	City of Virginia Beach – Planning Department	<i>cpayne@vbgov.com</i>
Bruce Pfirrmann	Virginia Dept of Conservation & Recreation	<i>bruce.pfirrmann@dcr.virginia.gov</i>
Andy Pineau	Stafford County – Wetlands Board	<i>andypineau@aol.com</i>
Stacy Porter	City of Portsmouth	<i>porters@portsmouthva.gov</i>
Walt Priest	Gloucester County – Wetlands Board	<i>wetlanddesign@gmail.com</i>
Phil Prisco	City of Poquoson – Wetlands Board	<i>priscop@verizon.net</i>
Scott Rae	Stafford County – Environmental Programs	<i>srae@staffordcountyva.gov</i>
Michael Reitelbach	City of Suffolk – Wetlands Board	<i>mreitelbach@suffolkva.us</i>
Joe Rieger	Elizabeth River Project	<i>jrieger@elizabethriver.org</i>
Hannah Sabo	City of Hampton	<i>hmsabo@hampton.gov</i>
Grace Saunders	Elizabeth River Project	<i>gsaunders@elizabethriver.org</i>

Participants List

Hunter Sledd	NNMG Shoreline Evaluation Program	<i>unc1971@gmail.com</i>
Porshia Smith	City of Virginia Beach	<i>psmith@vbgov.com</i>
Ben Snyder	Timmons Group	<i>ben.snyder@timmons.com</i>
Travis Spangler	Timmons Group	<i>travis.spangler@timmons.com</i>
Steve Ballard	City of Norfolk – Wetlands Board	<i>steveballard@cox.net</i>
Elizabeth Taraski	Nansemond River Preservation Alliance	<i>taraski.nrpa@gmail.com</i>
Troy Thompson	City of Hampton – Wetlands Board	<i>troyrennthompson@gmail.com</i>
Andrew Tiefenback	Stantec	<i>andrew.tiefenback@stantec.com</i>
Mary Turville	NNMG Shoreline Evaluation Program	<i>m2turville@aol.com</i>
Mike Vanlandingham	Virginia Dept of Conservation & Recreation	<i>mike.vanlandingham@dcr.virginia.gov</i>
Leigh Waldron	Concerned Citizen	<i>buildodqc@gmail.com</i>
Ann Hayward Walker	Town of Cape Charles – Wetlands Board	<i>ahwalker@seaconsulting.com</i>
Nicole Ward	City of Suffolk – Wetlands Board	<i>nward@suffolkva.us</i>
Herman Weaver	City of Portsmouth – Wetlands Board	<i>doc.weaver60@gmail.com</i>
Aaron Wendt	DCR Shoreline Erosion Advisory Service	<i>aaron.wendt@dcr.virginia.gov</i>
Clyde Williams	Concerned Citizen	<i>bubbasue1@cox.net</i>
Charles Wingo	Concerned Citizen	<i>chasew3@gmail.com</i>
Jim Winters	Nansemond River Preservation Alliance	<i>jamesmwinters@yahoo.com</i>
Billy Wood	<i>past</i> City of Hampton – Wetlands Board	<i>woodsorchards@verizon.net</i>
Eric Woodley	City of Portsmouth – Wetlands Board	<i>ericwoodley08@gmail.com</i>
Peter Worgess	City of Norfolk – Wetlands Board	<i>pworgess@msn.com</i>
Rebecca Yasky	York County – Wetlands Board	<i>ryasky@gmail.com</i>

Shoreline Best Practice Case Studies

Thursday June 14, 2018

Virginia Institute of Marine Science

Gloucester Point, VA

PLANNED AGENDA

8:00 – 9:00 am *Check-in & Coffee*

9:00 – 10:30 am **CASE STUDY REVIEWS** *Watermen's Hall auditorium*

Workshop Objectives *Karen Duhring, VIMS Center for Coastal Resources Management*

Living Shoreline Ecology Case Studies

Molly Mitchell, VIMS Center for Coastal Resources Management

Residential-Scale Case Studies: Examples from River Star Homes

Barbara Gavin, River Star Homes Program Manager, Elizabeth River Project

Urban Estuary Restoration: Restoration of multiple habitats to provide great habitat quality

Joe Rieger, Deputy Director of Restoration, Elizabeth River Project

Nature-Based Features for Coastal Resilience: Quantifying Wave Dissipation

Maura Boswell, P.E. Old Dominion University & Virginia Sea Grant Graduate Research Fellow

10:30 – 10:50 am *20-minute Break*

10:50 – 12:00 pm **CASE STUDY REVIEWS (continued)** *Watermen's Hall auditorium*

Shoreline Management BMP Verification for Chesapeake Bay TMDL Credits

Aaron Wendt, VA Department of Conservation & Recreation – Shoreline Erosion Advisory Service

Case Study Best Practices Review

Moderated by Karen Duhring, VIMS Center for Coastal Resources Management

12:00 – 1:00 pm **LUNCH** *included for registered participants*

1:00 – 1:45 pm **SHORELINE PROGRAM UPDATES** *Watermen's Hall auditorium*

VMRC Group 1 & Group 2 Living Shoreline General Permits

Funding Support Programs Update

2018 Virginia General Assembly Update

Other Tidal Shoreline News & Announcements

1:45 – 2:00 pm *Break & transition to Indoor & Outdoor Sessions*

PLANNED AGENDA *continued*

2:00 – 3:15 pm **CONCURRENT INDOOR & OUTDOOR SESSIONS** *See map for locations*

*Choose between 5 stations for 30-minute sessions
VIMS cart shuttles available to move between stations*

2:00 – 2:30 pm **Indoor - Outdoor Session 1**

2:30 – 2:45 pm *Transfer between stations*

2:45 – 3:15 pm **Indoor - Outdoor Session 2**

1 VIMS Offshore Breakwaters & Beach Nourishment Case Study

Scott Hardaway, VIMS Shoreline Studies Program & Bruce Pfirrmann, DCR-SEAS

Preferred features in beach nourishment and offshore breakwater projects are demonstrated, including a wide, dynamic beach created with suitable sand, a stable planted dune area, and stable breakwater structures. This case study also illustrates how a bulkhead shoreline was converted to a nature-based feature & how submerged aquatic vegetation (SAV) can affect project designs.

2 VIMS Teaching Marsh Case Study *Christine Tombleson & Julie Bradshaw, VIMS-CCRM*

Preferred features in living shoreline marshes are demonstrated at the Teaching Marsh. These features include wide planted marshes with both low and high marsh, gradual slopes, a low-profile marsh sill, salt- & flood-tolerant native plants in the riparian buffer, and an oyster restoration reef. The co-benefits of multiple habitats located in close proximity are also illustrated.

3 Drone Demonstration *Kory Angstadt, VIMS-CCRM*

Learn how a Mavic Pro drone is being used for CCRM shoreline & wetlands research, including the steps required to create a flight plan, capture still & video images, collect elevation data, and the process of converting all of the collected images and data into meaningful analyses.

4 Hands-On Shoreline Management Tools *Technology Classroom, Watermen's Hall*

Molly Mitchell & Tamia Rudnicky, VIMS-CCRM

This station provides an opportunity to learn about and practice using GIS mapping tools at individual computer stations. After a short introduction to various tools, CCRM staff will be present to provide guidance and answer questions while you practice using the tools. Please don't bring food or drinks into this computer classroom.

5 Wetlands Board e-Handbook *Owens-Bryant Board Room, Davis Hall*

Pamela Mason, VIMS-CCRM & Clay Bernick, Clay Bernick Environment & Sustainability, LLC

This session will introduce a proposed e-Handbook for Wetlands Boards explaining what it is and what should be included. Participants will be asked about what contents are most needed to support best practice policies and efficient programs.

3:15 - 3:30 pm *Complete Workshop Evaluations & leave at Registration Table
Visit VIMS Gift Shop*

Shoreline Best Practice Case Studies

Thursday June 14, 2018

Virginia Institute of Marine Science

Gloucester Point, VA

SPEAKER CONTACT INFORMATION

An electronic version of this handout will be available on the CCRM Workshop web site.

Speaker Contact Info	Related Web Site(s)
<p>Karen Duhring Outreach & Training Coordinator VIMS Center for Coastal Resources Management karend@vims.edu (804) 684-7159</p>	<p>Center for Coastal Resources Management (CCRM) http://www.vims.edu/ccrm/</p>
<p>Molly Mitchell Marine Scientist VIMS Center for Coastal Resources Management molly@vims.edu (804) 684-7931</p>	<p>CCRM Coastal Ecology Research http://www.vims.edu/ccrm/research/ecology/index.php</p>
<p>Pamela Mason Marine Scientist VIMS Center for Coastal Resources Management mason@vims.edu (804) 684-7158</p>	<p>CCRM Wetlands Management http://www.vims.edu/ccrm/wetlands_mgmt/index.php</p>
<p>Barbara Gavin River Star Homes Program Manager Elizabeth River Project bgavin@elizabethriver.org (757) 399-7487 x215</p>	<p>Elizabeth River Project https://www.elizabethriver.org/</p>
<p>Joe Rieger Deputy Director of Restoration Elizabeth River Project jrieger@elizabethriver.org (757) 392-7133</p>	<p>Elizabeth River Project https://www.elizabethriver.org/</p>
<p>Maura Boswell, P.E. Old Dominion University doctoral candidate mbosw002@odu.edu</p>	<p>Civil Engineering Ph.D. Student Puts Virginia Sea Grant Fellowship to Work on Living Shorelines https://www.odu.edu/news/2018/1/maura#.Wx_RC1onZhE</p>
<p>Aaron Wendt Shoreline Engineer VA Department of Conservation & Recreation Shoreline Erosion Advisory Service SEAS aaron.wendt@dcr.virginia.gov (804) 443-5642</p>	<p>Shoreline Erosion Advisory Service SEAS http://www.dcr.virginia.gov/soil-and-water/seas</p>

Shoreline Best Practice Case Studies

Thursday June 14, 2018

Virginia Institute of Marine Science

Gloucester Point, VA

ADDITIONAL RESOURCES

General Living Shorelines Information

[VIMS Center for Coastal Resources Management – Outreach – Living Shorelines](http://www.vims.edu/ccrm/outreach/living_shorelines/index.php)

http://www.vims.edu/ccrm/outreach/living_shorelines/index.php

[VIMS Living Shorelines Story Map – Marshes & Oysters](https://vims-wm.maps.arcgis.com/apps/MapJournal/index.html?appid=0132309272c44ffeb61cac08ae07798f)

<https://vims-wm.maps.arcgis.com/apps/MapJournal/index.html?appid=0132309272c44ffeb61cac08ae07798f>

[VIMS Living Shorelines Story Map – Beaches & Dunes](https://vims-wm.maps.arcgis.com/apps/MapJournal/index.html?appid=92e2148aa11e4216a21012ae1b2413e3)

<https://vims-wm.maps.arcgis.com/apps/MapJournal/index.html?appid=92e2148aa11e4216a21012ae1b2413e3>

[VIMS Living Shoreline Design Guidelines](https://scholarworks.wm.edu/reports/833/) *updated September 2017*

<https://scholarworks.wm.edu/reports/833/>

[VIMS Living Shorelines Laws, Policies & Permits](http://www.vims.edu/ccrm/outreach/living_shorelines/laws/index.php)

http://www.vims.edu/ccrm/outreach/living_shorelines/laws/index.php

GIS Mapping & Decision Tools

[Adapt Virginia](http://www.adaptva.org/) <http://www.adaptva.org/>

[VIMS Comprehensive Coastal Resource Management Portals](http://www.vims.edu/ccrm/ccrmp/index.php) <http://www.vims.edu/ccrm/ccrmp/index.php>

[VIMS Shoreline Management Model & Best Management Practices](http://www.vims.edu/ccrm/ccrmp/bmp/smm/index.php)

<http://www.vims.edu/ccrm/ccrmp/bmp/smm/index.php>

[VIMS Self-Guided Decision Tools](http://www.vims.edu/ccrm/ccrmp/bmp/decision_tools/index.php) http://www.vims.edu/ccrm/ccrmp/bmp/decision_tools/index.php

Shoreline Management & TMDL Information

[Shoreline Management Fact Sheet](https://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2018/06/U-14-Shoreline-Management-Fact-Sheet_final.pdf) *for TMDL credits by the Chesapeake Stormwater Network*

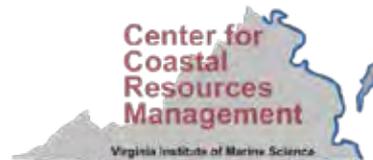
https://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2018/06/U-14-Shoreline-Management-Fact-Sheet_final.pdf

[TMDLs in Virginia](http://deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx) *Department of Environmental Quality (DEQ)*

<http://deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx>

Shoreline Best Practice Case Studies: What Nature-Based Tidal Shorelines Look Like & How They Work

Thursday June 14, 2018
Virginia Institute of Marine Science
Gloucester Point, VA



Funded in part by





Supporting Integrated & Adaptive Management
of Coastal Zone Resources

www.vims.edu/ccrm



Dr. Carlton Hershner
Director

Tidal Shoreline Workshops



Annual meetings for
Virginia's tidal shoreline
management community

Since 1997



Workshop Agenda

Shoreline Best Practice Case Studies
Thursday June 14, 2018
Virginia Institute of Marine Science
Gloucester Point, VA

PLANNED AGENDA

8:00 - 9:00 am Check-in & Coffee

9:00 - 10:30 am **CASE STUDY REVIEWS** Watermen's Hall auditorium

Workshop Objectives Karen Duhring, VIMS Center for Coastal Resources Management

Living Shoreline Ecology Case Studies
Molly Mitchell, VIMS Center for Coastal Resources Management

Residential-Scale Case Studies: Examples from River Star Homes
Barbara Gavin, River Star Homes Program Manager, Elizabeth River Project

Urban Estuary Restoration: Restoration of multiple habitats to provide great habitat quality
Joe Rieger, Deputy Director of Restoration, Elizabeth River Project

Nature-Based Features for Coastal Resilience: Quantifying Wave Dissipation
Maura Boewell, P.E. Old Dominion University & Virginia Sea Grant Graduate Research Fellow

10:30 - 10:50 am 20-minute Break

10:50 - 12:00 pm **CASE STUDY REVIEWS (continued)** Watermen's Hall auditorium

Shoreline Management BMP Verification for Chesapeake Bay TMDL Credits
Aaron Wendt, VA Department of Conservation & Recreation - Shoreline Erosion Advisory Service

Case Study Best Practices Review
Moderated by Karen Duhring, VIMS Center for Coastal Resources Management

12:00 - 1:00 pm **LUNCH** included for registered participants

1:00 - 1:45 pm **SHORELINE PROGRAM UPDATES** Watermen's Hall auditorium

VMRC Group 1 & Group 2 Living Shoreline General Permits

Funding Support Programs Update

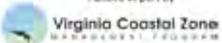
2018 Virginia General Assembly Update

Other Tidal Shoreline News & Announcements

1:45 - 2:00 pm Break & transition to Indoor & Outdoor Sessions

 **VIMS** | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

 Center for Coastal Resources Management

 Funded in part by
Virginia Coastal Zone
MANAGEMENT PROGRAM

Case Study Review Presentations

Lunch Break

Shoreline Program Updates

Workshop Agenda

PLANNED AGENDA *continued*

2:00 - 3:15 pm **CONCURRENT INDOOR & OUTDOOR SESSIONS** *See map for locations*

*Choose between 5 stations for 30-minute sessions
VIMS cart shuttles available to move between stations*

2:00 - 2:30 pm **Indoor • Outdoor Session 1**

2:30 - 2:45 pm *Transfer between stations*

2:45 - 3:15 pm **Indoor • Outdoor Session 2**

1 VIMS Offshore Breakwaters & Beach Nourishment Case Study

Scott Hardaway, VIMS Shoreline Studies Program & Bruce Pfirrmann, DCR-SEAS

Preferred features in beach nourishment and offshore breakwater projects are demonstrated, including a wide, dynamic beach created with suitable sand, a stable planted dune area, and stable breakwater structures. This case study also illustrates how a bulkhead shoreline was converted to a nature-based feature & how submerged aquatic vegetation (SAV) can affect project designs.

2 VIMS Teaching Marsh Case Study *Christine Tombleston & Julie Bradshaw, VIMS-CCRM*

Preferred features in living shoreline marshes are demonstrated at the Teaching Marsh. These features include wide planted marshes with both low and high marsh gradual slopes, a low-profile marsh sill, salt- & flood-tolerant native plants in the riparian buffer, and an oyster restoration reef. The co-benefits of multiple habitats located in close proximity are also illustrated.

3 Drone Demonstration *Kory Angstadt, VIMS-CCRM*

Learn how a Mavic Pro drone is being used for CCRM shoreline & wetlands research, including the steps required to create a flight plan, capture still & video images, collect elevation data, and the process of converting all of the collected images and data into meaningful analyses.

4 Hands-On Shoreline Management Tools *Technology Classroom, Watermen's Hall*

Molly Mitchell & Tania Rudnicki, VIMS-CCRM

This station provides an opportunity to learn about and practice using GIS mapping tools at individual computer stations. After a short introduction to various tools, CCRM staff will be present to provide guidance and answer questions while you practice using the tools. Please don't bring food or drinks into this computer classroom.

5 Wetlands Board e-Handbook *Owens-Bryant Board Room, Davis Hall*

Pamela Mason, VIMS-CCRM & Clay Bernick, Clay Bernick Environment & Sustainability, LLC

This session will introduce a proposed e-Handbook for Wetlands Boards explaining what it is and what should be included. Participants will be asked about what contents are most needed to support best practice policies and efficient programs.

3:15 - 3:30 pm *Complete Workshop Evaluations & leave at Registration Table
Visit VIMS Gift Shop*

Concurrent Indoor & Outdoor Sessions

Choose between 5 stations
30-minute sessions repeated twice

Choose 1st station for Session 1
Choose 2nd station for Session 2

After the Workshop



- **Participant List Distribution**

opt out with Dawn Fleming

- **Workshop Summary & Presentations**

posted to a Workshop Web Site

Please contact presentation authors for permission prior to using or reproducing photos or other content

What is a Case Study ?

A particular instance of something used or analyzed in order to illustrate a thesis or principle

Shoreline Best Practice Principles

- Risk avoidance
- Intercept & filter stormwater runoff
- Protect, restore & enhance natural shoreline habitats
- Provide erosion control & water quality benefits simultaneously
- Maintain coastal processes that support living resources

EXAMPLE 1

VIMS Stormwater Management Case Study

Bio-Retention Area with native plants

Stormwater infiltration instead of runoff



CCRM Riparian Buffer Case Study

April 2000



Converted a sloped lawn & bulkhead to.....

June 2018



....a restored riparian buffer
with closed tree canopy

Closed Tree Canopy

Rainfall interception & less stormwater runoff flowing down slope

Wind & storm surge buffer



Photo
captured
with Mavic
Pro drone

Workshop Objectives

- Learn about case studies from people directly involved
- Think about Shoreline Best Practice principles during case study reviews
- Think about your own case study examples & how principles are applied
- Experience VIMS beach & Teaching Marsh, hands-on tool demonstrations

What is a Case Study ?

A particular instance of something used or analyzed in order to illustrate a thesis or principle

Shoreline Best Practice Principles

- Risk avoidance
- Intercept & filter stormwater runoff
- Protect, restore & enhance natural shoreline habitats
- Provide erosion control & water quality benefits simultaneously
- Maintain coastal processes that support living resources

EXAMPLE 1

VIMS Stormwater Management Case Study

Bio-Retention Area with native plants

Stormwater infiltration instead of runoff



CCRM Riparian Buffer Case Study

April 2000



Converted a sloped lawn & bulkhead to.....

June 2018



....a restored riparian buffer
with closed tree canopy

Closed Tree Canopy

Rainfall interception & less stormwater runoff flowing down slope

Wind & storm surge buffer



Photo
captured
with Mavic
Pro drone

Workshop Objectives

- Learn about case studies from people directly involved
- Think about Shoreline Best Practice principles during case study reviews
- Think about your own case study examples & how principles are applied
- Experience VIMS beach & Teaching Marsh, hands-on tool demonstrations



Science and management

Living shorelines

Molly Mitchell

Donna Marie Bilkovic

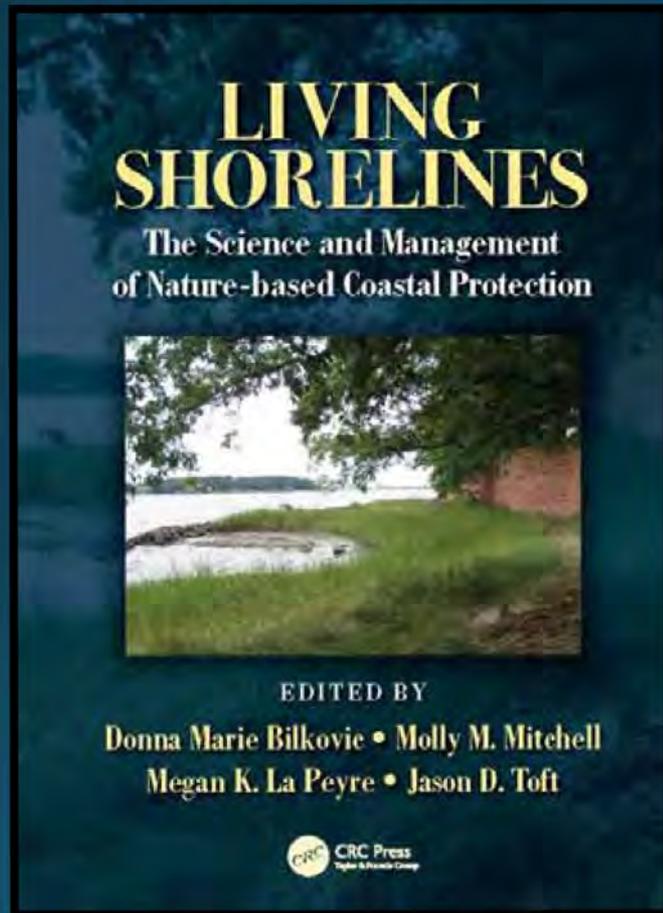
Christine Tomblason

June 14, 2018

Wetland Workshop: Shoreline Best Practice Case Studies



A synthesis of major points:



- What makes it “living”?
- How do living components enhance shoreline protection?
- What are co-benefits?
 - Habitat & water quality
- What makes it resilient?

Benthic invertebrates – who cares?

Ecosystem Service providers

Suspension/filter feeders: feed on algae & detrital particles suspended in the water
-Filter water, improve clarity



Tagelus plebeius
Stout Razor Clam



Oysters-sill



Ribbed Mussels –
marsh

Interface feeders:
can switch



Tellina agilis
Tellin Clam



Macoma balthica
Baltic Macoma Clam



Corophium lacustre
tube-builder amphipod
Favored fish food



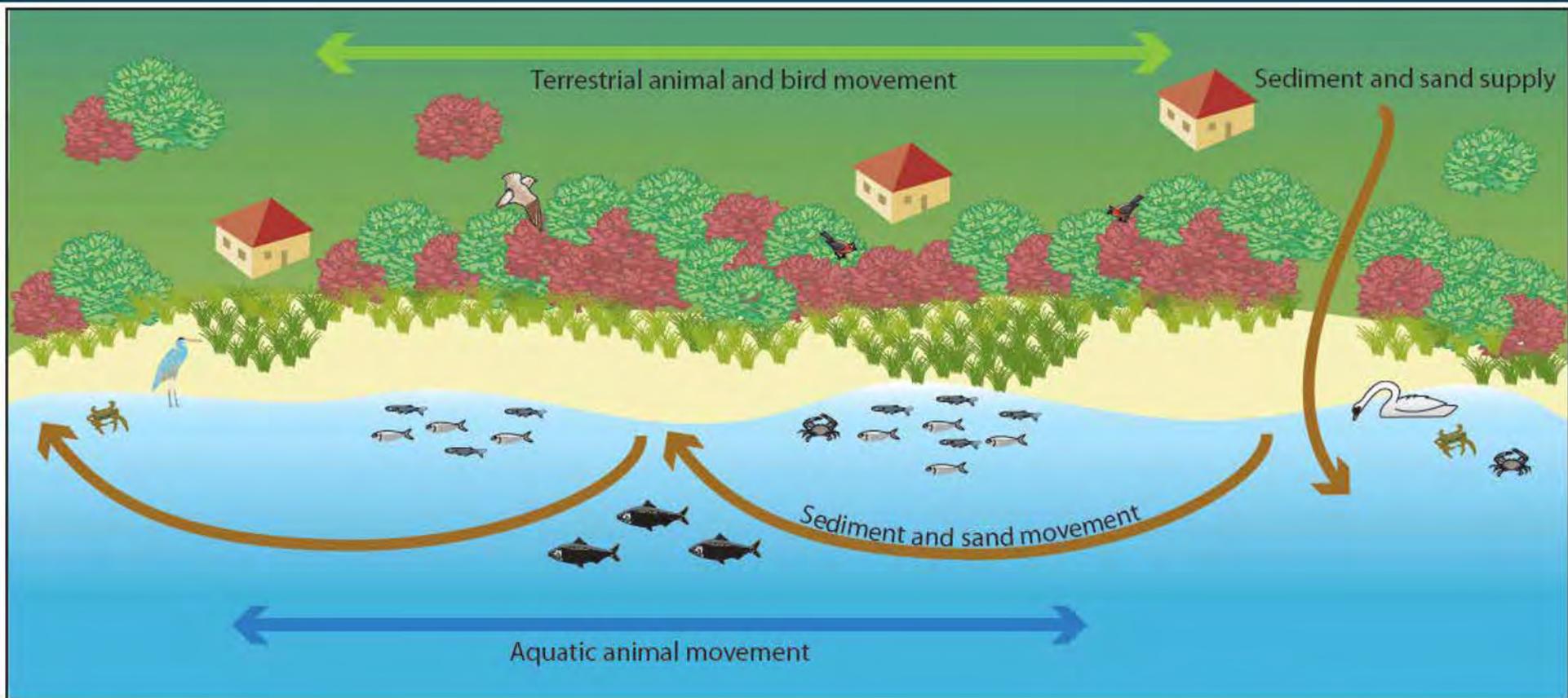
Infaunal Deposit feeders : ingest sediment & digest associated bacteria, microalgae & organic matter
-Mixing of sediment – increase oxygenation & nutrient cycling



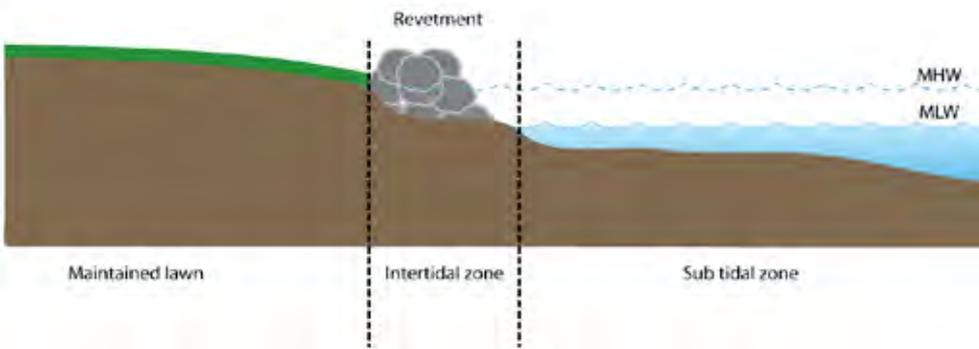
Clymenella torquata
bamboo worm



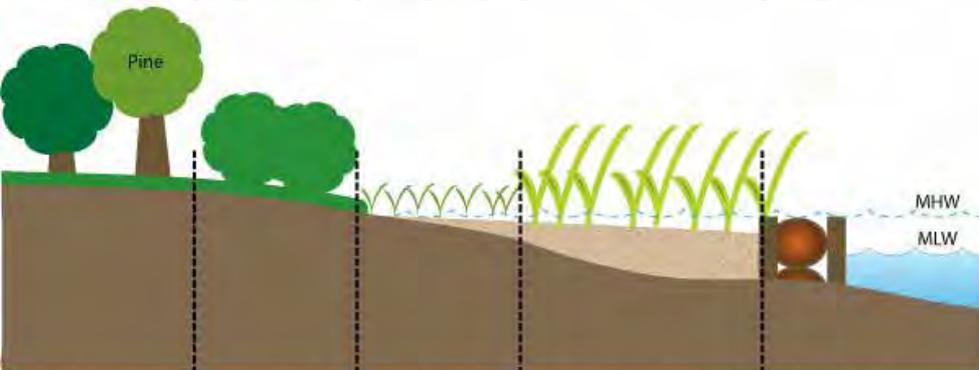
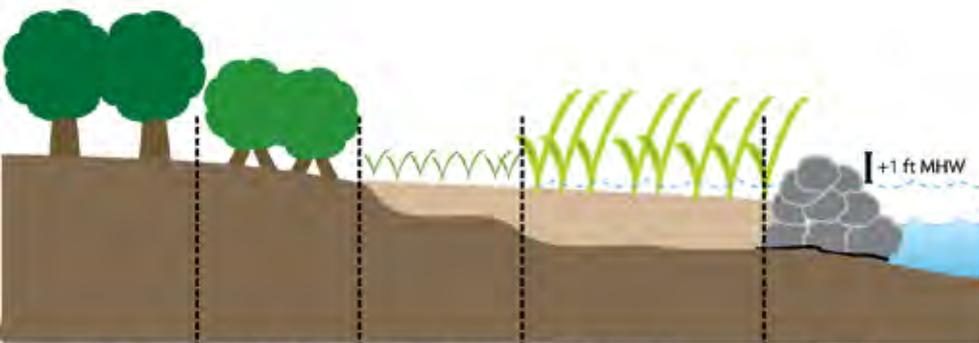
Heteromastus filiformis
worm



Existing



Enhanced



Upland shrubs:
native evergreen
& fruit bearing

Salt bushes
& switch grass

High marsh
6:1 or flatter

Low marsh
10:1 or flatter

Staked 18-inch
fiber logs

+ 10-15 feet from
existing marsh edge

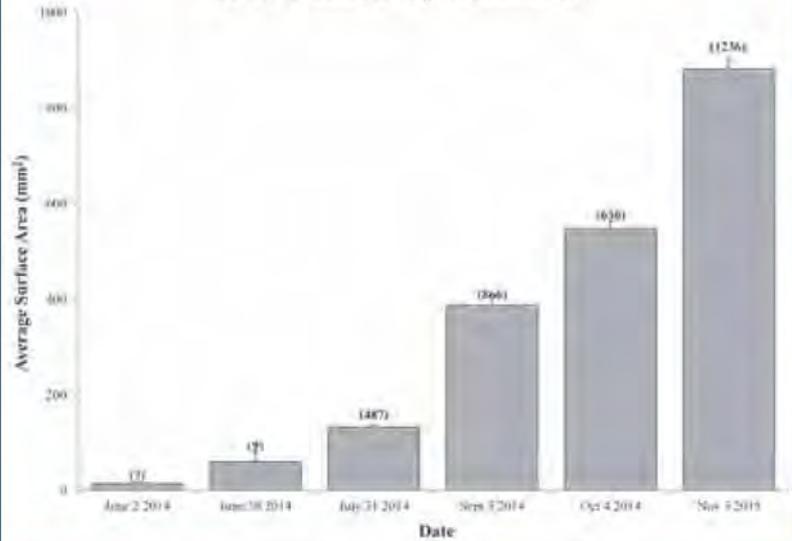


Connectivity improved
Natural habitat maximized
Artificial habitat minimized

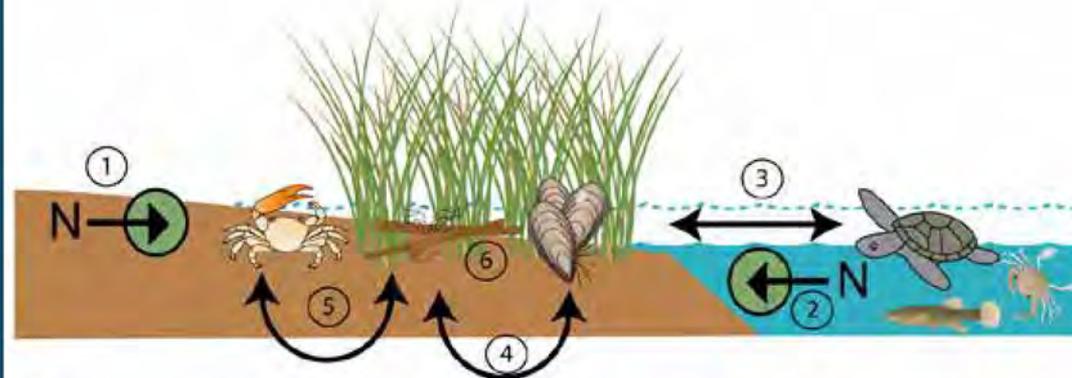
1. Preserve the integrity and connectivity of shoreline processes
2. Maintain and enhance shoreline habitat diversity and function
3. Minimize and reduce pollutants to the shoreline environment
4. Reduce and reverse cumulative impacts to shoreline systems

Emmett et al. 2017. Using voluntary ratings and certification programs to guide sustainable shoreline development

Oyster *Crassostrea virginica* settlement

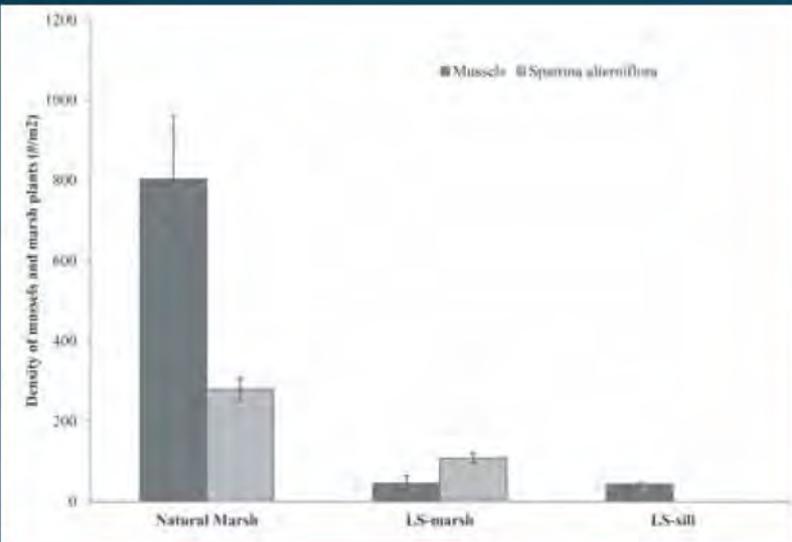
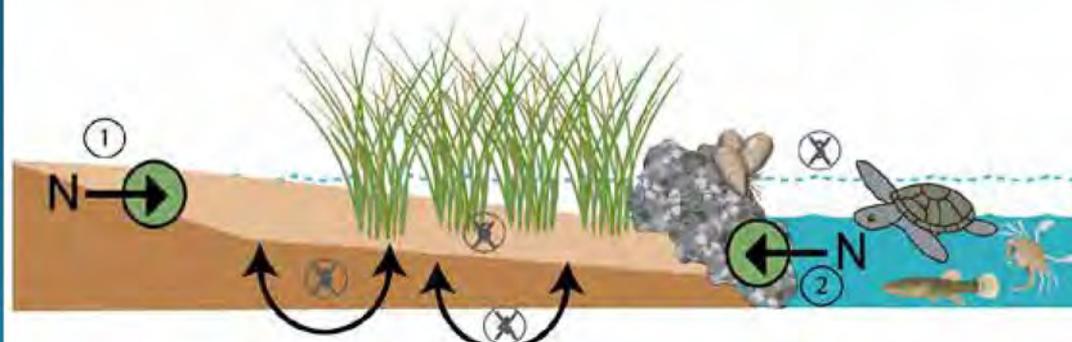
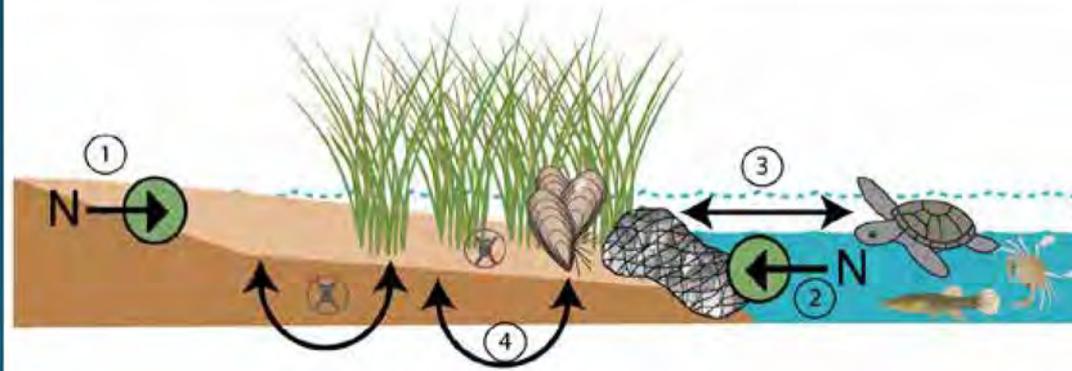


Tidal marsh functions



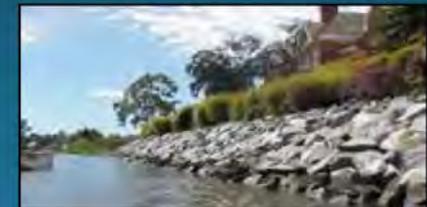
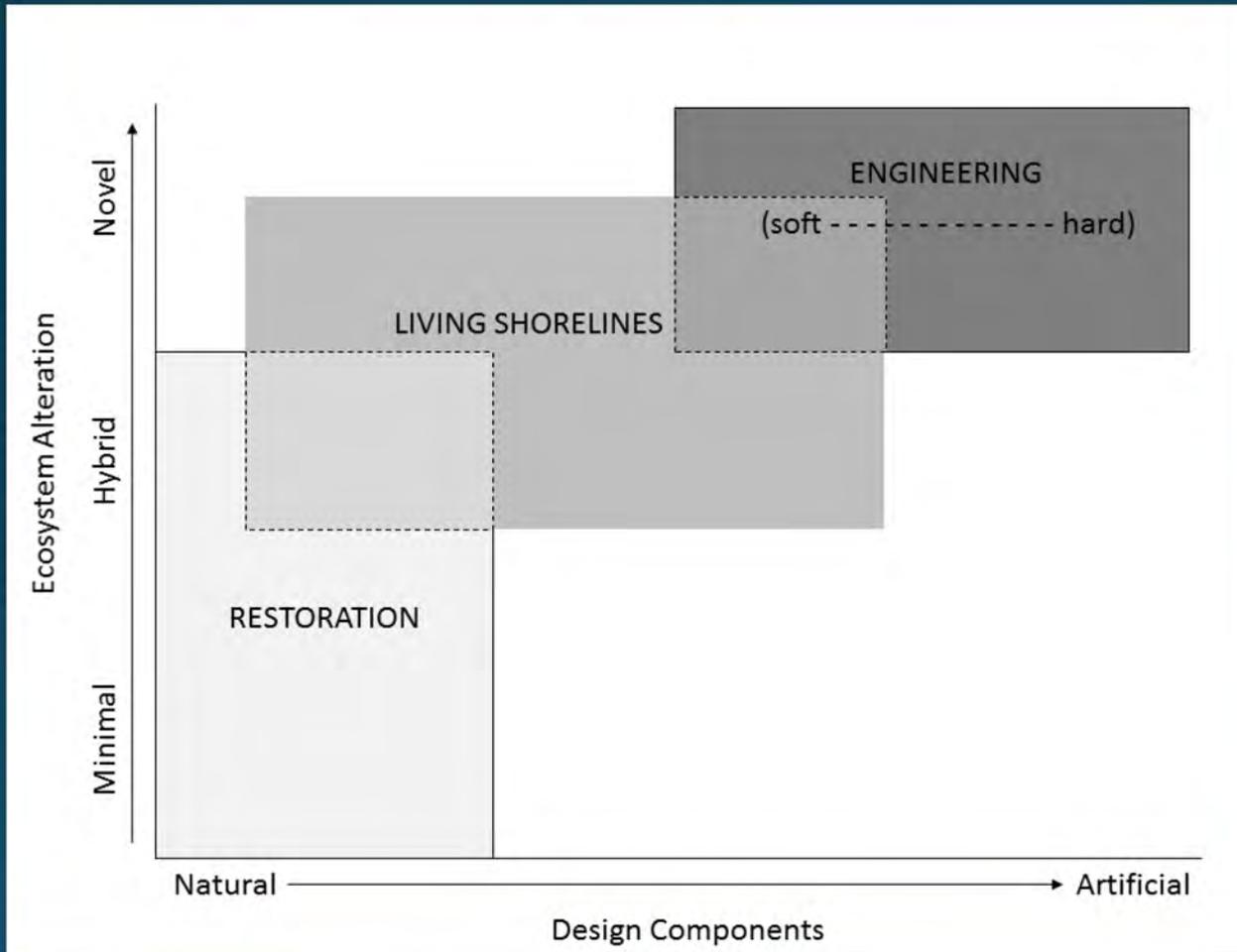
- ① Nutrient removal from groundwater
- ② Nutrient removal from tidal waters
- ③ Nekton use during high tide
- ④ Mussels fertilize grass, grass stabilizes sediment for mussels
- ⑤ Crabs aerate sediment for grass, grass provides shelter for crabs
- ⑥ Detritus and algal production provide food

Living Shoreline Functions



Bilkovic & Mitchell 2017. Designing living shoreline salt marsh ecosystems to promote coastal resilience.

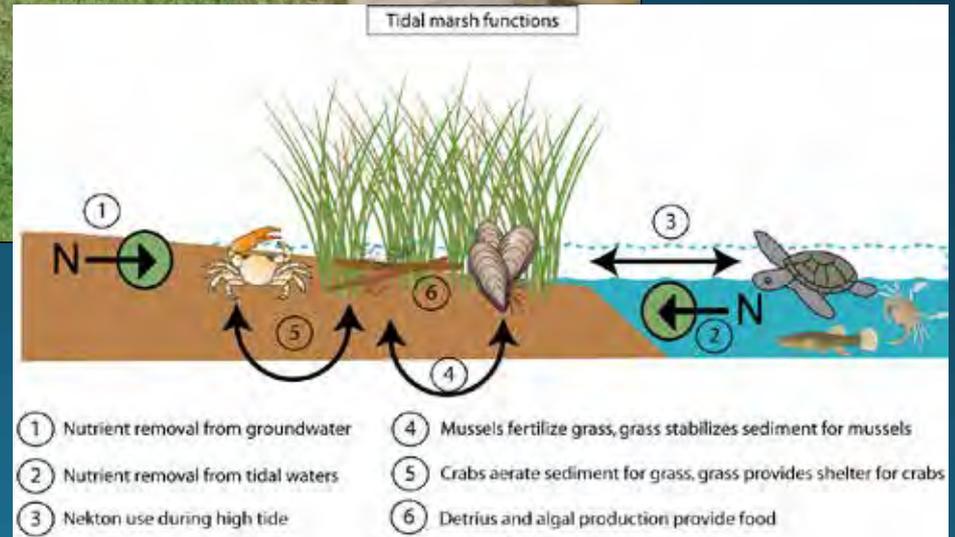
Living shoreline continuum



Preserve the integrity and connectivity of shoreline processes?



Photo from VMRC 14-1793



Co-benefits of living shorelines



LIVING SHORELINES SUPPORT RESILIENT COMMUNITIES

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.



One square mile of salt marsh stores the carbon equivalent of **76,000 gal of gas** annually.



Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.



Living shorelines improve **water quality**, provide fisheries **habitat**, increase **biodiversity**, and promote **recreation**.



Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of incoming wave energy.



Living shorelines are **more resilient** against storms than bulkheads.



33% of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.



Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.

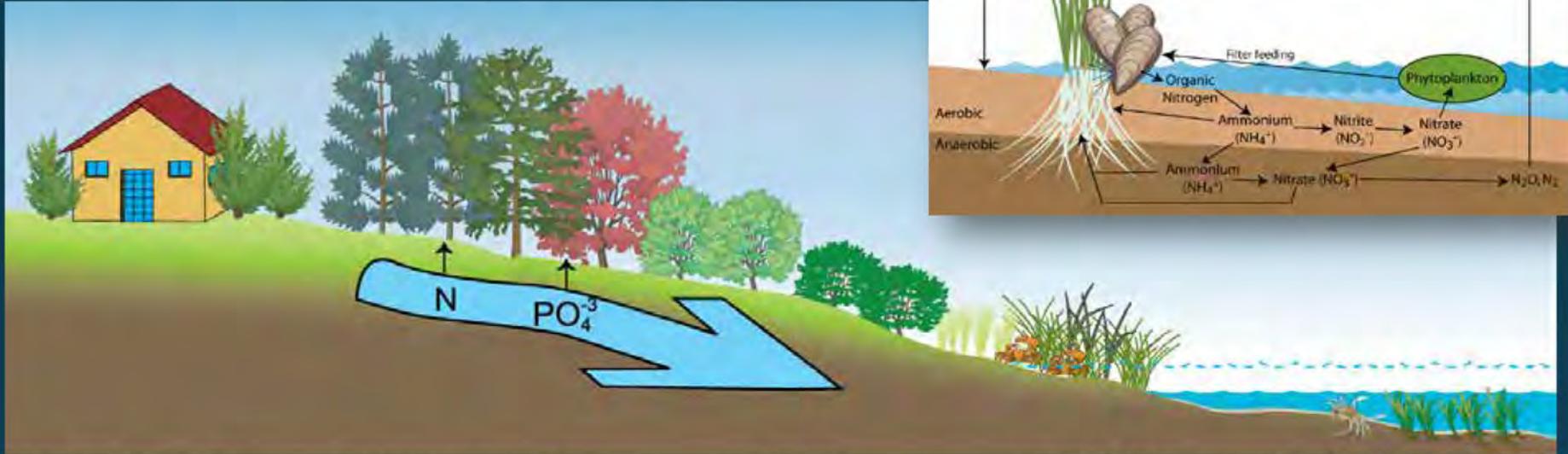


The National Centers for Coastal Ocean Science | coastalscience.noaa.gov

Some graphics courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/)

Vegetation → water quality

Bilkovic et al. Ecosphere 2017



Upland Landuse	Riparian Landuse	Banks	Intertidal Zone	Subaqueous Lands
Trees, shrubs, tall grass	Trees, shrubs, tall grass	Vegetated, Stable	Marshes, Phragmites	Seagrass (SAV)
		Partial vegetation	Coastal Sand Dunes	Oyster Reefs
Agriculture	Residential, Agriculture	Undercut	Riprap, Bulkheads	Aquaculture
Residential, Commercial	Industrial	Bare, Unstable	Boat ramps	Marinas

Symbols courtesy of the Integration and Application Network (ian.umces.edu/symbols/), University of Maryland Center for Environmental Science.



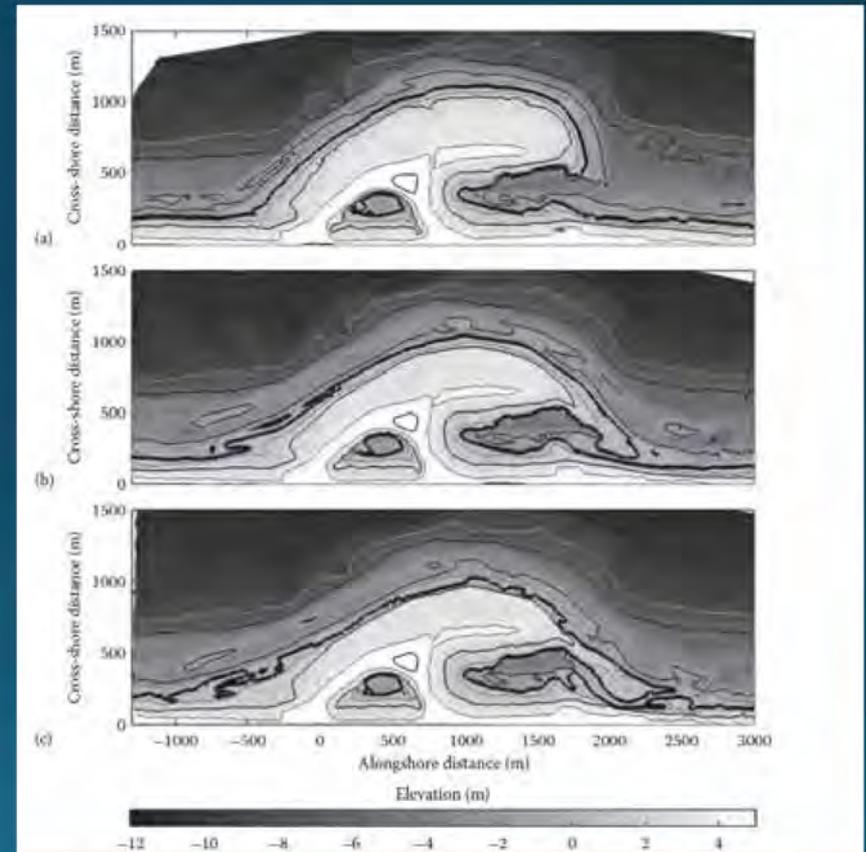
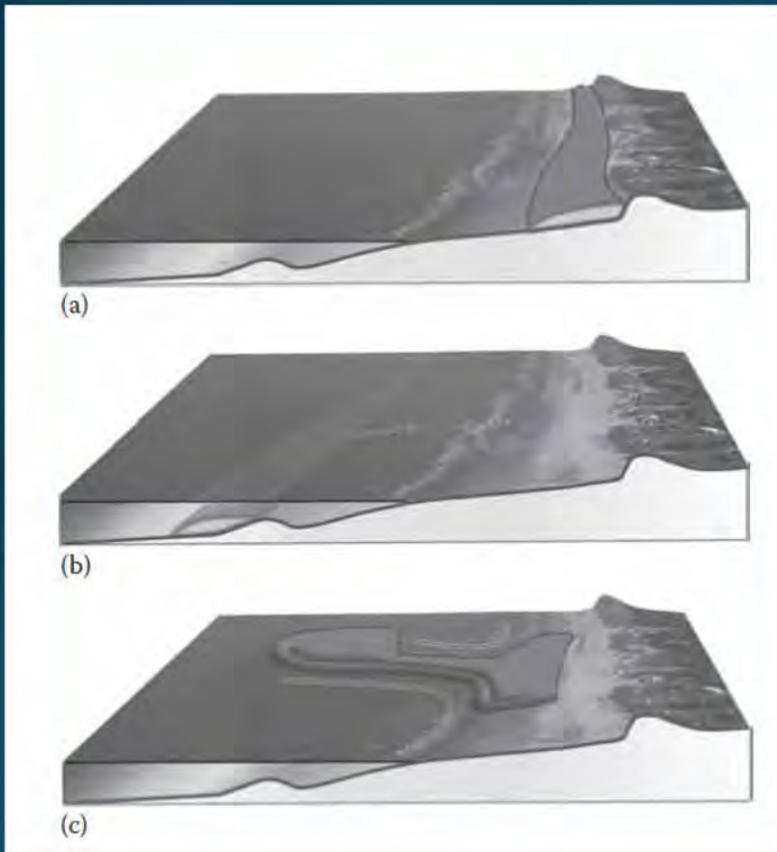
Cross shore Connectivity = min necessary structure

Parameter	Score	Criteria Values		
		1	2	3
Storm surge		2'	2' - 4'	>4'
Fetch		< 0.5 mi	0.5 - 1 mi	1 - 5 mi
Bank height		<3'	3' - 6'	>6'
Bank condition		Stable	Transitional	Eroding
Nearshore depths		<1'	1' - 2'	>3'
Sediment type		Mud	Mud/sand	Sand
Tide range		1' - 2'	2' - 4'	>4'
Erosion rate		1'	2'	>3'
Shoreline orientation		South	East or west	North
Shoreline configuration		Cove	Linear	Point
Infrastructure proximity		>100'	50' - 100'	<50'
Width of waterway		>300'	300' - 100'	<100'
Buffer condition		Lawn	natural grasses	Forest
Total Score	13 - 18	Low energy, trim trees and plant marsh		
	19 - 32	Medium energy, sill system		
	33 - 39	High energy, breakwater system		

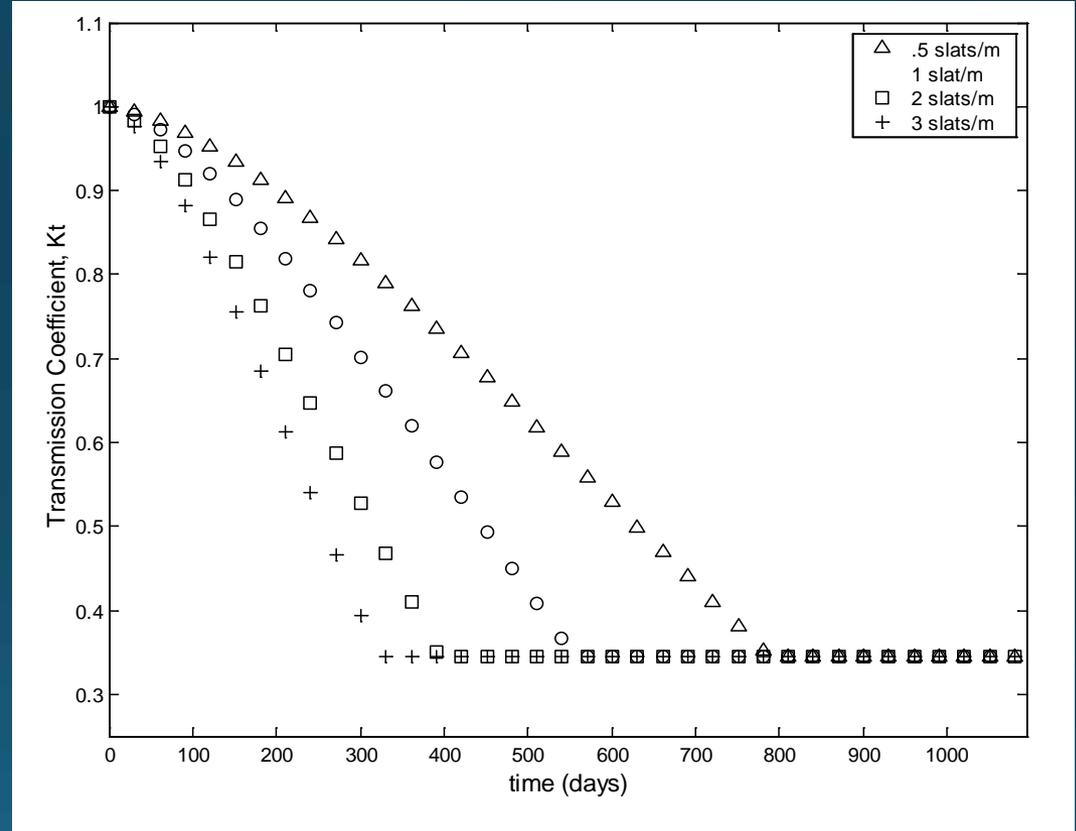
These criteria are used in the shoreline management model



Shorescape connectivity: use dynamic components for sustainable protection



Leveraging dynamic biotic components for increased protection



Dense installation achieves excellent wave reduction in ~ 1 year; less dense structures achieve excellent wave reduction in ~ 3 year of good growth, with far less use of materials and construction costs

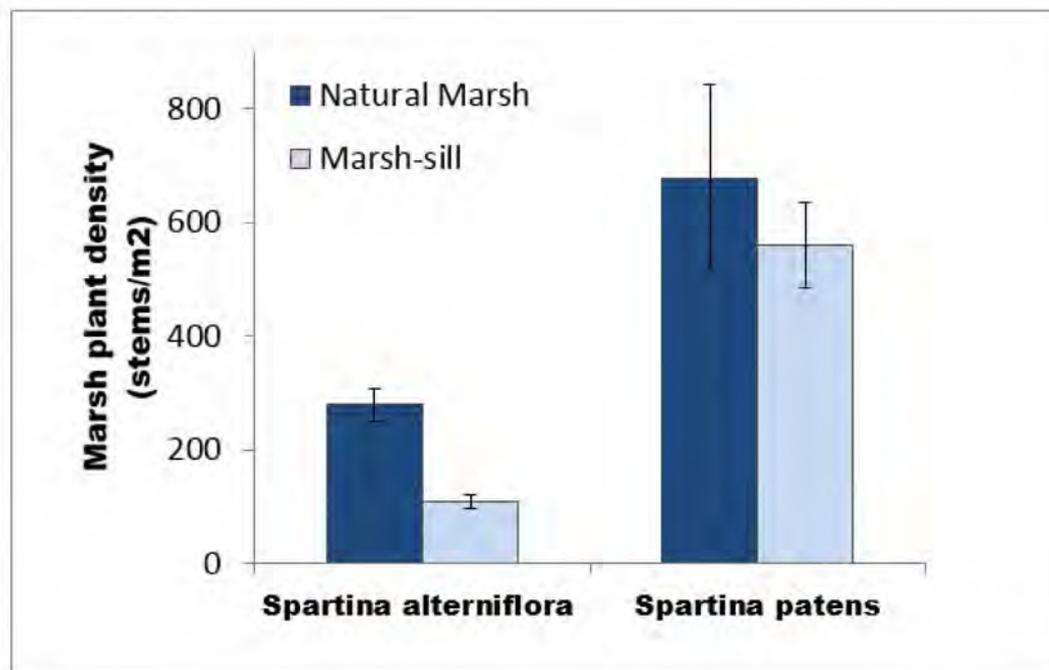
Living shoreline resiliency



Living shorelines must be able to migrate or accrete with sea level rise!

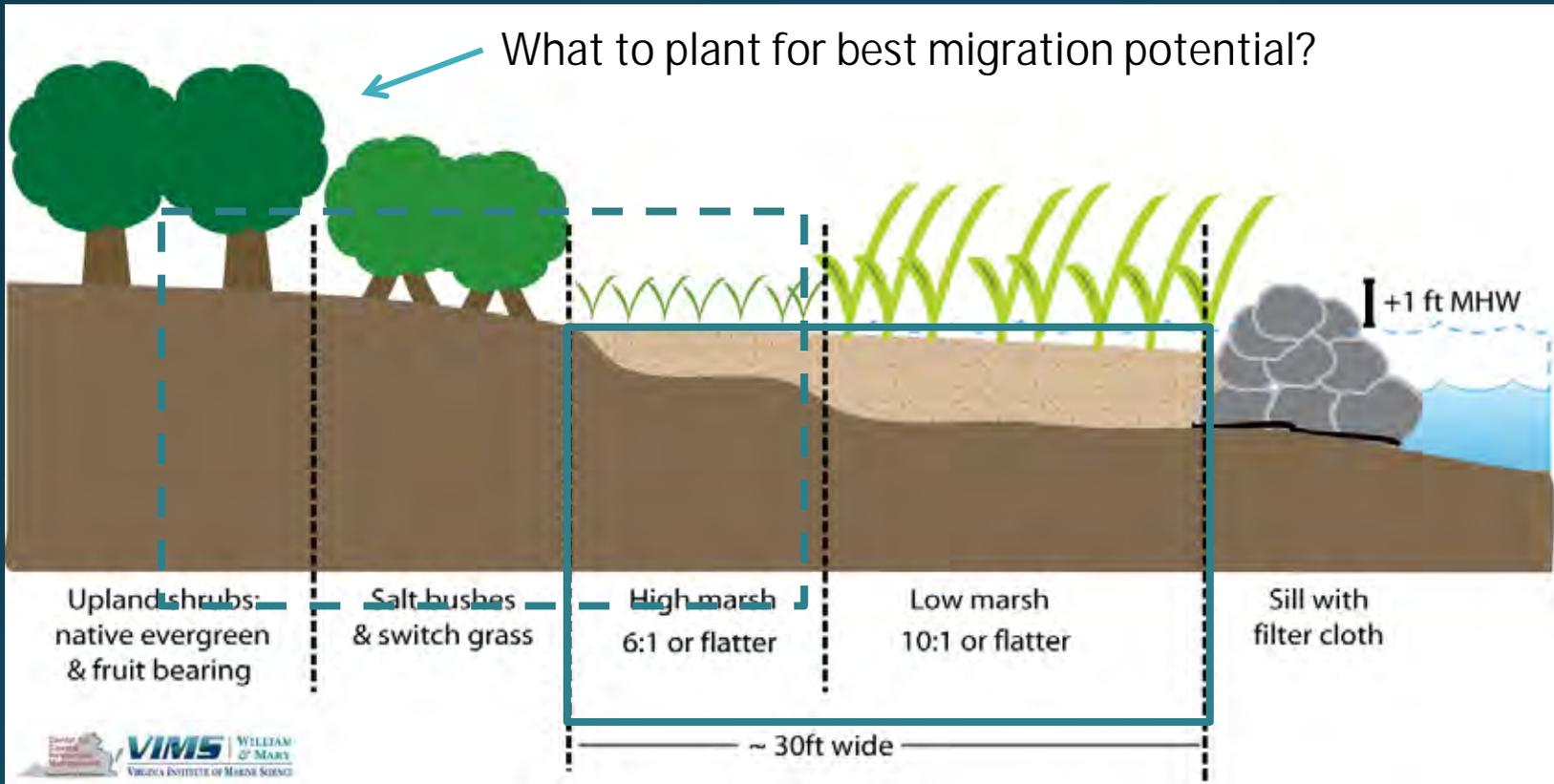
Accretion potential in living shoreline design

Marsh plant stem density, stem height, and aboveground biomass influence the marsh's ability to trap sediments and attenuate wave energy



- ❖ Marsh-sill low marsh stem counts lower than natural fringing marshes; high marsh similar
- ❖ No evident trajectory across age of marsh sampled (1-11 yrs)
- ❖ Organic matter very low in marsh-sills (<2%)

Migration potential in living shoreline design

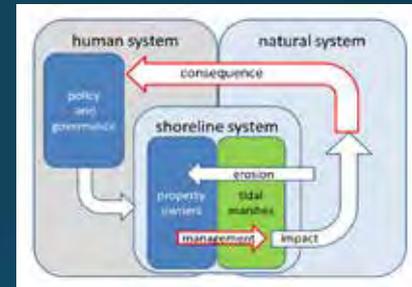


- ✓ Focus planting in the upper elevations of the tidal range
- ✓ Preserve riparian land where elevations are suitable for marsh migration

Living shoreline related projects

NSF Coastal SEES

- Investigates the linkages between human and natural components of Chesapeake Bay shorescapes
- Research on ecology of living shorelines, human decision making, model changes under sea level rise
 - Talk to Donna Bilkovic (donnab@vims.edu) or Molly Mitchell (molly@vims.edu)

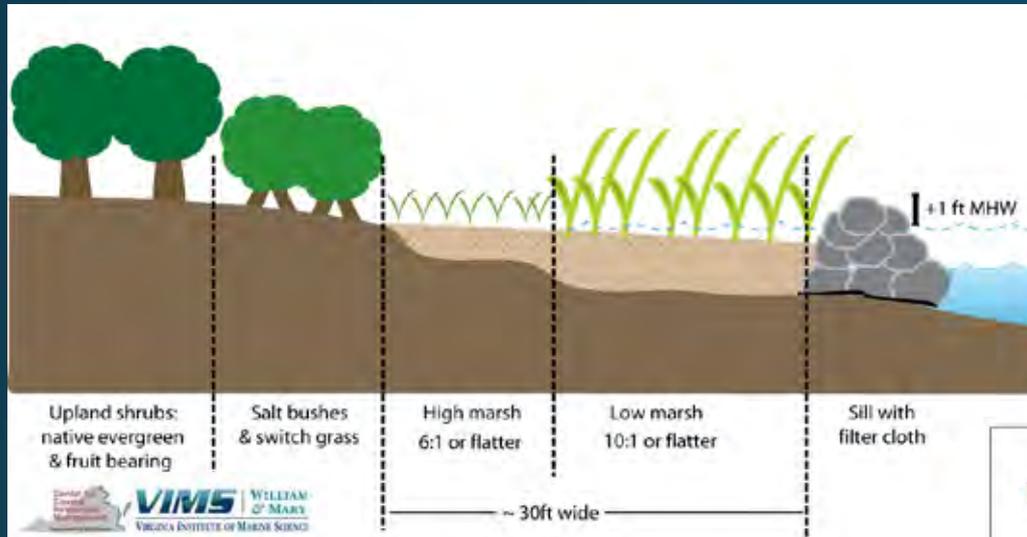


NOAA Coastal Resilience

- Focused on increasing the use of natural and nature-based features (NNBFs) to increase resilience of coastal communities to flooding caused by extreme weather events
- Develop siting and design guidance for NNBFs, explore crediting and co-benefits, help localities leverage NNBFs for resilience
 - Talk to Pam Mason (mason@vims.edu)

Accretion potential in living shoreline design

Sill design influences the marsh's ability to trap sediments and attenuate wave energy



Results from Surface Elevation Tables placed at the lower and upper edges of *Spartina alterniflora* in marshes behind stone sills (Sill) and nearby natural fringing marshes (Natural)

Marsh type	Marsh edge location	Net sediment accretion (mm y ⁻¹)	n
Natural	Lower	-6.92 A	4
Sill	Lower	5.36 B	4
Natural	Upper	1.18 A	4
Sill	Upper	4.73 B	4

- ✓ The height should be ~MHW in low energy settings to allow regular wave overtopping and access for marine organisms
- ✓ The height can be raised ~1 ft above MHW in moderate energy settings

VIMS Tidal Wetlands Workshop Residential-Scale Case Studies

Barbara Gavin
River Star Homes Program Manager
June 14, 2018

Elizabeth River Project
Making restoration a reality





The Elizabeth River Watershed

A "watershed" is the area that drains into a river when it rains.

If you live in the Elizabeth River watershed, rain water runs off your lawn and street, then into storm drains and then the river. Along the way, this runoff becomes a toxic soup of

Great Dismal

ath
st
f
lity
ips





River Star Homes

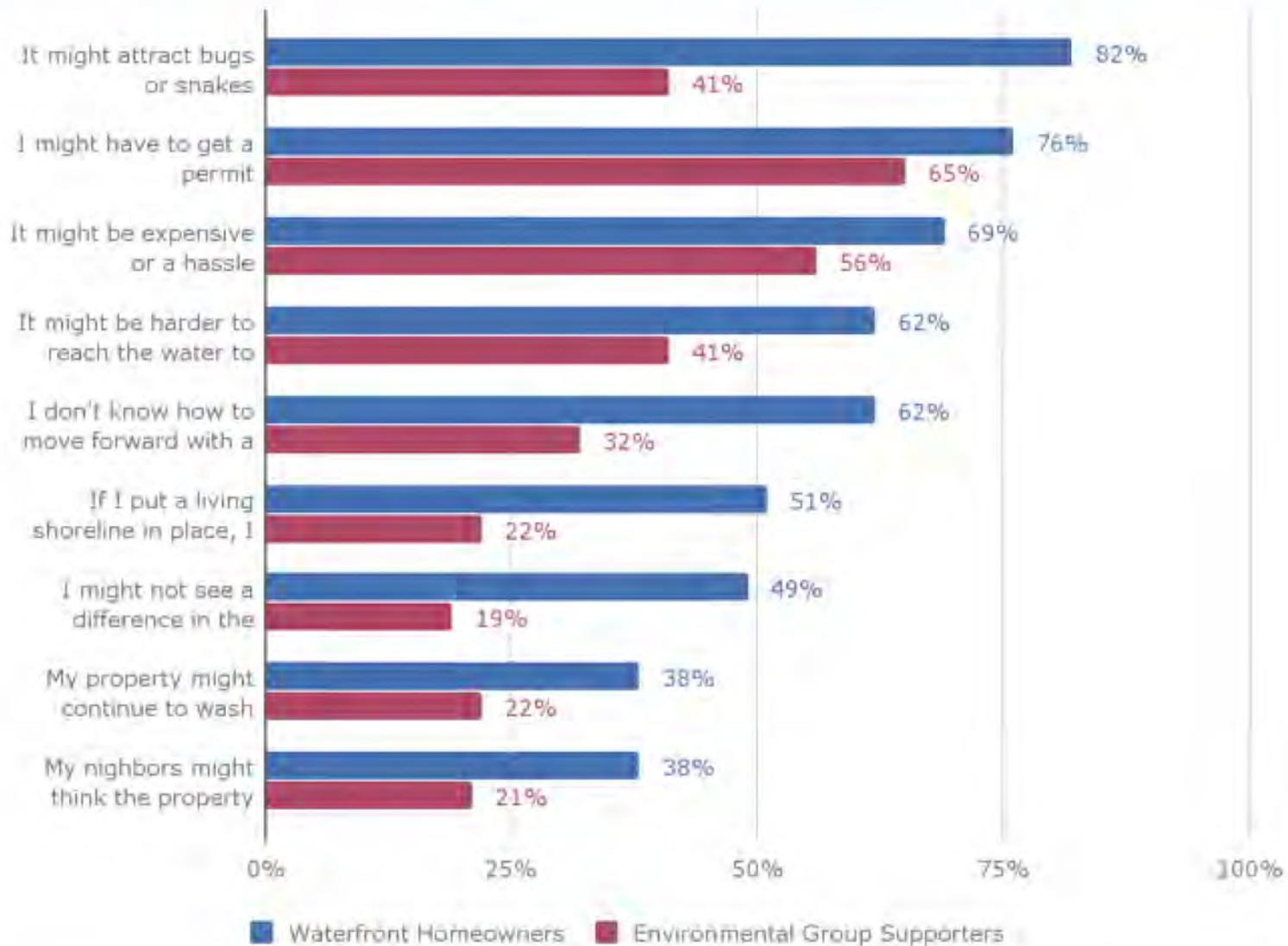
Recruiting homeowners since 2011

There are almost 4,700 River Star Homes in the Elizabeth River Watershed committed to seven behavior changes for environmental sustainability.

- ✦ 2014 – began contracting with the City of Norfolk
- ✦ 2015 – began contracting with the City of Chesapeake
- ✦ 2017 – began contracting with the City of Virginia Beach

Living Shoreline Benefits & Barriers Survey

- ✦ Survey conducted with Water Words that Work
- ✦ Audience - waterfront homeowners, including ERP supporters
- ✦ Key results –
 - ✦ ERP supporters think highly of living shorelines, waterfront homeowners do not
 - ✦ Environmental groups are most trusted source for information on living shorelines
 - ✦ Feel good messages are most persuasive
 - ✦ "Bugs & Snakes", permitting process, and cost all big barriers
- ✦ Incorporated into process for finding projects



Living Shoreline Process

- ❦ River Star Homes Living Shoreline Process
 - ❦ Outreach to new & existing RSH and community
 - ❦ Homeowner signs up for site visit, ERP determines if site will work



Living Shoreline Process



- ✦ River Star Homes Living Shoreline Process
 - ✦ Project designed by contractor or in-house by ERP
 - ✦ ERP completes permit applications, coordinates with VMRC, USACE, City officials as needed
 - ✦ ERP oversees construction or coordination with contractor, final invoicing, maintains contact with homeowner for maintenance
 - ✦ ERP reports BMP dimensions, pollution reduction credits

Site Scale Examples – Westminster Ave

- ✦ Hybrid Living Shoreline
 - ✦ Oyster reef and Coir logs used
 - ✦ 165 linear ft. & 1,350 sq. ft.
 - ✦ CBPA coordination required
 - ✦ No tree removal after April 15th
 - ✦ Cost share from City of Norfolk and NFWF
 - ✦ Homeowner referred to ERP by Norfolk Env't. planning Manager
 - ✦ Riparian Buffer being designed
- ✦ Key Take Away: Some sites need multiple approaches



Site Specific Examples – Oaklette Drive

- ✈ 200 Linear ft., 2,200 sq. ft. living shoreline along entire shoreline
- ✈ Riparian buffer installed fall 2017
- ✈ Experienced rills in sand from upland high-velocity stormwater run off
- ✈ Key Take Away: upland protection sometimes crucial for success



Site Specific Examples – Oaklette Drive

- ✦ 200 Linear ft., 2,200 sq. ft. living shoreline along entire shoreline April 2017
- ✦ Riparian buffer installed fall 2017
- ✦ Experienced rills in sand from upland high-velocity stormwater run off
- ✦ Key Take Away: Maintain clear understanding of client expectations vs reality



Site Specific Examples – Oaklette Drive

Check-in 5/18



Check-in 5/18

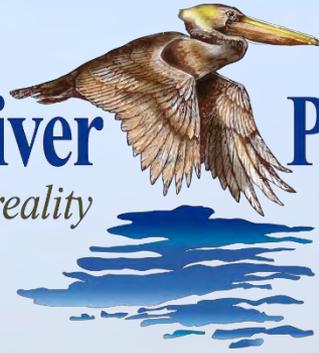


Key Take-Home Messages

- ✦ Understand perceived barriers to living shorelines
- ✦ Project completion is dependent on multiple factors
 - ✦ Time of year, site acquisition, contractor scheduling, permitting process, cost
- ✦ Every project site is different, visit many to find a few
- ✦ Manage client expectations – Patience is a virtue!

Elizabeth River Project

Making restoration a reality



Barbara Gavin

bgavin@elizabethriver.org

elizabethriver.org

Follow 'Elizabeth River Project'
on Facebook



Urban Estuary Restoration: Large Scale and Co-Located Projects with Multiple Benefits

2018 Tidal Shoreline Management Workshop

Joe Rieger, Deputy Director of Restoration
(Elizabeth River Project)



The Elizabeth River Project

Mission: Restore the Elizabeth River to the highest practical level of environmental quality through government, business, & community partnerships.

- Ø Working on restoring the river for 25 years
- Ø 120 **River Star** facilities
- Ø Over 4,673 River Star Homes
- Ø **Government** projects with US Navy, NOAA, US EPA, VA DEQ, VA DCR, Norfolk, Portsmouth, Virginia Beach, & Chesapeake



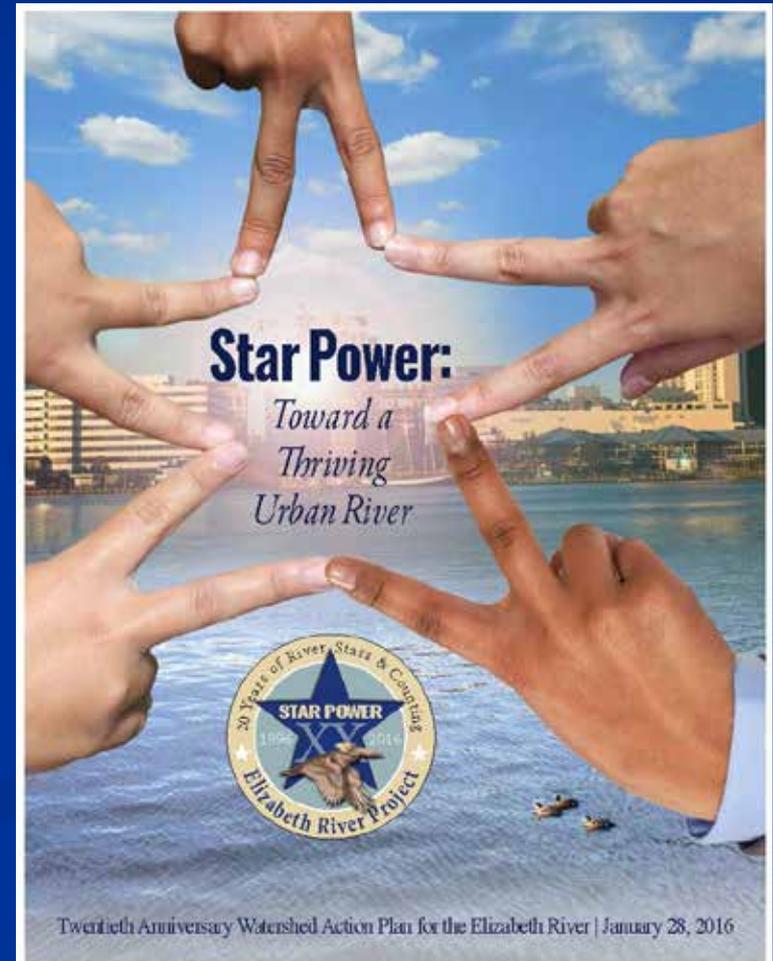
Elizabeth River Watershed



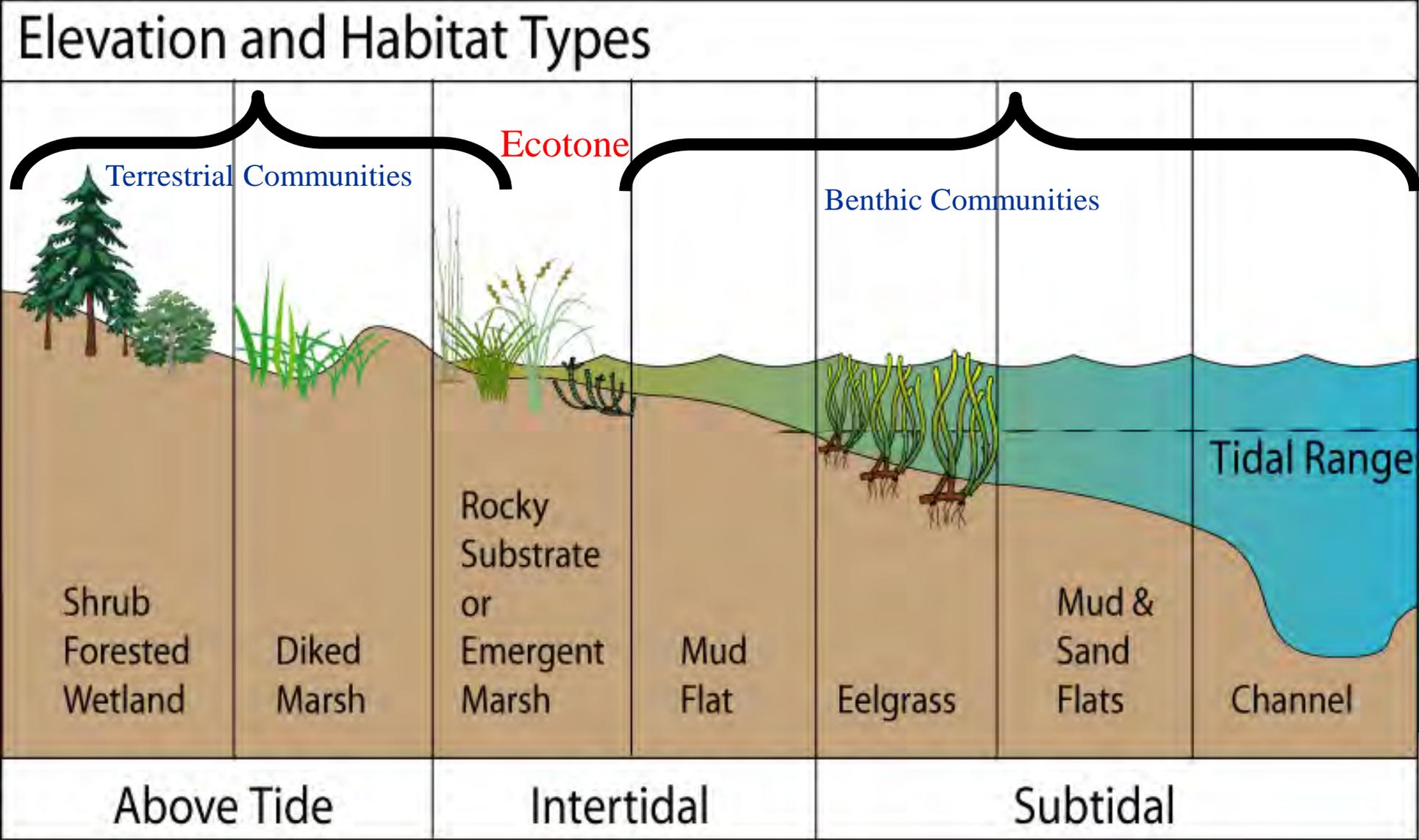
Action – Restore Resilient Shores

2025 Goal – Create or restore 20 acres of tidal wetlands and oyster reefs.

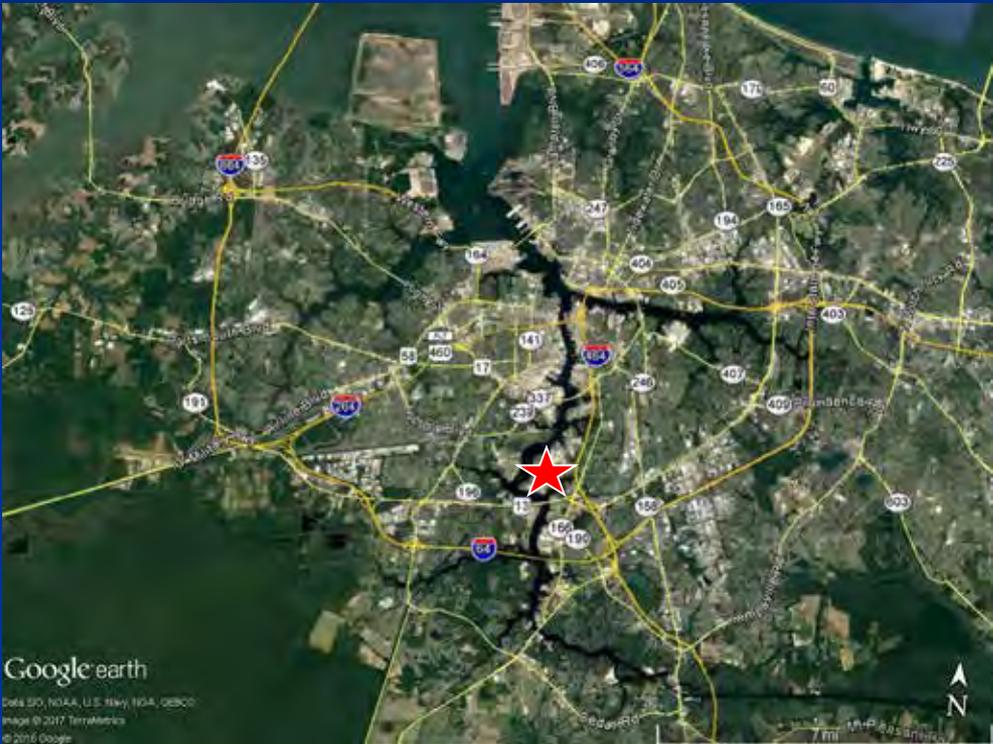
- Promote and carry out living shorelines and oysters reefs with citizens, government, business, and schools.



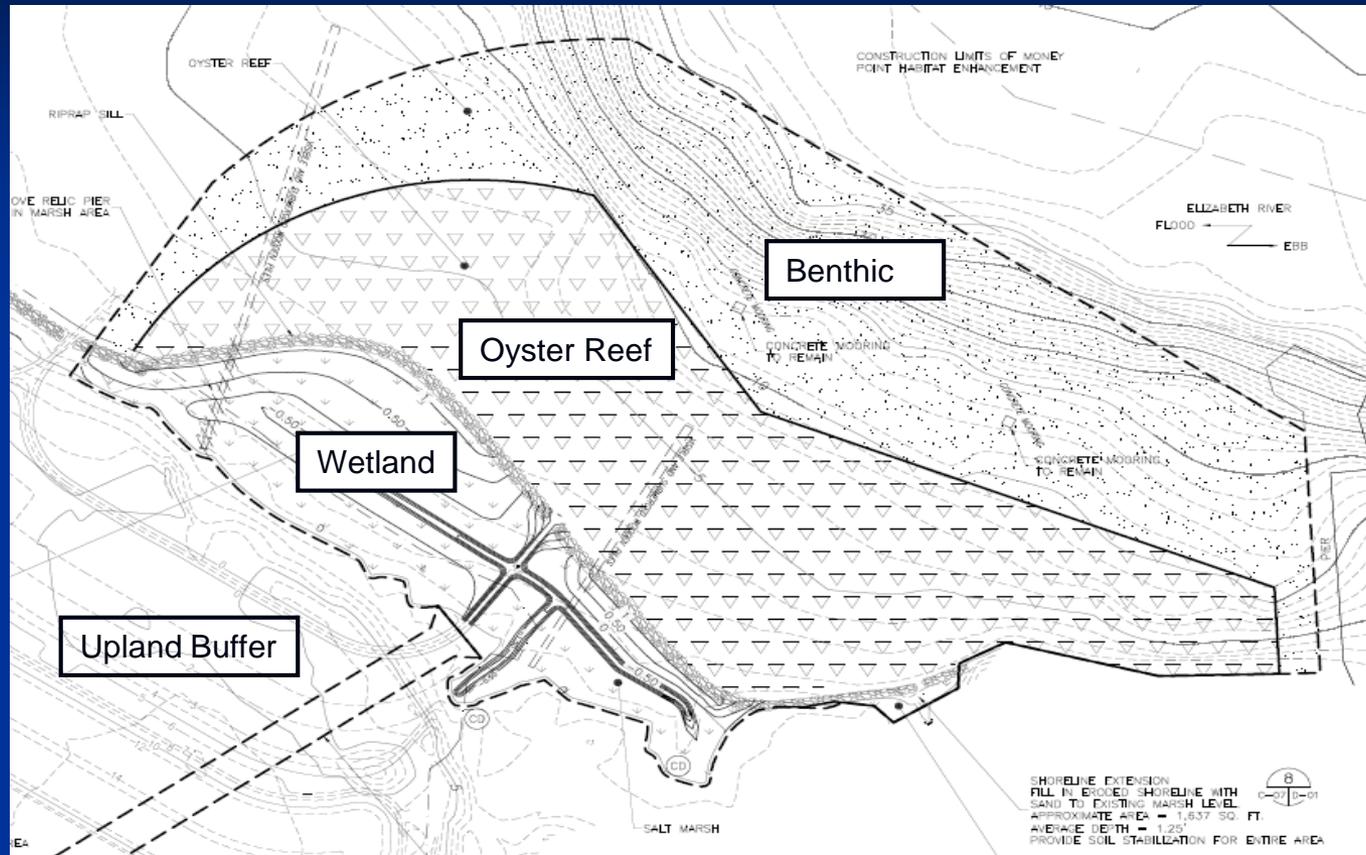
Habitat Continuum



Money Point Restoration Elizabeth River



Phase 2 Sand & Oyster Placement



Area 5

12 inches of restoration sand
12-18 inches oyster shell

Money Point Living Cap Chesapeake, VA



Living Cap



ERT Wetlands

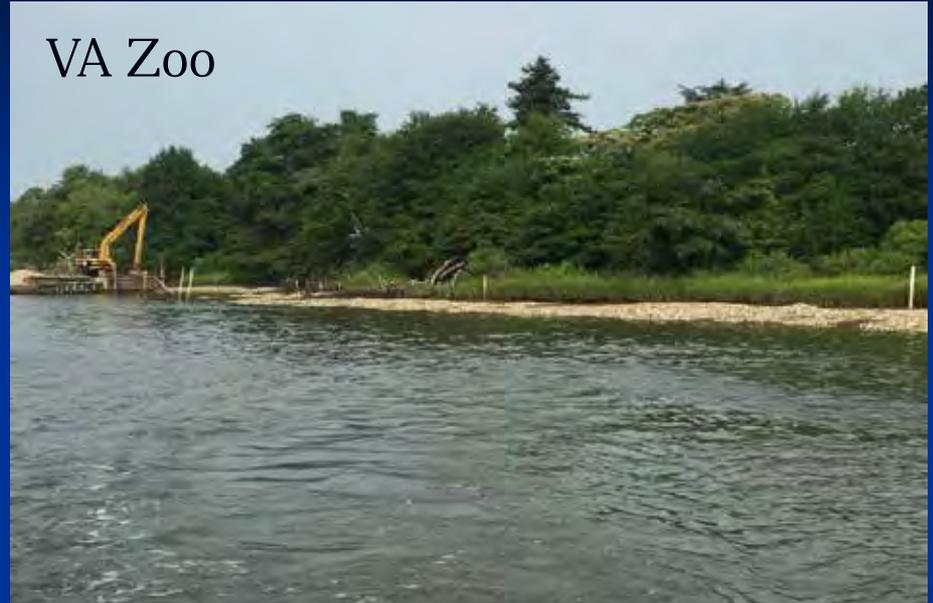


Oyster Reef Restoration on the Lafayette River

Lafayette Winona



VA Zoo



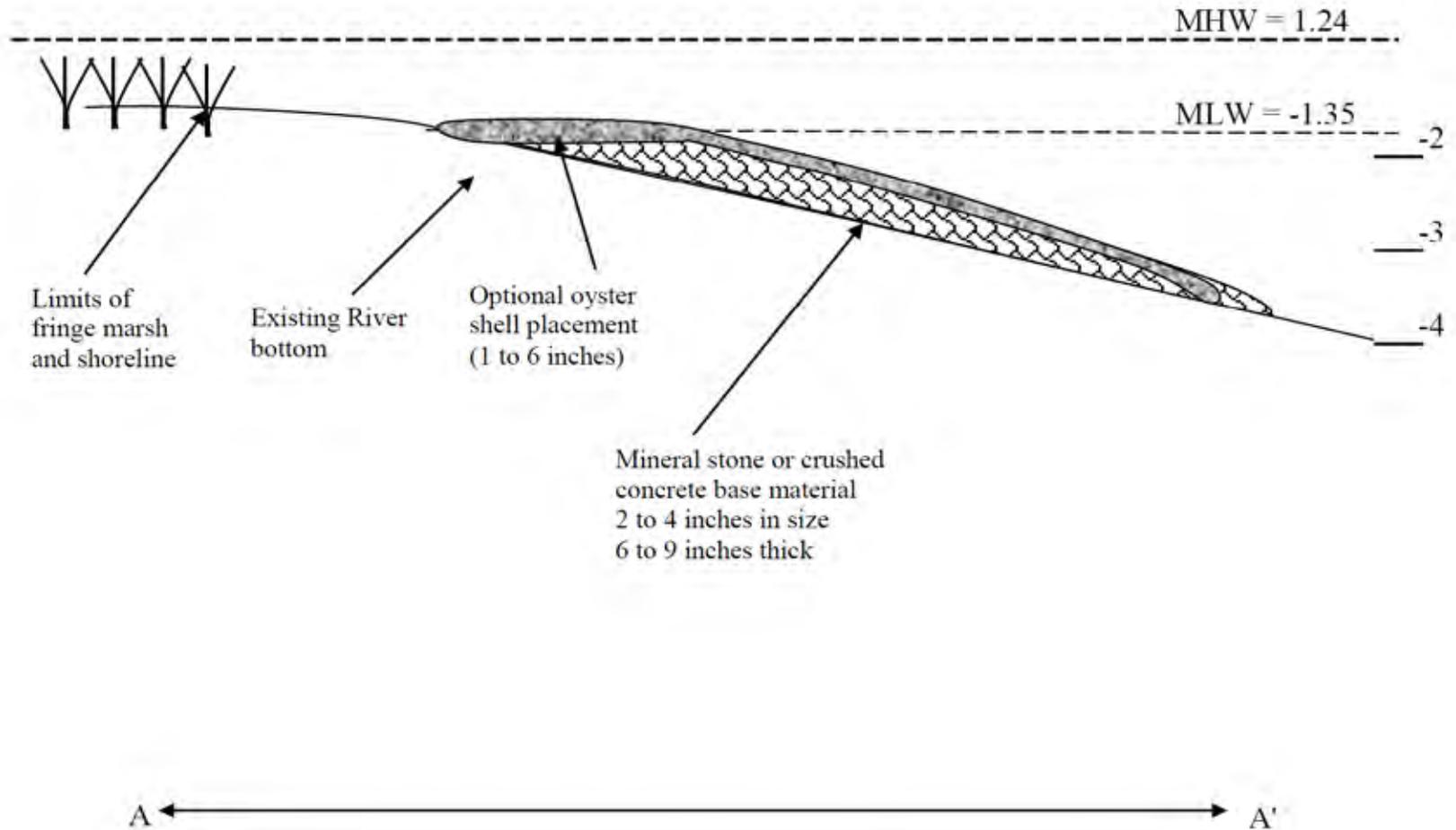
Knitting Mill Creek



Hampton Blvd

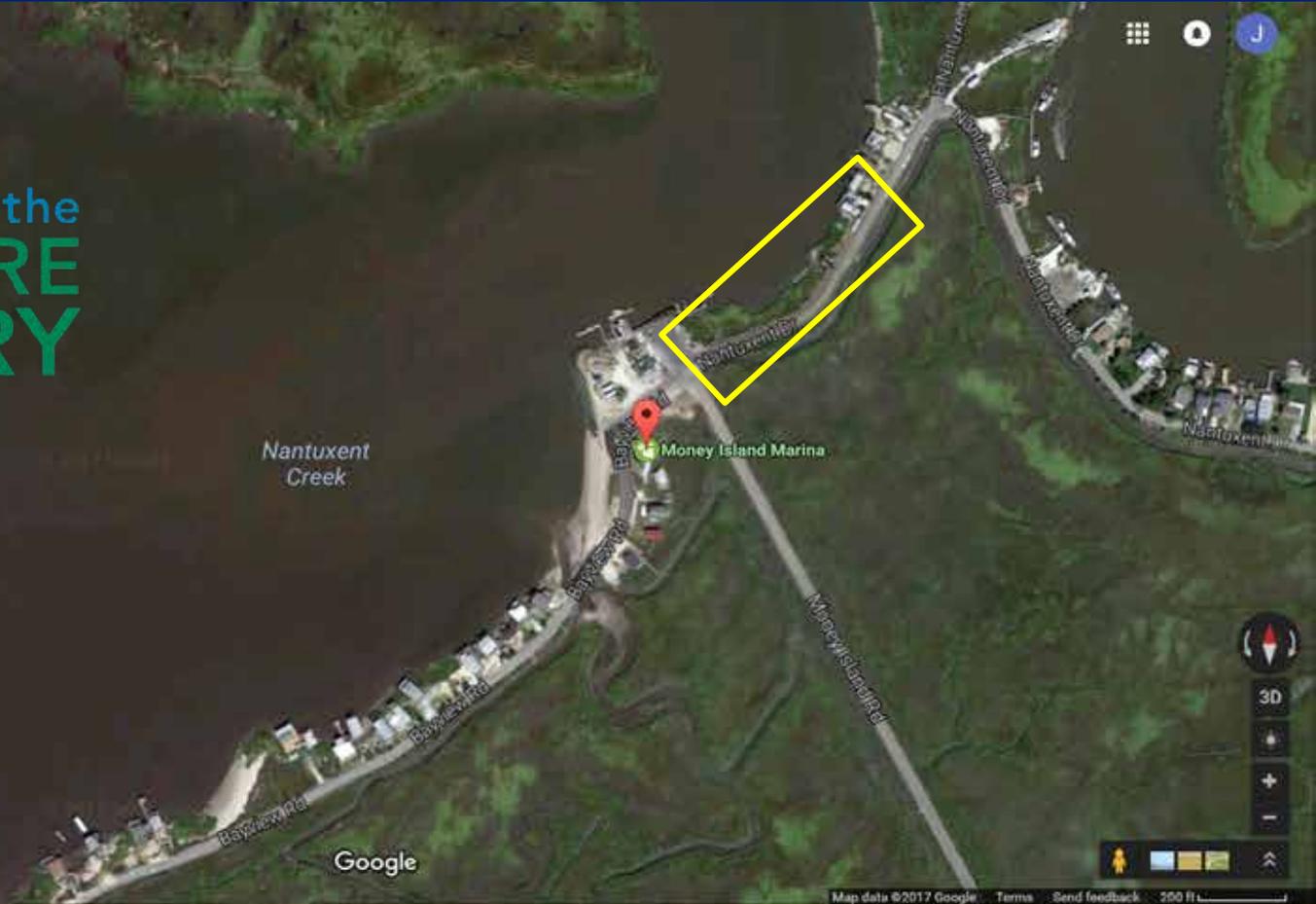


Cross-section of Typical Reef



Note: Elevations listed above are in NAVD 88.

Nantuxent Hybrid Living Shoreline



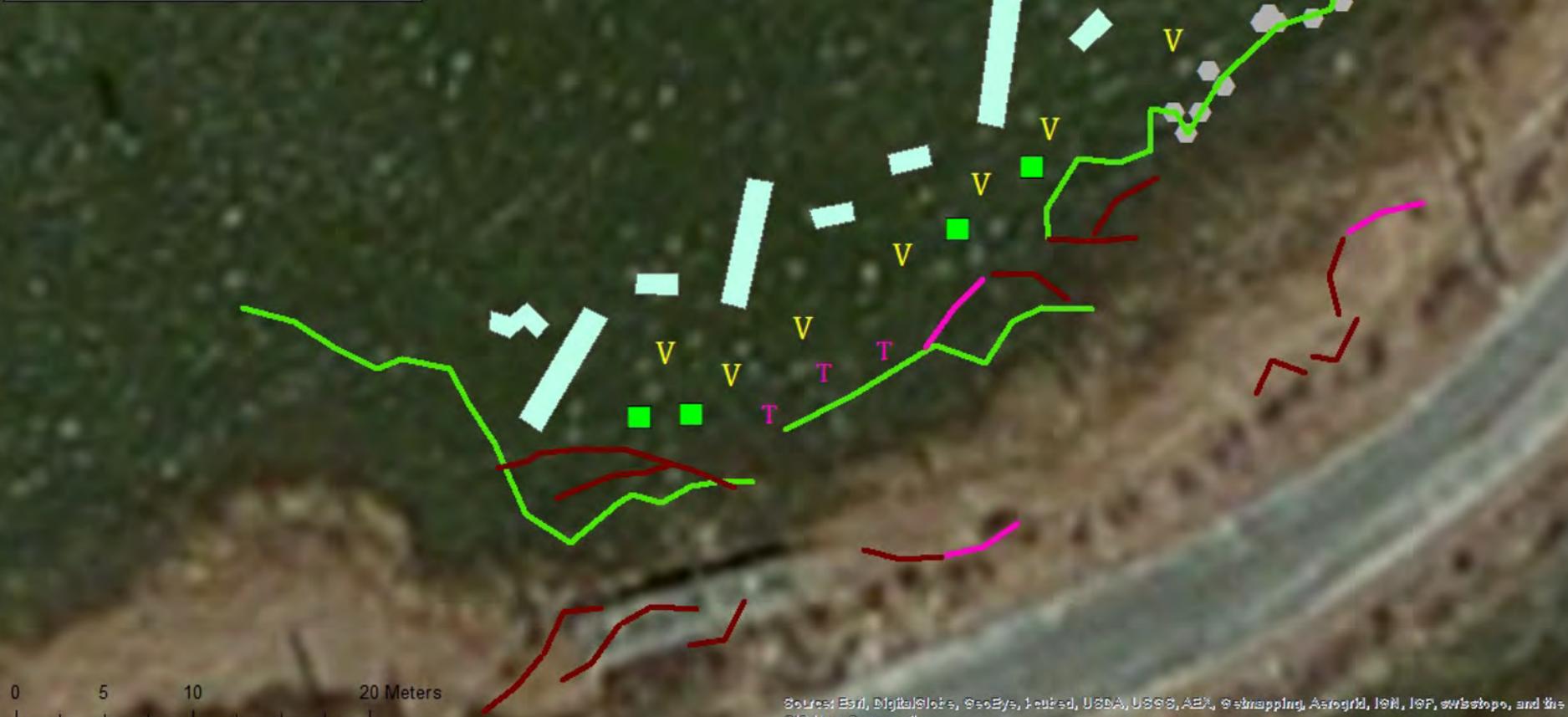
Hybrid Approach







- sq
- T t
- V v
- Breakwaters
- Log: In Tact
- Log: Damaged
- Vegline_Spring2016



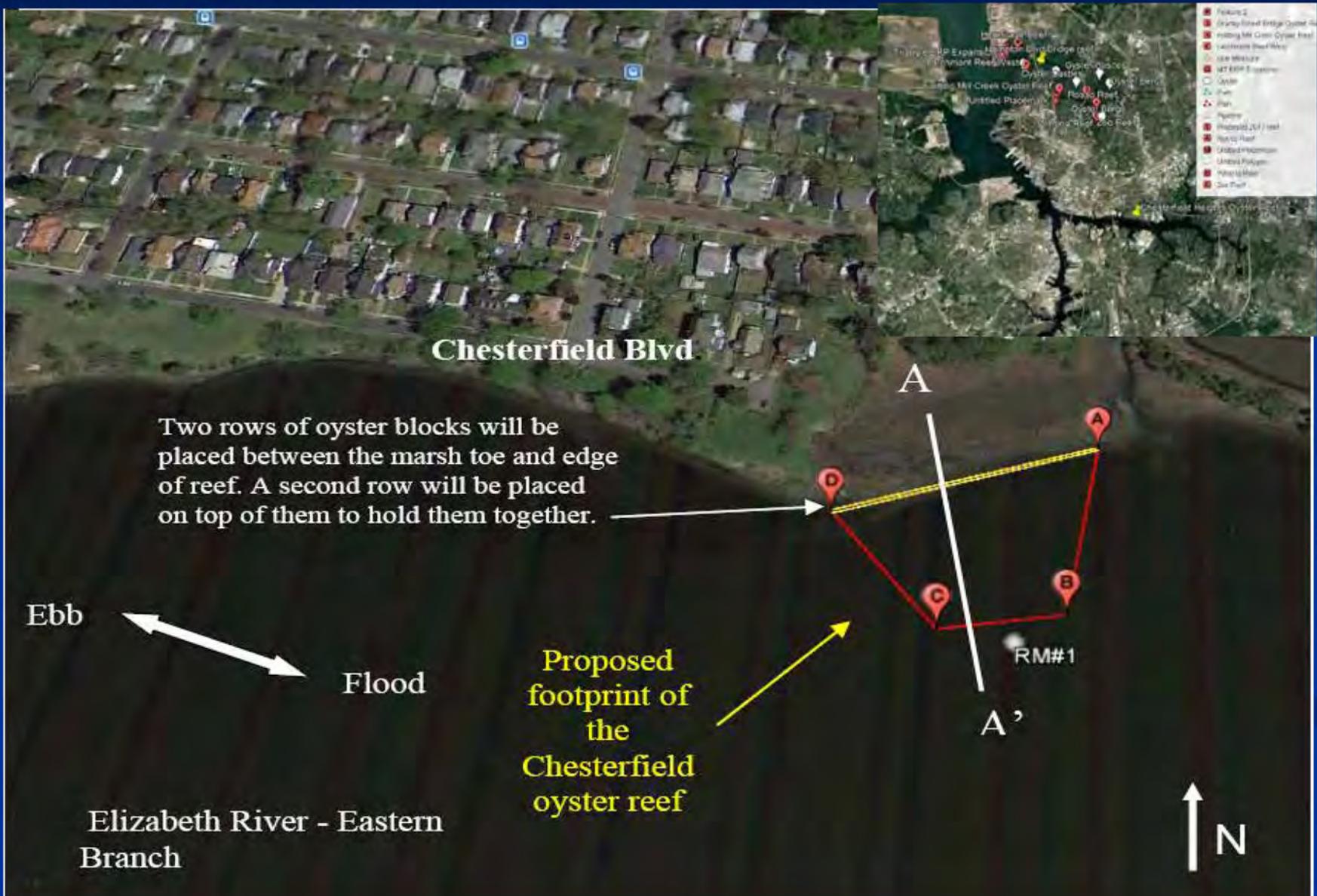
0 5 10 20 Meters

Source: Esri, DigitalGlobe, GeoEye, United, USDA, USGS, AeroX, @ mapping, AeroGRID, IGN, IGP, swisstopo, and the GIS User community

Oyster Structures and Coastal Resilience



Chesterfield Heights Oyster Reef



Diamond Face



Straight Face



Zig Zag



Install Completed By Volunteers



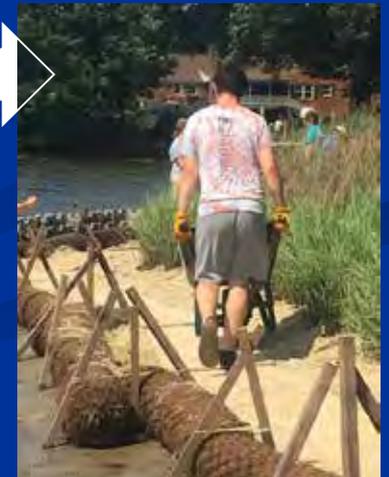
Oyster Castle Restoration Combined with Living Shorelines in Lafayette River



Oyster Castle Recruitment



Our Largest Living Shoreline Project – Rivercrest, Chesapeake 640 LF



HELP INSTALL A LIVING SHORELINE!



With Elizabeth River Project on Indian River in Chesapeake

Help us revitalize Indian River by constructing a 670-foot "Living Shoreline!" We will place some oyster castles, sand and native wetland grasses to protect the site from erosion and create habitat. We'd love to have you join us!

OYSTER CASTLES & SAND

Help install Oyster Castles® and place clean sand.

- WED, JUNE 13 (1P-5P)
- MON, JUNE 18 (8A-10A)
- TUE, JUNE 19 (8A-11A)
- WED, JUNE 20 (8A-NOON)
- THU, JUNE 21 (9A-1P)
- FRI, JUNE 22 (9A-2P)

Attire - Please bring gloves and wear shoes that can get muddy. We'll have tools, water, snacks, sunscreen, but please bring your own lunch (if applicable).

Age - This will be hard work, so we recommend adults or young adults and not young children.

RSVP - Grace Saunders, gsaunders@elizabethriver.org, 399-7487.

Contact numbers - Grace Saunders 651-3446, Pam 288-1379 or Joe 348-2047.

Location- 3800 Rivercrest Place, Chesapeake (off Indian River Road). Limited parking available at Rivercrest Condo. Overflow parking at Post Office next door (3810 Indian River Road).

Dates, duties, and times are subject to change due to weather or other factors.



Sylvan Street Norfolk This Past Weekend



Knitting Mill Creek Shoreline Restoration



New Product Ideas



Concrete Oyster Reef Restoration Tile
from Grow Oyster Reefs, LLC

Lessons Learned

- Start permitting early, be persistent with your permit writer, and try to permit multiple habitat projects together.
- We need to do better as a community sharing ideas and new designs for living shorelines.
- Never underestimate how much work you can get done with volunteers.
- Make sure you have a reliable contractor who is willing to use these materials.
- Always be looking for better materials and ways of building these projects (e.g. gap designs).
- Use high density coir logs

Nature-Based Features for Coastal Resilience: Quantifying Wave Dissipation

Presented By: Maura K. Boswell, P.E.
Old Dominion University, Ph.D. Candidate
Virginia Sea Grant Research Fellow



Dissertation Advisor: Navid Tahvildari, Ph.D.



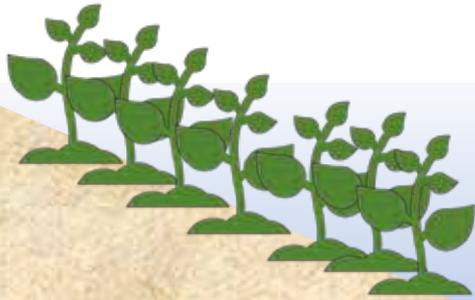
Background

- Living shorelines are the preferred method
- Minimal post-construction study
- Engineering design guidance is lacking
- Cross-disciplinary success



How do living shorelines work?

Marsh Sill

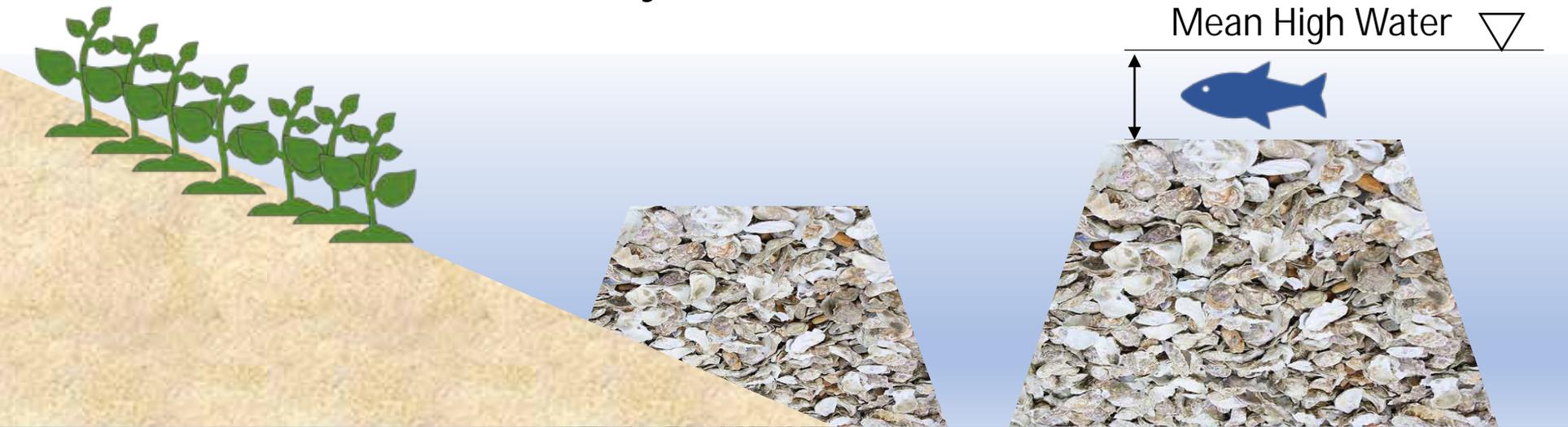


Mean High Water 

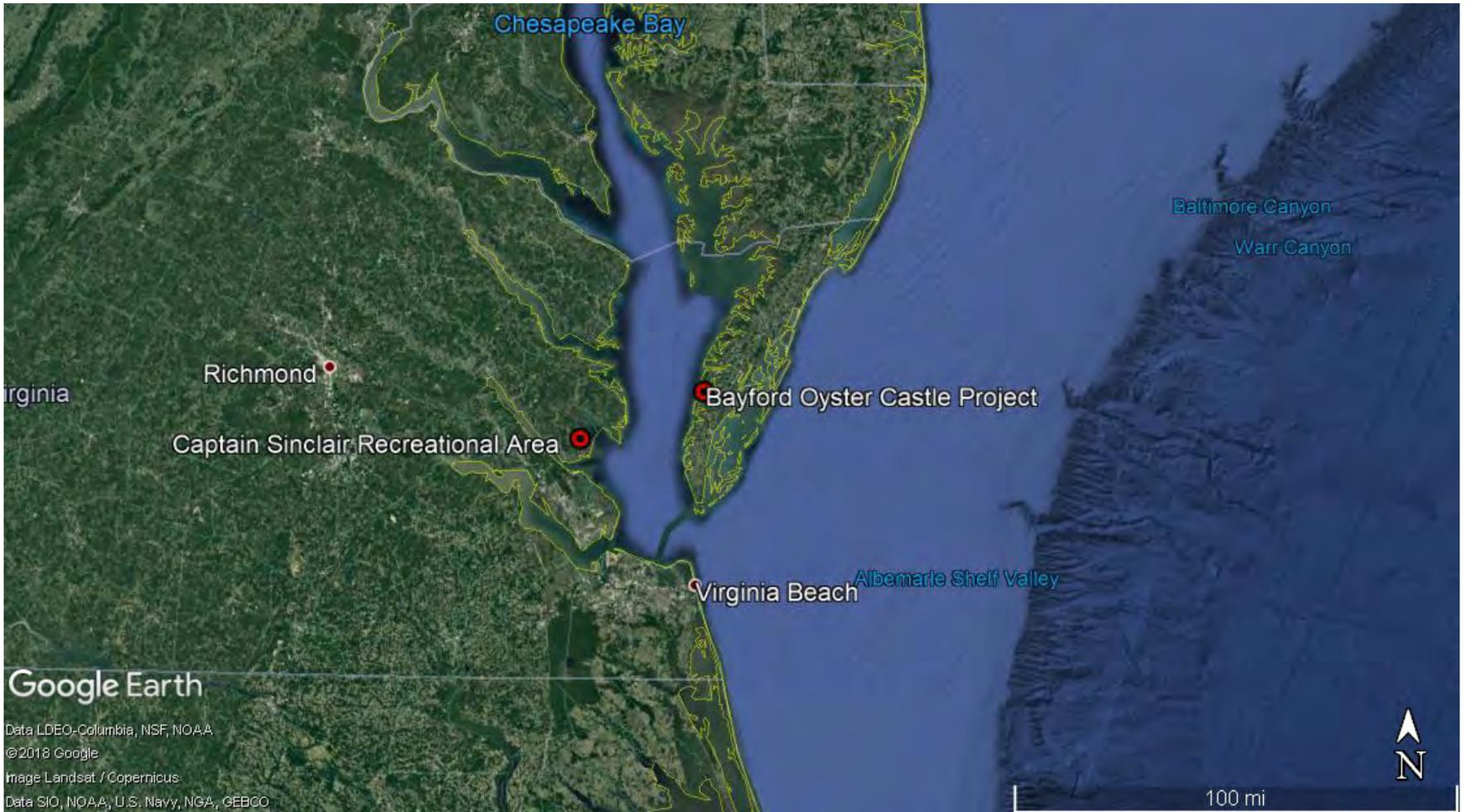


How do living shorelines work?

Oyster Castle



Locations



Captain Sinclair Marsh Sill

- Eroding marsh
- Constructed in 2016
- 4 rock sills, sand fill, vegetation



Captain Sinclair Marsh Sill



Low Tide



High Tide

Bayford Oyster Castle Project

- Eroding marsh
- Constructed in 2014
- 756 feet of oyster castle array



Bayford Oyster Castle Project

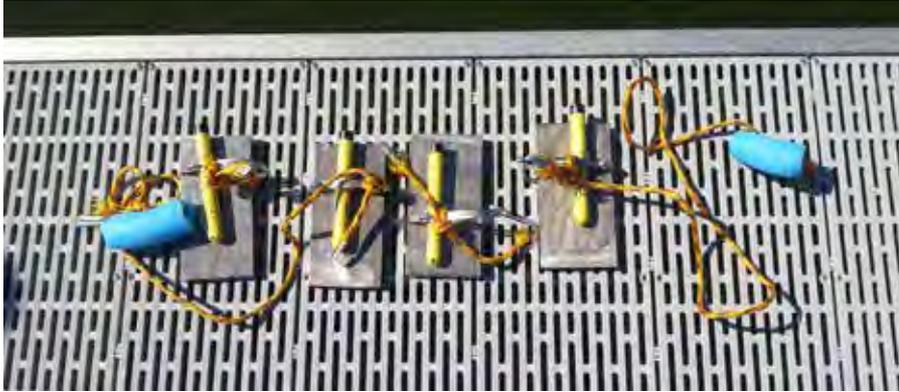


Low Tide



High Tide

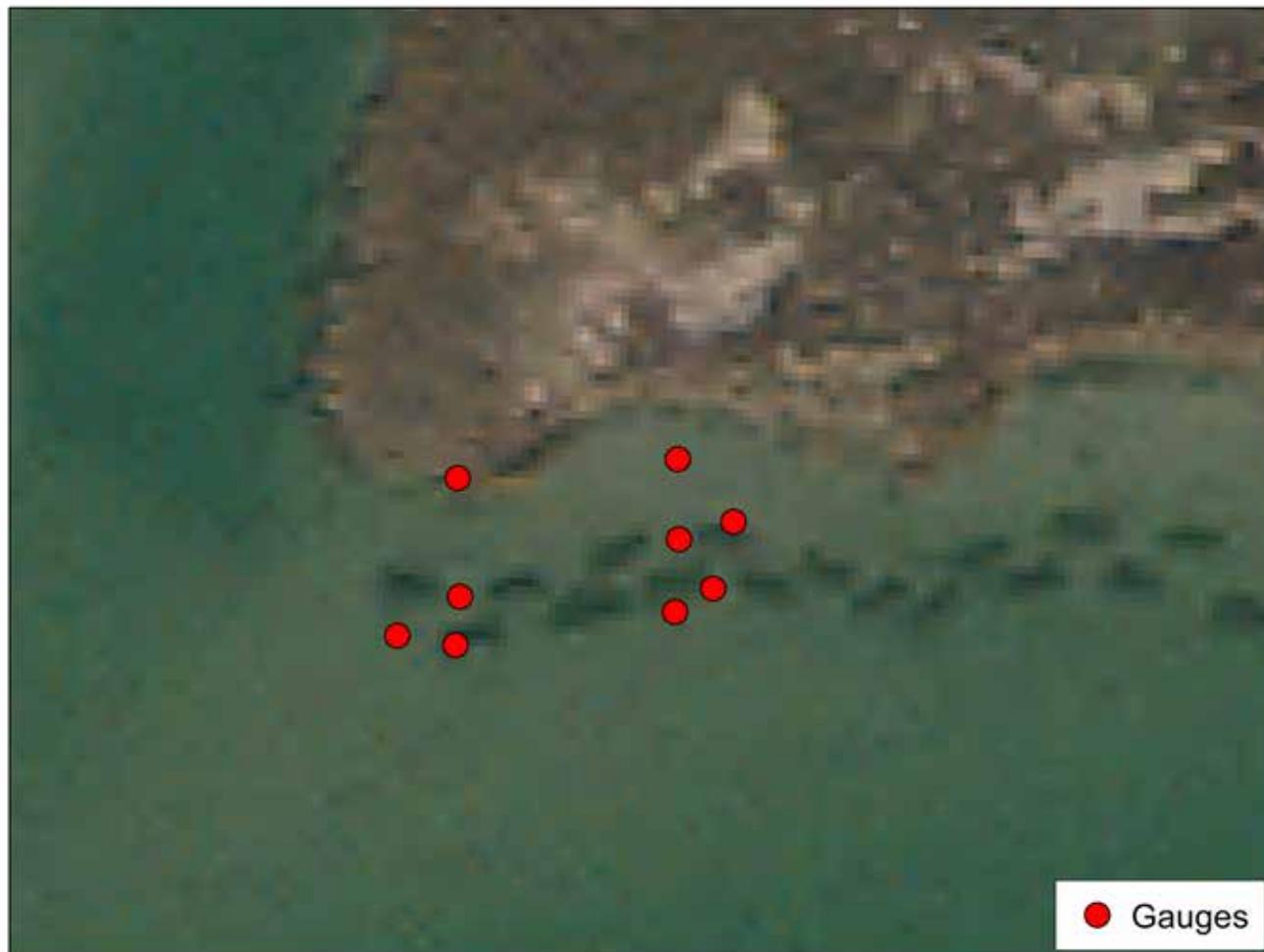
Data Collection



Captain Sinclair



Bayford



Next Steps

- Finish data post-processing
- Quantify wave dissipation
- Numerical modeling for optimization



Acknowledgments

- Virginia Sea Grant
- Virginia Institute of Marine Science
 - Center for Coastal Resources Management
 - Shoreline Studies Program



Shoreline Erosion Advisory Service

A Resource for Shoreline Landowners and Communities

Aaron Wendt
Virginia Department of Conservation and Recreation

Virginia Institute of Marine Science
Tidal Shoreline Management Workshop

June 14, 2018
Gloucester Point, VA

Overview

- What is the Shoreline Erosion Advisory Service?
- Chesapeake Bay TMDL WIP
Shoreline Management BMP Verification
and Reporting Pollutant Load Reduction Credits

Shoreline Erosion Advisory Service

What is a Homeowner To Do?



Erosion Rates

- Erosion is a natural process
- In coastal regions, waves, currents, tides, rises in sea level and wind all contribute to erosion
- Erosion of banks supplies sand to beaches and marshes
- Excess suspended sediment and associated nutrients can negatively impact SAV and water quality

- Generally, lower sections of rivers and the Bay experience highest rates of erosion
- Some Virginia shorelines have historic erosion rate of -30 feet per year
- Some areas are accreting +10 feet per year

HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?

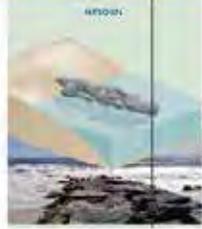
GREEN - SOFTER TECHNIQUES
Small Waves | Small Fetch | Gentle Slope | Shaded Coast

LIVING SHORELINE

<p>VEGETATION ONLY</p> 	<p>PODING</p> 	<p>RI&S</p> 	<p>BEACH NOURISHMENT ONLY</p> 	<p>BEACH NOURISHMENT & VEGETATION ON DUNE</p> 
---	--	--	--	---

GRAY - HARDER TECHNIQUES
Large Waves | Large Fetch | Steep Slope | Open Coast

COASTAL STRUCTURE

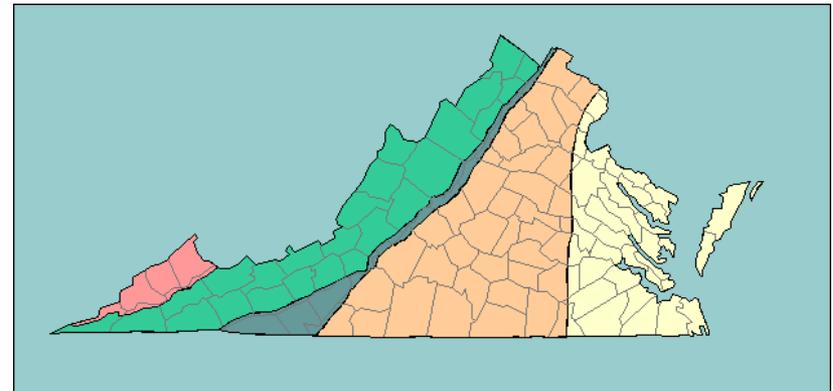
<p>BREAKWATER</p> 	<p>REEF</p> 	<p>REVETMENT</p> 	<p>BULKHEAD</p> 	<p>SEAWALL</p> 
--	---	---	--	---

SEAS Created

- Created by Virginia General Assembly in 1980
- Provides technical assistance to property owners, localities, and state and federal agencies experiencing shoreline or streambank erosion in Virginia

SEAS Geography

- Service area historically
 - from fall line to Eastern Shore
 - from Fairfax County to North Carolina
- Chesapeake Bay in Virginia has over 5,000 miles of tidal shoreline
- Service area now expanded across entire Commonwealth



SEAS Services

- Site investigations
- Written reports
- Design/plan reviews
- Construction inspections
- Information
- VCAP Living Shorelines
- All SEAS services are **FREE!**



The collage features several key elements: a photograph of a person in a field; a letter from the Commonwealth of Virginia, Department of Conservation and Forestry, dated October 13, 2011, addressed to Mr. Cliff Arnes; a map showing a shoreline with a 'PROPOSED BEACH' area; a 'RECEIVED' stamp from the Marine Resources Commission dated December 1, 2011; a photograph of a rocky shoreline; a sign for the 'VIRGINIA SHORELINE EROSION ADVISORY SERVICE'; a 'VCAP PROCESS' flowchart with six steps; and the 'SWCD' logo for the Virginia Conservation Assistance Program.

Chesapeake Bay TMDL WIP

Shoreline Management BMPs

Verification and Reporting of Pollutant Load Reduction Credits

Expert Panel report

- Convened by USEPA Chesapeake Bay Program
- Report approved 2015, revised 2017
- review the science and published literature
- develop protocols to estimate pollutant load reductions associated with different shoreline erosion BMPs

Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects

Submitted by:

Nathan Fozard, Kevin DuBois, Jeff Halka, Scott Hardway, George Janek, Lee Karth, Eva Koch, Lewis Linker, Pam Mason, Ed Moegerech, Daniel Proctor, Kevin Smith, Bill Stack, Steve Stewart, and Bill Wolanski

Accepted by Urban Stormwater Work Group: April 15, 2014

Approved by Watershed Technical Work Group: February 13, 2015

Approved by Water Quality Goal Implementation Team: July 13, 2015

Amended by WTWG and WQGIT: June, 2017

NOTE: THIS VERSION SUPERCEDES ALL PRIOR VERSIONS

Prepared by:

Sadie Drescher and Bill Stack (Chair), Center for Watershed Protection, Inc. and EPA Chesapeake Bay Program Office (CBPO) Sediment Stream Restoration Coordinator



Expert Panel report

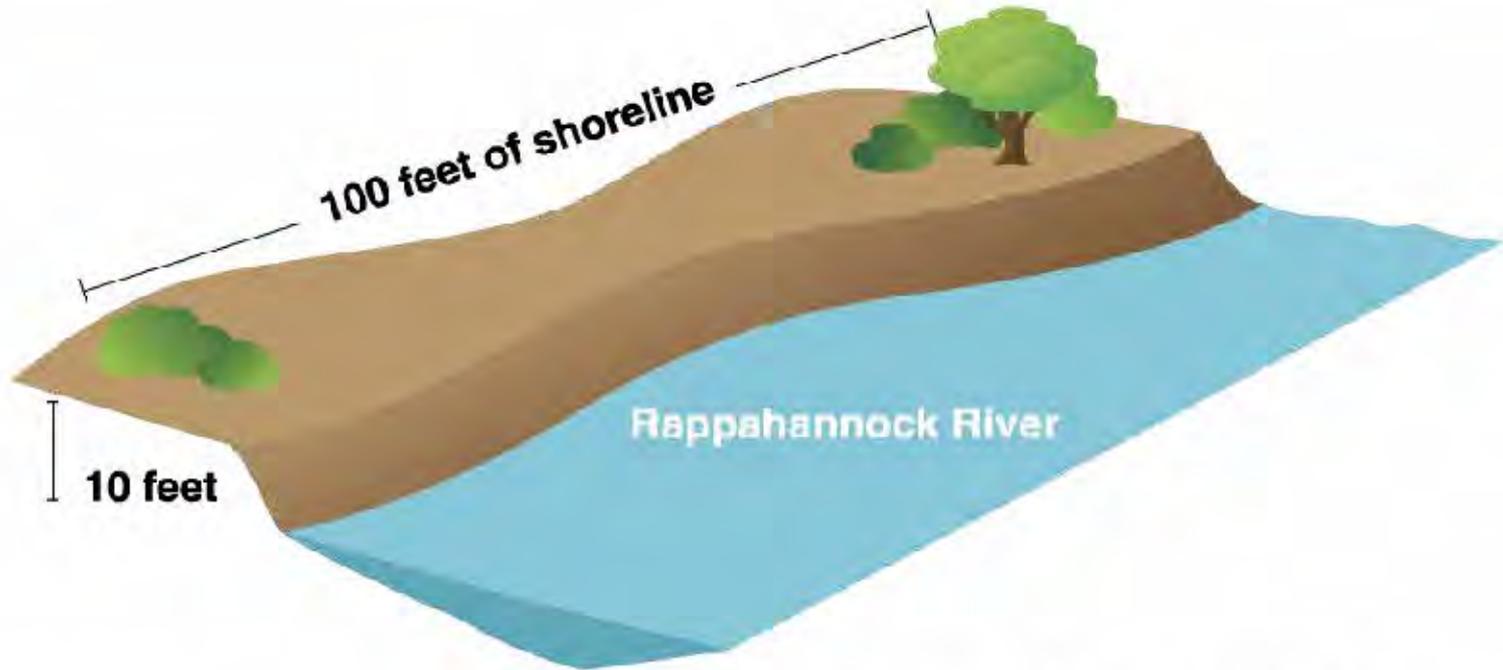
Table 1. Summary of shoreline management pollutant load reduction for individual projects.

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

- Basic qualifying conditions for BMPs/sites
- 4 general protocols to define load reductions associated with specific BMPs
- 5-year BMP life, renewable upon field verification

BMP Verification Project

- Virginia Dept. of Conservation and Recreation
 - Shoreline Erosion Advisory Service
 - Virginia Institute of Marine Science
 - Sea Grant's Commonwealth Coastal & Marine Policy Fellowship
 - Shoreline Studies Program
 - Center for Coastal Resources Management
 - Virginia Marine Resources Commission
 - Habitat Management Division
 - Virginia Dept. of Environmental Quality
-
- utilize Expert Panel report and protocols to quantify, verify, and report Chesapeake Bay TMDL WIP pollutant load reduction credits associated with specific shoreline stabilization practices implemented in Virginia tidal waters since 2008



Annual erosion rate = 1 foot

**46.8 tons of sediment
34 pounds of nitrogen
22.5 pounds of phosphorus**

Methodology – Permits

- VMRC Habitat Permit Database
 - January 1985-June 2016 (>11,000 records)
 - Records also at VIMS-CCRM database
- Selected permit applications received since 01/01/2008
- Selected permit applications where Structures included
 - Riprap, Revetment, Sill, Breakwater, Living Shoreline, Bioengineered Structure, Coir Log, Marsh Toe Sill
 - >2,500 records

Methodology - Parameters

- Project Construction Date
 - VMRC permit database
- Protected Shoreline Length (feet)
 - VMRC permit database
- Marsh Planted (acres)
 - VMRC permit database
- Erosion Rate (feet per year)
 - VIMS Shoreline Studies Program shapefiles – actual historic shoreline erosion from aerial images (1937-2009)
- Bank Height (feet)
 - VGIN LiDAR digital elevation model files (2009-2013)
- Upland Land Use (Agricultural, Forest, or Urban)
 - National Land Cover Dataset (2011), VBMP Land Cover (2013-2015), VBMP 2013 aerial photography, NAIP 2016 aerial photography

Virginia Marine Resources Commission

Habitat Management Division > Habitat Permits

Contact Us |

<< Search Again

Export Results to PDF

Export Results to Excel

Display Results in Google Maps

Search Results: 1 Permits

Search Criteria:

Application Number is like 20110174

Applications received since January 2010 may include a scanned image of the original application, a Google Map of the area, and the permit document (depending on permit status) which can be found in the right-hand column. Additional documents such as revisions, protests, and partner agency comments are only included for applications entered after September 1, 2013.

Requires Google Chrome, Mozilla Firefox, Safari, or IE 10.0 or greater. Please turn off pop-up blocker for this site.

Application Number	Applicant	Date Application Received	Status	Project Description	Locality	Waterway	Local Wetlands Board Action	Application Permit Map Report Add Docs
20110174	BALDWIN, ERIC	02/11/2011	Issued	Rock Sill/Beach Nourishment/Living Shoreline Beach Nourishment: 750 Cubic Yards Sill: 225 Linear Feet	Gloucester	Cedarbush Creek	Approved as Proposed	Application Google Map Report



Protected shoreline length:
From VMRC Permit Database

Virginia Marine Resources Commission

Habitat Management Division > Habitat Permits

Contact Us |

[« Search Again](#)
 [Export Results to PDF](#)
 [Export Results to Excel](#)
 [Display Results in Google Maps](#)

Search Results: 1 Permits
Search Criteria:
 Application Number is like 20150214

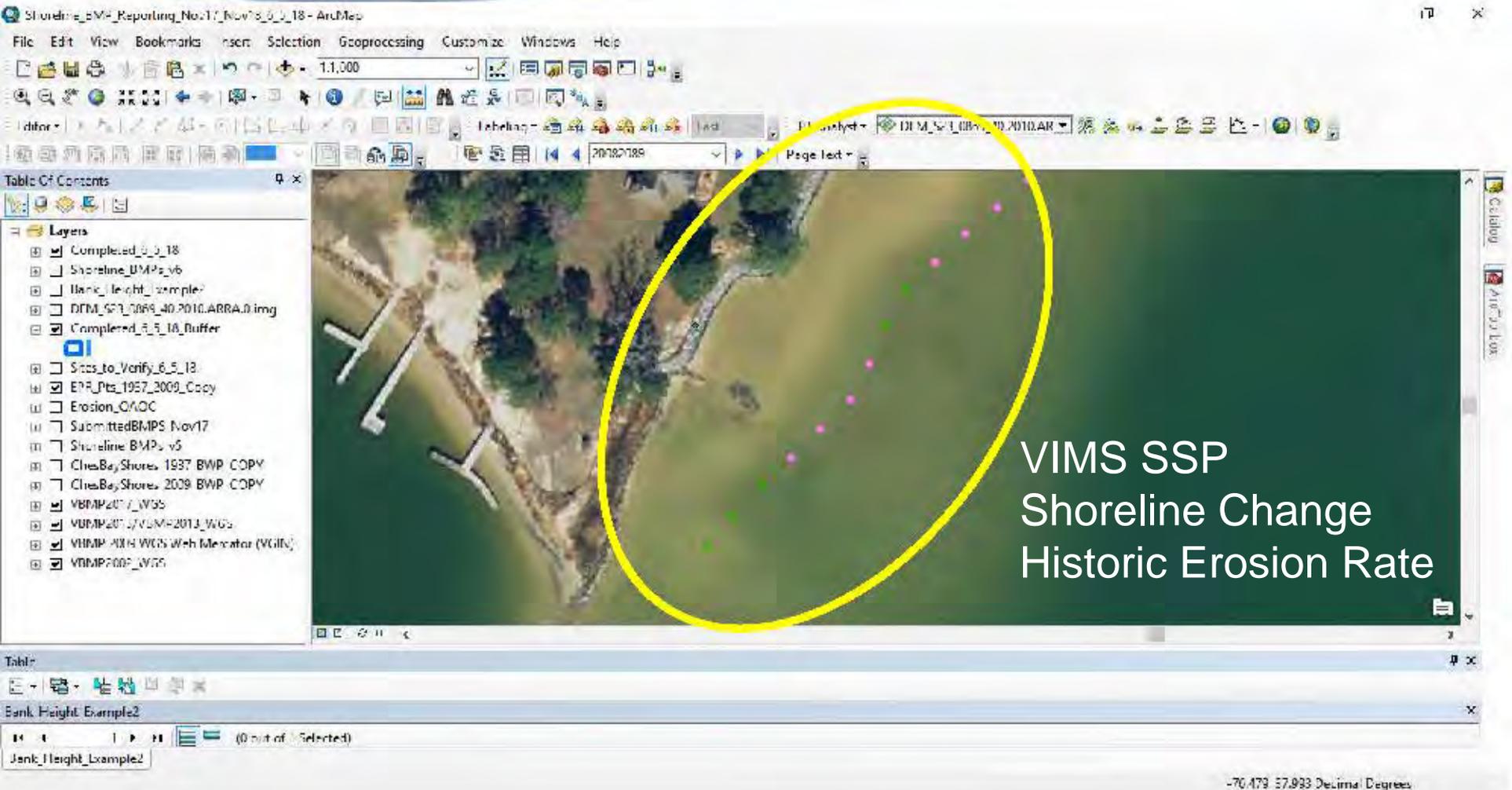
Applications received since January 2010 may include a scanned image of the original application, a Google Map of the area, and the permit document (depending on permit status) which can be found in the right-hand column. Additional documents such as revisions, protests, and partner agency comments are only included for applications entered after September 1, 2013.

Requires Google Chrome, Mozilla Firefox, Safari, or IE 10.0 or greater. Please turn off pop-up blocker for this site.

Application Number	Applicant	Date Application Received	Status	Project Description	Locality	Waterway	Local Wetlands Board Action	Application Permit Map Report Add Docs
20150214	NORFOLK, CITY OF	02/18/2015	No Permit Necessary	LaValette Boat Ramp Living Shoreline Project Sill: 187 Linear Feet Sill Fill: 454 Cubic Yards Core Log: 238 Linear Feet Living Shoreline: 408 Linear Feet Fill/Plantings: 9349 Square Feet	Norfolk	Lafayette River	No Permit Required	Application Google Map Report Additional Docs



Planted Acreage:
From VMRC Permit Database





Shoreline_BMP_Reporting_Nov17_Nov18_6_5_18 - ArcMap

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:2,000

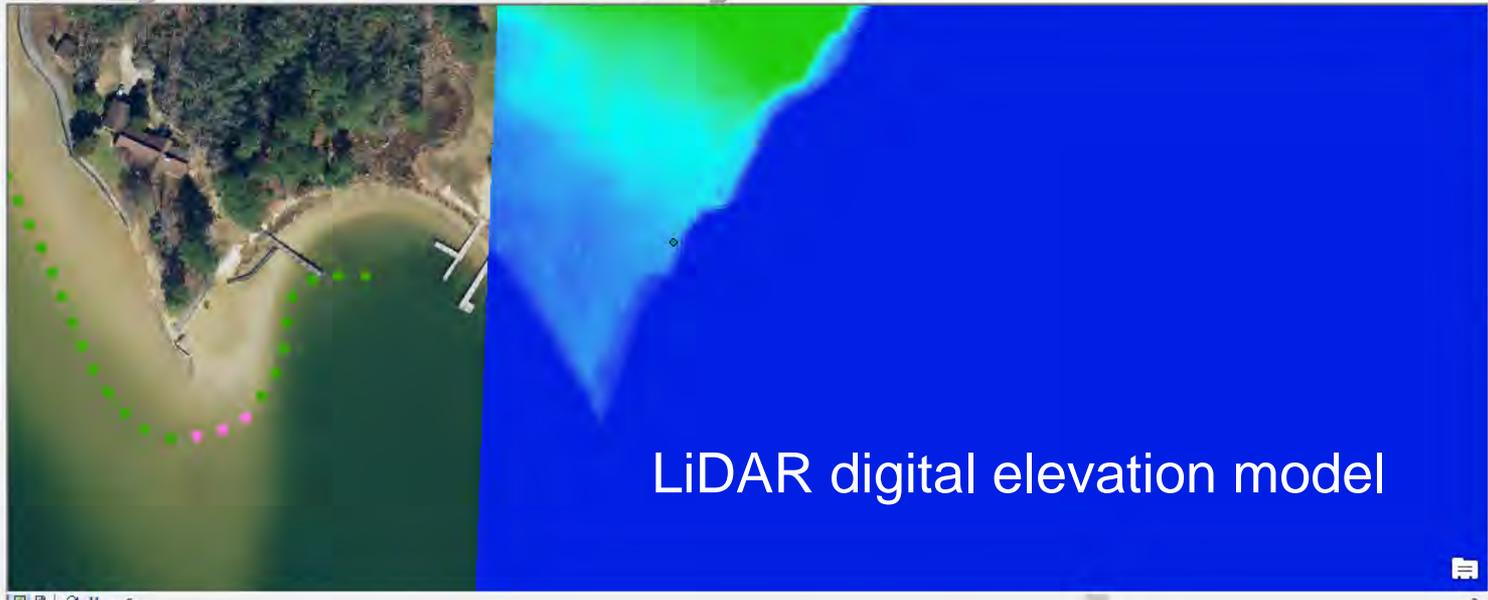
DEM_S23_0869_40.2010.AR

20082089

Page Text

Table Of Contents

- Layers
 - Completed_6_5_18
 - Shoreline_BMPs_v6
 - Bank_Height_Example2
 - DEM_S23_0869_40.2010.ARRA.0.img
 - Completed_6_5_18_Buffer
 - Sites_to_Verify_6_5_18
 - EPR_Pts_1937_2009_Copy
 - Erosion_QAQC
 - SubmittedBMPs_Nov17
 - Shoreline_BMPs_v5
 - ChesBayShores_1937_BWP_COPY
 - ChesBayShores_2009_BWP_COPY
 - VBMP2017_WGS
 - VBMP2013/VBMP2013_WGS
 - VBMP 2009 WGS Web Mercator (VGIN)
 - VBMP2002_WGS



LiDAR digital elevation model

Table

Bank_Height_Example2

1 (0 out of 1 Selected)

Bank_Height_Example2

-76.481 37.993 Decimal Degrees

Verification

1. VMRC-inspected and deemed 'in compliance'
 - Inspection Date = BMP 'Installation Date'
2. Not inspected, but visible via aerial imagery (desktop verification)
 - Date of Imagery = BMP 'Installation Date'
3. Not inspected and not visible (field verification required)
 - Date of field visit = BMP 'Installation Date'

Calculated Load Reductions

	# of Sites	Sites with Plants	Miles of Shoreline	N (lbs/yr)	P (lbs/yr)	S (lbs/yr)
Reported	481	9	17.7	3,750	2,630	6,410
Verified	514	12	20.0	4,975	3,395	8,259
Assessed	248	29	10.0	2,361	1,549	3,758
Total	1,243	50	47.7	11,086	7,574	18,427

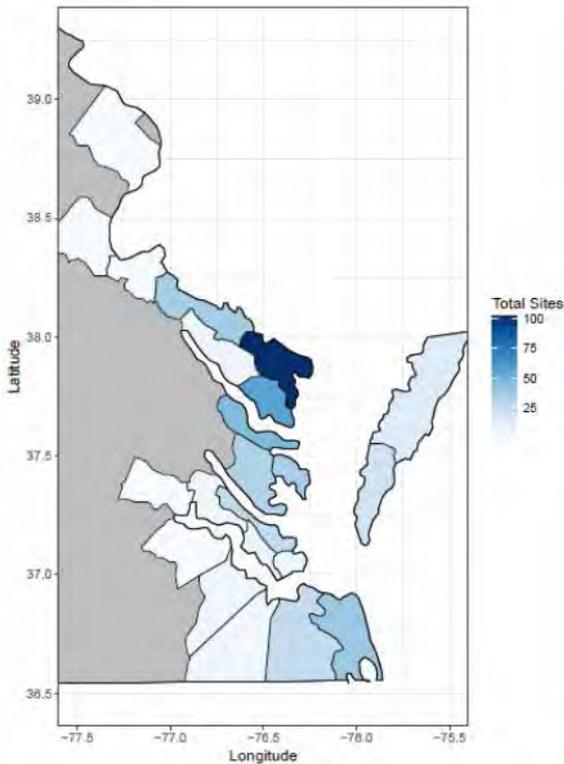
- Reported to DEQ (and subsequently USEPA) in Nov. 2017
- Verified and Ready to Report to DEQ by Nov. 2018
- Assessed and Needs to be Verified either by Desktop or Field

Outcomes

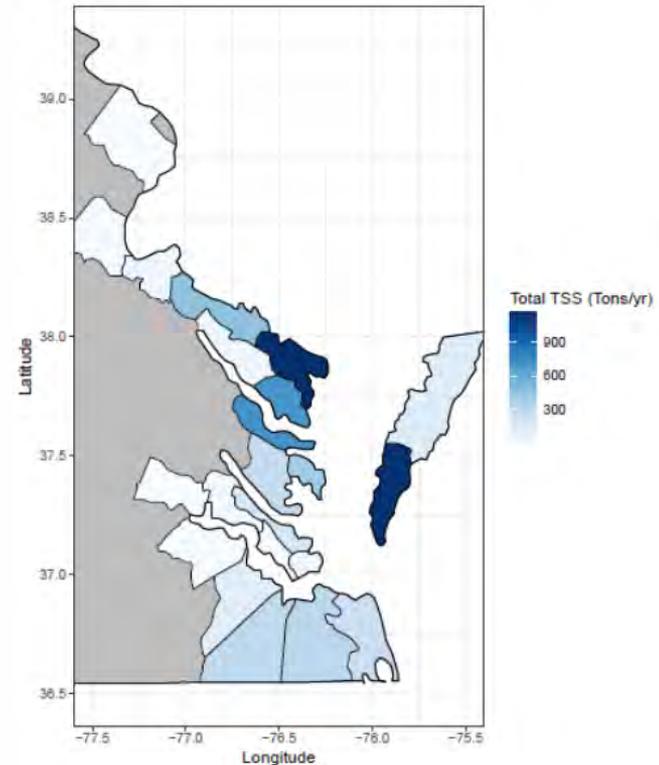
Parameter	Value
Total Number of Sites	481
Protected Length (ft)	93,599
Protected Length (mi)	17.73
Number Planted Sites (subset of total)	9
Total Planted Area (sq.ft)	15,424
Planted Area (ac)	0.35

Pollutant	Total Load Reduction (lbs/year)	Average Reduction (lbs/site)	Per-Unit Reduction (lbs/ft/year)
TP	2,629.51	5.47	0.02809
TN	3,749.51	7.8	0.04006
TSS	12,819,702	26,652.19	137

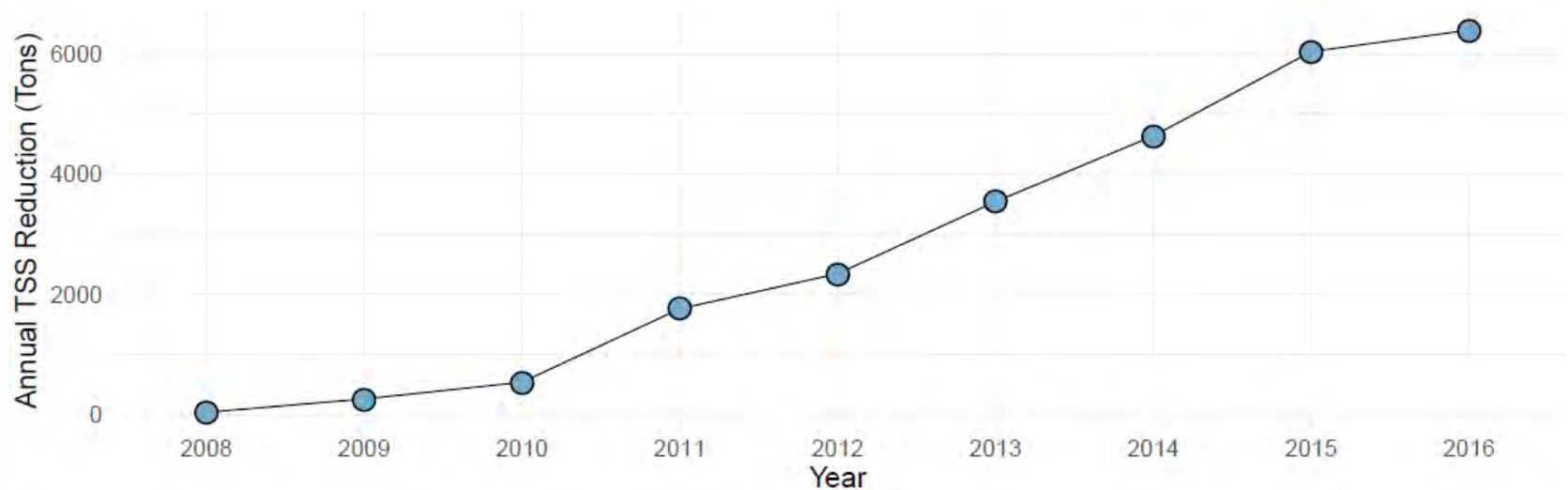
Number of Sites by Locality



Total Sediment Reductions by Locality

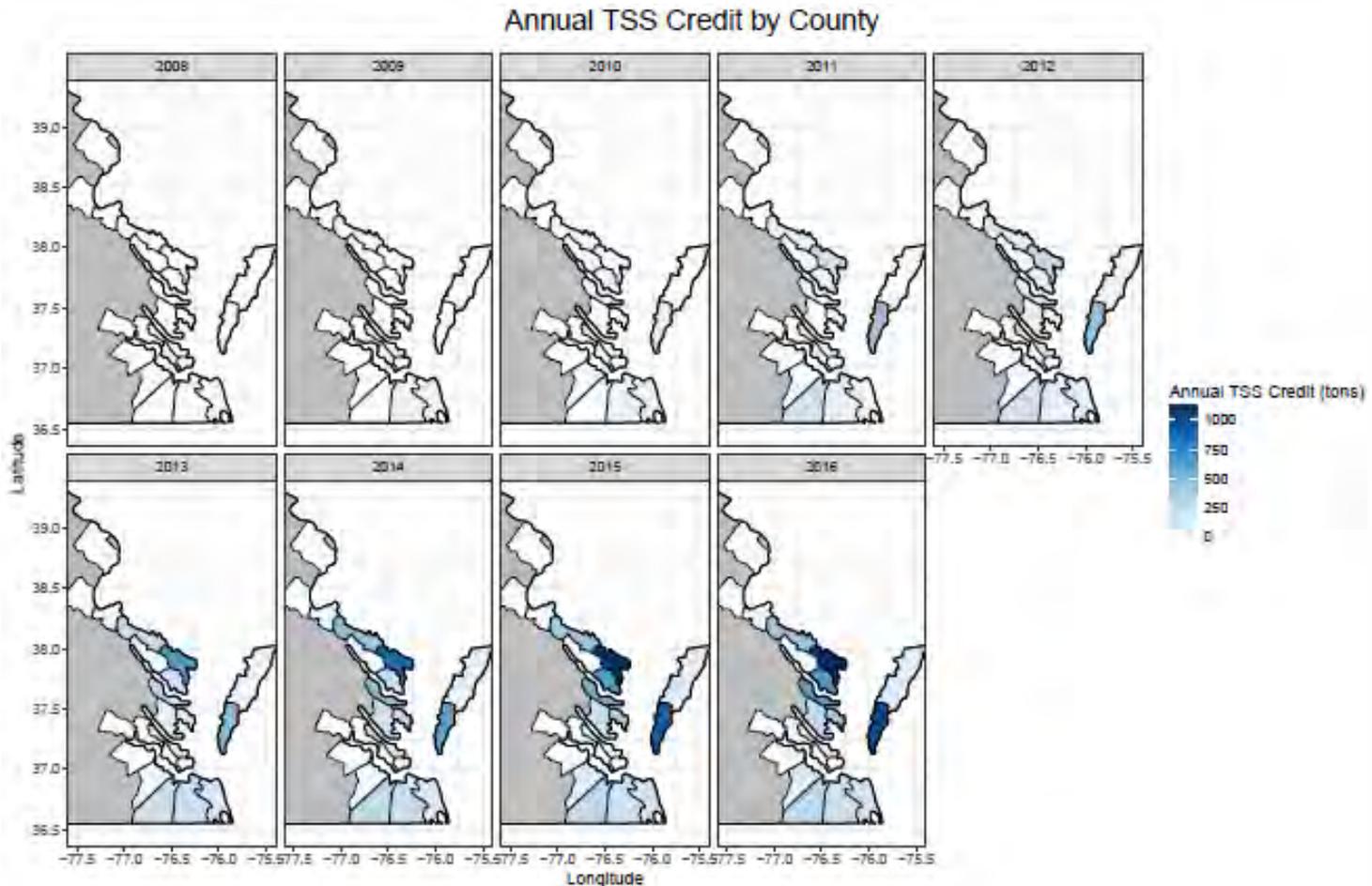


Cumulative Annual TSS Reduction



- 5 year BMP life

Annual TSS Credit by Locality



Next Steps

- Complete verification of historic sites
 - Determine credits for sites not inspected by VMRC
 - Use remote sensing, aerial photography, Google Earth (desktop verification)
 - Prioritize sites for field verification, by land or sea
 - Start with sites on Rappahannock and York Rivers
- Process for reporting and verifying new shoreline BMPs
 - Obtaining VMRC permit application data on new sites
 - July 2016 thru December 2017, and beyond
 - Keep up with on-going VMRC inspections
- Reporting “renewed” sites after 5-year life of BMP
- Transition (Bruce’s Fellowship is ending)

Feedback

- Any other entities reporting?
- BMP Warehouse; Protocols vs. Default Rates
- Inspections: Schedule, collecting information
- Living Shorelines and Plantings
- Possibility to collect more required data up front or during inspection?
- Verification as logistical challenge

Aaron Wendt
Shoreline Engineer

Virginia Department of Conservation and Recreation
Division of Soil and Water Conservation
Shoreline Erosion Advisory Service

PO Box 1425
Tappahannock, VA 22560

O (804) 443-5642
C (804) 296-1701
F (804) 443-4534

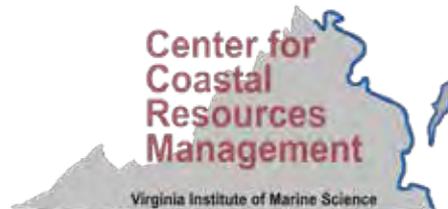
aaron.wendt@dcr.virginia.gov

<http://www.dcr.virginia.gov/soil-and-water/seas>

*Authorization for use or reproduction of any original material contained in this presentation is freely granted.
DCR would appreciate acknowledgement.*

2018 Legislative Update

Pamela Mason



Funded in
part by

Virginia Coastal Zone
MANAGEMENT PROGRAM

Legislation Passed

- **SB 265 Coastal Adaptation and Protection, Special Assistant to the Governor for; position created.**
(HB345) Initiate and assist with economic development opportunities associated with adaptation, to advance academic expertise at the Commonwealth Center for Recurrent Flooding and Resiliency, and to pursue federal, state, and local funding opportunities for adaptation initiatives.

Legislation Passed con't

HB 1307 Stormwater management; rural Tidewater, tiered approach to water quantity technical criteria

- Rural Tidewater localities to comply with water quantity criteria based on percentage impervious cover in the watershed.
- Localities adopt map of % impervious cover in each watershed updated annually.
- Apply one of three standards to new development based on % impervious cover: (i) < 5.0% the standard shall be MS-19; (ii) > 5.0% and < 7.5% the standard shall be the one-year, 24-hour release method; and (iii) if >7.5% the standard shall be the energy balance method.
- Department of Environmental Quality to assist in clarifying the interpretation and application of the MS-19 standard.
- Follow-on legislation from 2017. HB1774 directed CCRFR to study stormwater management in rural Tidewater localities. Report crafted by VCPC and CCRM

Legislation Passed con't Dredging

- **SB 693 Virginia Waterway Maintenance Fund and Grant Program:**

Virginia Port Authority to provide grants for certain dredging projects and related activities. VPA to manage the grant program by developing guidelines and procedures and for the awarding of annual grants.

- **HB 1096 Dredged material siting:**

Directs the Marine Resources Commission to develop a fast-track regulatory permitting program for the selection and use of appropriate sites for the disposal of material dredged no later than July 1, 2019.

- **HB 1095 Chesapeake Bay public water access authorities:**

Authorizes the Middle Peninsula Chesapeake Bay Public Access Authority and the Northern Neck Chesapeake Bay Public Access Authority to undertake dredging projects and authorizes public access authorities to work together in any combination to undertake dredging projects

- **HB 1091 Virginia Resources Authority; dredging projects:**

Adds dredging program or project to the list of eligible activities under the Authority

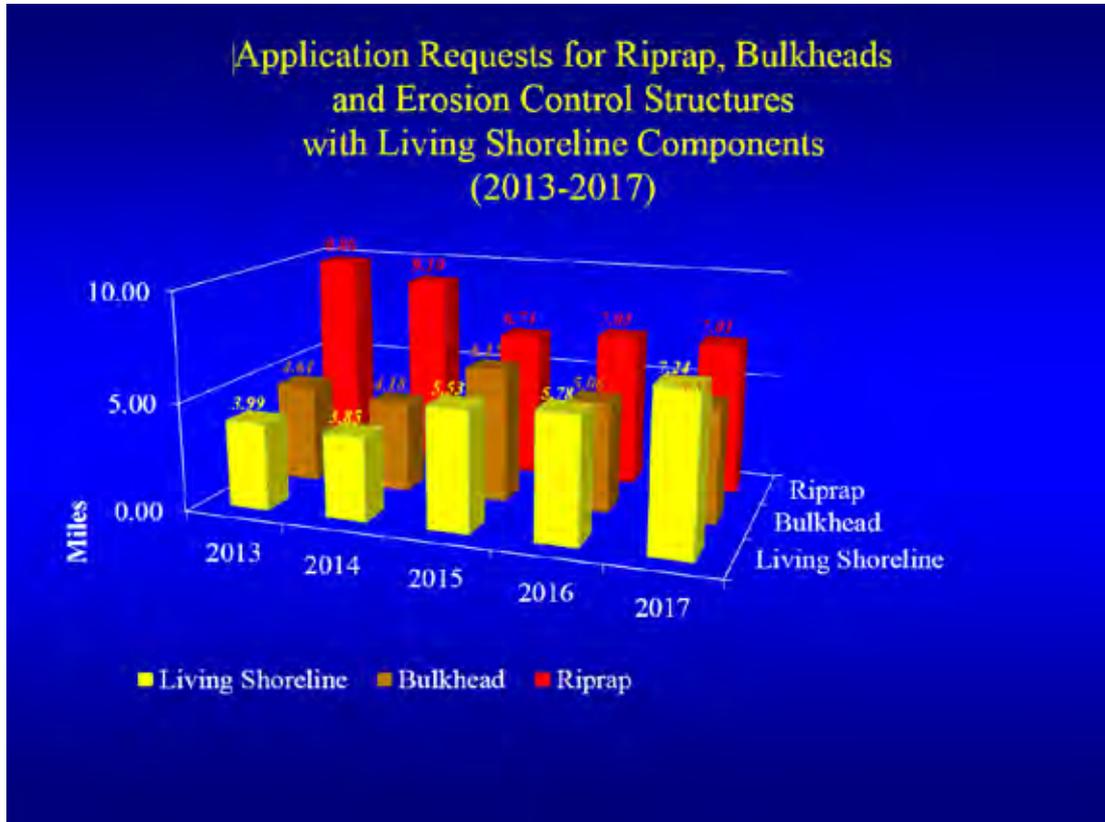
Failed to Pass

- **SB 397 Hampton Roads Coastal Resiliency Authority; created**
- **HB 1094 Chesapeake Bay Preservation Areas; regulations, local permit to raise land.** Directs the State Water Control Board to adopt regulations to establish criteria for use by local governments in granting, denying, or modifying a request by any landowner within a Chesapeake Bay Preservation Area to raise the base elevation of his land for the purpose of mitigating the effects of flooding.

Bill resulted in a letter from Committee Chair to VIMS to direct a study of the issue. Study underway at CCRM

Shoreline Program Updates

VMRC Permit Tracking



January 1 – June 8, 2018

Structure	Miles
Riprap	2.82
Bulkhead	1.73
Living Shoreline	2.26

Source: VA Marine Resources Commission

VMRC Habitat Management Permits & Applications Database
<https://webapps.mrc.virginia.gov/public/habitat/>

VMRC Living Shoreline General Permits

streamlined permitting process as an incentive

Group 1 *in effect since 2015*

Certain specified sand fill, fiber logs, fiber mats, shell bags & temporary grazing protection

29 permitted projects issued to date

City of Norfolk (8)

Lancaster Co. (6)

City of Virginia Beach (4)

City of Chesapeake (3)

Gloucester Co. (3)

York Co. (2)

Mathews Co. (1)

Northampton Co. (1)

Westmoreland Co. (1)

VMRC Living Shoreline General Permits

streamlined permitting process as an incentive

Group 2 *in effect since 2017*

Certain specified sand fill, fiber logs, fiber mats, shell bags, riprap, woven containment bags, temporary grazing protection, establishment of oysters & ribbed mussels may be incorporated e.g. oyster castles

6 permitted projects issued to date

City of Chesapeake (2)	Oyster Castle® projects
Middlesex Co. (2)	Stone sills
Gloucester Co. (1)	Oyster shell bag sill
Mathews Co. (1)	Ready Reef sill

Funding Support Program Updates

Virginia Conservation Assistance Program VCAP

First round of living shoreline cost-share projects = 14

Some now under construction

New applications currently being accepted

State Water Control Board – Virginia Water Facilities Revolving Fund

Middle Peninsula Planning District Commission homeowner loans

No other new programs yet

New CCRM Web Site

<http://www.vims.edu/ccrm/>



- VIMS template
- Automatic re-size for small screens *except for map viewers*
- Updated content
- Publications moved to William & Mary ScholarWorks *digital library archive service*

Comprehensive Coastal Resource Management Portals CCRMPs

<http://www.vims.edu/ccrm/ccrmp/index.php>



- **Locality-Specific portals now available for all major coastal localities**
Smaller cities & towns included with larger adjacent or surrounding locality
- **Each Locality Portal includes:**
 - Interactive map viewer
 - Shoreline best practice recommendations
 - Shoreline & tidal marsh inventories
 - Comprehensive plan update guidance
 - Tidal shoreline laws & policies
 - Locality-specific shoreline publications & reports
- **4 more updates currently in progress 2018**
 - Richmond Co.
 - Essex Co.
 - Caroline Co.
 - New Kent Co.

Comprehensive Coastal Resource Management Portals CCRMPs

2017 Completed

Chesterfield Co. & area cities
City of Fredericksburg
Hanover Co.
Henrico Co.
Isle of Wight Co.
King George Co.
Spotsylvania Co.
Surry Co.

2018 in progress

Richmond Co.
Essex Co.
Caroline Co.
New Kent Co.

Learn more & practice using
Concurrent session 4
Hands-On Shoreline Management Tools

Thank You to Invited Speakers!

Workshop Presentations & Supporting Information will be posted
on a web site

Look for e-mail with link

Please fill out Workshop Evaluation form

&

leave on registration table or mail to address provided



Thank You for Attending!

Workshop Evaluation & Follow-Up

Karen Duhring karend@vims.edu (804) 684-7159



Shoreline Best Practice Case Studies
Thursday June 14, 2018
Virginia Institute of Marine Science
Gloucester Point, VA

Map for Indoor & Outdoor Sessions

Choose between 5 stations for 30-minute sessions

VIMS cart shuttles available to move between stations or public parking areas also available

- | | |
|-----------------------|-----------------------------------|
| 2:00 – 2:30 pm | Indoor - Outdoor Session 1 |
| 2:30 – 2:45 pm | <i>Transfer between stations</i> |
| 2:45 – 3:15 pm | Indoor - Outdoor Session 2 |



Available Tools



Comprehensive Coastal Resource Management Portals (CCRMPs)

url: <http://www.vims.edu/ccrm/ccrmp/index.php>

description: Information to help implement Virginia's tidal shoreline laws and policies including general guidance for the entire coastal area and locality specific information.

Locality Portals		Shoreline Management Best Practices	
http://www.vims.edu/ccrm/ccrmp/portals/index.php		http://www.vims.edu/ccrm/ccrmp/bmp/smm/index.php	
Each locality portal is a gateway to current and historic shoreline management information, including interactive mapping tools, shoreline and tidal marsh inventory reports, sea level rise and flooding information, GIS data for downloading, and other locality-specific VIMS shoreline publications.		Guidance for choosing the most effective erosion control strategy while minimizing harmful practices based on surrounding shoreline conditions.	
Comprehensive Map Viewer	Sea-Level Rise Risk and Vulnerability Tool	Self-Guided Decision Tools	Shoreline Management Model
Each locality has its own map viewer. Select locality from Locality Portal list.	Each locality has its own map viewer. Select locality from Locality Portal list.	http://www.vims.edu/ccrm/ccrmp/bmp/decision_tools/index.php	http://www.vims.edu/ccrm/ccrmp/bmp/smm/index.php
An interactive map viewer that displays shoreline conditions, preferred shoreline best management practices, one sea level rise scenario, and other pertinent layers (SAV, Conservation Lands, Bathymetry, etc.).	An interactive map viewer that illustrates sea level rise risk conditions.	A series of decision trees that leads users through questions about shoreline conditions to produce a best practice recommendation.	A GIS spatial model that determines appropriate shoreline best management practices using available spatial data and decision tree logic. To view spatial data, the user is referred to the Locality Portals.

WetCAT

url: http://cmap2.vims.edu/WetCAT/WetCAT_Viewer/WetCAT_VA_2D.html

description: The Virginia Wetland Condition Assessment Tool (WetCAT) is an interactive online tool for assessing comprehensive and cumulative non-tidal wetland stress condition for habitat and water quality at multiple scales. The tool also provides information on permitted activities, impaired waters, surrounding landuse, wetlands mitigation as well as geoprocessing tools for cumulative impacts, downstream flow paths, and the contributing watersheds of specified points identified on the landscape.

AdaptVA

url: <http://www.adaptva.org/>

description: ADAPTVA is a gateway to information for individuals, local programs, and agencies engaged in climate adaptation that focuses on the physical and social vulnerabilities by integrating the best available science, legal guidance, and planning strategies.

Tools		
http://www.adaptva.org/info/tools.html		
Tools are available to help assess risk and vulnerability to climate impacts, build community resiliency against extreme events, and provide guidance to prepare and respond to a changing environment.		
Flood Risk: VFRIS	Shoreline Management	AdaptVA Interactive Map
http://cmap2.vims.edu/VaFloodRisk/vfris2.html	http://www.adaptva.org/info/tools_bmp.html	http://cmap2.vims.edu/AdaptVA/adaptVA_viewer.html
Virginia Flood Risk Information System (VFRIS) helps communities, real estate agents, property buyers and property owners discern an area's flood risk.	What is the best management strategy for your shoreline? Provides a link to the Comprehensive Coastal Resource Management Portal (CCRMP).	View water levels, social vulnerability, infrastructure and natural capital in one viewer.

Forecasts	Adaptations
http://www.adaptva.org/info/forecasts.html	http://www.adaptva.org/info/adaptations.html
Forecasting water levels, temperature, and precipitation helps mitigate impacts and plan resilient communities. Access a tide forecast & sea level projections for Virginia.	Case studies and story maps that illustrate how adaptation works. Topics are group by Shorelines, Infrastructure, Planning, and Funding.
Sea Level Viewer	
http://cmap2.vims.edu/SeaLevelRise_Depth/SLRDepth_revised4.html	
An interactive viewer that illustrates how deep and where will the water be from various sea level rise scenarios.	

Planning & Policy	
http://www.adaptva.org/info/planning.html	
Management strategies from local and State code to socioeconomic issues and the Community Rating System. Learn about social vulnerability, relevant local ordinances, state legislation, and legal issues.	
Social Vulnerability	Legal Authorities & Analyses
http://cmap2.vims.edu/SocialVulnerability/SocioVul_SS.html	http://www.adaptva.org/info/planning_ord.html
An interactive viewer that represents the overall ability of a community to withstand a given disaster.	Search local ordinances related to sea level rise or recurrent flooding by locality or type of ordinance.

Scenarios/Questions & Tools to Use to Find Answers

I own waterfront property and want to stabilize the shoreline.

→ ***Locality specific Comprehensive Map Viewer; AdaptVA Interactive Viewer; Self-Guided Decision Tools***

What are the shoreline protection structures in my creek and how many miles of shoreline are in my locality?

→ ***Locality specific Comprehensive Map Viewer***

What resources in the water might impact pier construction and/or boat navigation?

→ ***Locality specific Comprehensive Map Viewer; Shoreline Assessment Mapper (SAM)***

Is my property potentially at risk due to sea level rise?

→ ***AdaptVA Interactive Viewer; Sea Level Viewer; locality specific (Comprehensive Map Viewer; Sea Level Rise Risk & Vulnerability Tool)***

How deep could the water be and when might it happen?

→ ***AdaptVA Interactive Viewer; Sea Level Viewer***

Is my property in a FEMA flood zone? Do I need flood insurance?

→ ***AdaptVA Interactive Viewer; VFRIS***

What is my community's vulnerability to withstand a natural or man-made disaster?

→ ***AdaptVA Interactive Viewer; Social Vulnerability Viewer***

Are there super fund or hazardous waste sites in my locality?

→ ***AdaptVA Interactive Viewer; Social Vulnerability Viewer***

How do I adapt to flooding?

→ ***Story Maps***

Tools and links:

AdaptVA Interactive Viewer: http://cmap2.vims.edu/AdaptVA/adaptVA_viewer.html

Comprehensive Map Viewer (locality specific): <http://www.vims.edu/ccrm/ccrmp/portals/index.php>

Sea Level Rise Risk & Vulnerability Tool (locality

specific): <http://www.vims.edu/ccrm/ccrmp/portals/index.php>

Sea Level Viewer: http://cmap2.vims.edu/SeaLevelRise_Depth/SLRDepth_revised4.html

Self-Guided Decision Tools: http://www.vims.edu/ccrm/ccrmp/bmp/decision_tools/index.php

Shoreline Assessment Mapper (SAM): <http://cmap2.vims.edu/SAM/ShorelineAssessmentMapper.html>

Social Vulnerability Viewer: http://cmap2.vims.edu/SocialVulnerability/SocioVul_SS.html

Story Maps: <http://www.adaptva.org/info/adaptations.html>

VFRIS: <http://cmap2.vims.edu/VaFloodRisk/vfris2.html>

**Shoreline Best Practice Case Studies:
What Nature-Based Tidal Shorelines Look Like & How They Work
Thursday, June 14, 2018
Virginia Institute of Marine Science
Gloucester Point, VA**

Workshop Evaluation

What is your affiliation?

- | | |
|---|--|
| <input type="checkbox"/> Wetland Board Member | <input type="checkbox"/> Federal Agency Staff |
| <input type="checkbox"/> Other Local Board Member | <input type="checkbox"/> Consultant / Contractor / Agent |
| <input type="checkbox"/> Elected Official | <input type="checkbox"/> Non-Profit / Community Organization |
| <input type="checkbox"/> Local Government Staff | <input type="checkbox"/> Other (please specify) _____ |
| <input type="checkbox"/> State Agency Staff | |

What was the best part of this workshop to you?

How could the workshop be improved?

What topic(s) would you like to see future workshops cover?

What applied research topic(s) or question(s) would you like VIMS to address?

Other Comments (use back of page also):

Please return evaluation to the registration table or mail to:
Center for Coastal Resources Management
Virginia Institute of Marine Science
PO Box 1346, Gloucester Point, VA 23062

Additional Training Summary

Although not a final product deliverable, CCRM continues to provide other training related to tidal wetlands and shoreline management.

Regional Training – CCRMP & Shoreline Best Management Practices

CCRM continues to raise awareness and provide orientation to new CCRM tools and guidance provided through the Comprehensive Coastal Resources Management Portal (CCRMP). Beginning in 2012, CCRM started developing portals for each Tidewater locality. As of September 30, 2018 updated shoreline and tidal marsh inventories and other content for 31 locality portals has been completed. Each portal serves as a gateway to resources that address data gaps, shoreline best management practices, and sea level rise issues at the local level. New locality portals were also created during this grant period for all other coastal localities as part of a CCRM web site update. All coastal locality portals are updated with content as shoreline and tidal marsh inventories are completed and new locality-specific publications become available.

Three different groups are targeted for CCRMP-related training: coastal planners, shoreline managers, and volunteer educators engaged with public outreach. Fifteen training sessions were held at VIMS and off-campus during the grant period for a combined total of 391 participants.

- 10/13/18 Northern Neck Master Naturalists Wetlands Training (28)
- 11/2/18 James City County Master Gardeners Shoreline Best Practices Training (75)
- 11/29/18 City of Hampton Wetlands Board Shoreline Management Training (18)
- 12/5/18 Stafford County Wetlands Board Shoreline Management Training (10)
- 3/13/18 Historic Southside Master Naturalists Wetlands & Coastal Mgmt. Training (25)
- 3/15/18 John Clayton Native Plant Society Shoreline Best Practices Training (32)
- 4/10/18 Northern Neck Master Naturalists Coastal Habitat Training (20)
- 4/18/18 Northern Neck Master Gardeners Living Shorelines Training (55)
- 5/7/18 Tidewater Master Naturalists Coastal Management & Wetlands Training (21)
- 5/12/18 Peninsula Master Naturalists Coastal Management Training (15)
- 5/24/18 City of Hampton Wetlands Board Shoreline Management Training (15)
- 6/28/18 Northern Neck Shoreline Evaluation Program Training (12)
- 6/30/18 Historic Rivers Master Naturalists Coastal Habitat Training (14)
- 8/7/18 SE Assoc. of Soil & Water Conservation Districts Living Shorelines Training (45)
- 9/17/18 Prince William County Wetlands Board CCRMP Training (6)

Publications

Center staff annually produces our *Rivers & Coast* newsletter. The *Rivers & Coast* covers one relevant topic in more detail through the use of charts, graphs, maps and photos in an 8-page color publication. The newsletter is available online and is announced through CCRM's quarterly e-newsletter to approximately 2500 email addresses which include local and state agency personnel, General Assembly members, and interested private citizens. *CCRM e-News* summarizes and communicates a variety of issues that support integrated management of coastal zone resources, announces pertinent publications, programs and events, and points the reader to more detailed information on our website (and others).

CCRM e-News

- **January 2018** - New CCRM web site, new 2017 and 2018 CCRMPs, new research paper, updated living shorelines design guidelines, living shorelines Group 2 general permit, Garden Club scholarship, VCPC Oct. 27th conference follow-up
<https://conta.cc/2Emgxqk>
- **April 2018** - VIMS Workshop announcement, Sea Level Report Cards, US Army Corps of Engineers Regional General Permit re-issuance, CCRM featured in video, VIMS Public Programs, and Spring Native Plant Sales
<https://conta.cc/2Nq1WP3>
- **July 2018** - VIMS Workshop results, CCRM Accolades, CCRM new location, TMDL Shoreline Management Fact Sheet, CCRM Student Research Spotlight, 2018 Coastal Wetland Scholarship winners
<https://conta.cc/2xHXs1p>
- **September 2018** - New *Rivers & Coast*, Catch the King Tide, StormSense Project award, Virginia CZM Program change, announcements for Coastal Partners Workshop and VA Coastal Policy Center, and CCRM Student Spotlight
<https://conta.cc/2Nq28Oh>

Rivers and Coast

- **Summer 2017, Vol. 12** *Forecasting Coastal Water Levels in Virginia* this issue explored sea level forecast tools available at the *AdaptVA.org* web site, including suggestions for using these forecasts for short and long-term infrastructure planning
<https://scholarworks.wm.edu/reports/1843/>



NEW CCRM WEB SITE

The Center recently updated our web site pages for a more contemporary look and to join the online VIMS community of web sites. Some of the page layouts and content were revised and updated with new information, such as the locality based Comprehensive Coastal Resource Management Portals (CCRMPs) and the Living Shorelines pages. Except for the GIS map viewers, the new CCRM web site pages automatically re-size for mobile devices and tablets.

Most publication links now go to W&M Publish. This is a library service where VIMS publications and reports are now archived and served electronically. After landing on a W&M Publish page that describes each publication or GIS data set, click on the download button in the upper right to view the document or data.

NEW CCRMP LOCALITY PORTALS & TRAINING OFFER

The new CCRM web site now includes locality-based Comprehensive Coastal Resource Management Portals for all 45 major coastal cities & counties in Virginia. Each Locality Portal contains tidal shoreline management resources in one convenient location. The content includes shoreline & tidal marsh inventory results, links to interactive map viewers, sea level rise and flooding information, GIS data for downloading, and locality-specific VIMS shoreline publications.

The Locality Portals are updated as new shoreline and tidal marsh inventories are completed. A **CCRMP Progress Map** displays the update status for coastal Virginia localities. Smaller cities and incorporated towns are included in the closest City or County portal on the list.

Updates Completed in 2017

- Chesterfield County (& area cities)
- City of Fredericksburg
- Hanover County
- Henrico County
- Isle of Wight County
- King George County
- Spotsylvania County
- Surry County

Old CCRM web site bookmarks should be re-directed to the new site. See the [web site map](#) for an overview of the reorganization of our site and/or [contact us](#) if you have any trouble finding something you need.

[CCRM Web Site](#)

- Arlington County
- Caroline County
- Essex County
- New Kent County
- Richmond County

Customized orientation and training can be arranged for anyone interested in learning more about CCRMP tools and content. Contact the [VIMS training coordinator](#) for more information.

[Visit Site](#)



ARTICLE ON MARSH PERSISTENCE

Marshes contribute to habitat and water quality in estuaries and coastal bays. Their importance to continued ecosystem functioning has led to concerns about their persistence. Concurrent with sea-level rise, marshes are eroding and appear to be disappearing through ponding in their interior; in addition, in many places, they are being replaced with shoreline stabilization structures.

CCRM Scientists Molly Mitchell, Julie Herman, Donna Bilkovic, and Carl Hershner examined the changes in marsh extent over the past 40 years within a subestuary of Chesapeake Bay, the largest estuary in the United States, to better understand the effects of sea-level rise and human pressure on marsh coverage.

Find out more in their recently published article: Marsh persistence under sea-level rise is controlled by multiple, geologically variable stressors

NEW LIVING SHORELINES DESIGN GUIDANCE

A new version of the VIMS Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments was recently published by shoreline experts at the VIMS Shoreline Studies Program and CCRM.

The original 2010 design guidelines were updated to include new information about sea-level rise, stormwater management, non-structural living shoreline practices, and lessons learned from tracking living shoreline project performance in Virginia. The new design guidelines were also featured during two recent courses for living shoreline professionals held this summer.

The 2017 publication, course presentations, a video recording, and related tools are all posted online at a VIMS living shoreline design guidance web site.

[Visit Web Site](#)

VCPC CONFERENCE FOLLOW UP

Presentations & videos are now available from the Virginia Coastal Policy Center's 5th annual conference *Defending Our Coasts: Ensuring Military Readiness & Economic Viability as Waters Rise* held on October 27th.

Invited panelists and guest speakers discussed the threats that flooding poses to Department of Defense facilities and DOD's efforts to develop resilience measures. The Honorable Rob Wittman (R-VA) Congressman, 1st District was the Keynote Speaker. Collaborative solutions for other government agencies and the private sector were also addressed.

[Read About It](#)

2018 GARDEN CLUB OF AMERICA SCHOLARSHIP

CCRM is accepting applications for the 2018 Garden Club of America Coastal Wetland Studies scholarship until **January 15**. The award is a one-year scholarship for graduate studies in coastal wetlands and carries a stipend of \$5,000 to support field-based research. For the purposes of this scholarship, coastal wetlands are defined as those tidal or non-tidal wetlands found within U.S. coastal states, including the Great Lakes. Applicants must be enrolled in a graduate program (M.S. or Ph.D.) at a university within the United States, and must be U.S. citizens or permanent residents. CCRM scientists will review all of the applications received, then suggested nominations will be sent to the Garden Club of America for the award selection. Previous award recipients have shared their results from a wide variety of



NEW LIVING SHORELINES GENERAL PERMIT

A new living shorelines general permit was approved by the Virginia Marine Resources Commission (VMRC) and became effective November 1, 2017.

The Living Shoreline Group 2 general permit allows certain activities involving subaqueous lands, tidal wetlands or sand dunes and beaches. The allowable activities include structures not covered by the Group 1 general permit, such as marsh sills, provided the project design meets specific criteria. Marine professionals, local wetlands board members and local government staff are encouraged to learn more about the new Group 2 general permit in order to share this incentive with property owners.

[Learn More](#)

wetland studies of salt marshes, marsh birds, wetland-dependent fishes, climate change effects, carbon storage, and many other wetland research topics.

Applications are due January 15, 2018.

Email questions to gcawetlands@vims.edu.

[More Information](#)

[CCRM WEBSITE](#)

[ABOUT CCRM](#)

[CCRM RESEARCH](#)



[JOIN OUR MAILING LIST](#)



[FORWARD TO A FRIEND](#)

This newsletter was funded, in part, by the Virginia Institute of Marine Science and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA17NOS4190152, Task #6 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its subagencies.



VIMS WORKSHOP JUNE 14, 2018

The annual tidal shoreline management workshop will be held on Thursday, June 14th at the VIMS Gloucester Point campus. These annual workshops provide an opportunity for Local Wetlands Board members, local and state agency staff, marine professionals, non-governmental organizations, and others to gather and discuss current events in tidal shoreline management.

This year's workshop theme will be **Shoreline Best Practice Case Studies**. The program will highlight what well-designed living shorelines and other practices look like and how they work for coastal protection, erosion reduction, water quality, and habitat ecosystem services. The workshop program will include indoor lectures & training sessions plus an outdoor field experience on the VIMS campus.



On-line workshop registration is now open until 9:00 am on June 11. The registration fee is \$25.00 per person (includes lunch). Payment options will be provided during the 2-step registration process.

[Register Here](#)



NEW SEA-LEVEL REPORT CARDS

CCRM researchers Molly Mitchell and Derek Loftis were part of a VIMS team that recently issued a new way to find out how sea level around the nation is changing. The new 'report cards' monitor and forecast sea level changes at 32 localities along the United States coastline from Maine to Alaska, including Norfolk, VA. Relative sea-level measurements are provided for each location to indicate the extent of potential flooding of homes, roads, and businesses. Evidence of recent acceleration in the rate of sea-level change at many tide stations is incorporated into the statistical approach used by the team.

Sea-Level Report Cards have 3 components:

- a 2050 projection displayed in an interactive chart
- recent sea-level change trends, and
- an explanation of processes affecting sea level at each locality

The year 2050 was selected for predicting water levels because there is sufficient historical data to allow inferences based on observed trends. The 30-plus year time span between now and 2050 is also an appropriate time frame for sea level adaptation planning by coastal communities. Each report card will be updated annually in January.

[See Related News](#)



REGIONAL PERMIT RE-ISSUANCE

The U.S. Army Corps of Engineers, Norfolk District Regulatory Branch recently announced the proposed re-issuance of some Regional General Permits (RP) in a public notice. Regional Permits improve regulatory consistency and avoid duplication with other agencies to simplify the permitting process. The Regional Permits to be re-issued are for activities that would result in minimal environmental impacts and are not contrary to the public interest, including RP-02, RP-15, RP-17, RP-18, RP-19, and RP-22. A re-issuance for these Regional Permits is necessary because all of them will expire in August, 2018.

One of the Regional Permits is RP-19 for living shorelines, low breakwaters, bulkheads, riprap, groins, jetties, spurs and/or baffles, associated beach nourishment, boat ramps, and aquaculture/mariculture activities. The proposed changes to RP-19 include, but are not limited to, removing the requirement for an accompanying Local Wetlands Board or VMRC regulatory action and revisions to what is considered Group 1 & Group 2 living shoreline project types. Contact your local USACE regulator for more information about regional permit changes, new conditions, and effective dates.

[More Info](#)



CCRM FEATURED IN NEW VIDEO SERIES

The Center's tidal shoreline program is featured in the first installment of a new VIMS video series called *A Deeper Dive*. These public relation videos give a behind-the-scenes look at how VIMS research is translated into practical solutions for our waters, communities, and economy.

The first video in the series titled ***Saving the Shoreline*** explores how CCRM's applied research and recommendations related to tidal shorelines help homeowners counteract shoreline erosion. Links to more information about living shorelines, sea-level rise, and nuisance flooding are posted as Related Links with this new video.

[View Videos](#)



VIMS PUBLIC PROGRAMS

Free public events and guided tours will take place at VIMS over the spring and summer.

Marine Science Day Open House Saturday May 19 10:00 am - 3:00 pm

VIMS' annual open house is a free, fun-filled event for the whole family. Join us in Gloucester Point for exhibits, children's activities, seining, lab tours, seafood cooking demonstrations, mini-lectures, and more. CCRM will participate by having an exhibit about biodegradable plastics and wetland experts will be posted at the Teaching Marsh.

Public Tours

Guided tours of VIMS are offered on select mornings during summer months, as well as special group tours year-round.

After Hours Lecture Series & Webinars

This free monthly lecture series by scientists from VIMS and elsewhere explores hot topics facing Chesapeake Bay and the ocean.

[More Info](#)

SPRING NATIVE PLANT SALES

It's that time of year for spring native plant sales hosted by non-profit organizations devoted to helping property owners introduce more native plants into gardens and landscapes, including tidal waterfront settings. Planting more native trees, shrubs, and other plants along the shoreline helps improve water quality, reduce erosion, and improve storm protection. The shoreline management community can help spread the word about where and when the general public can buy native plants well-adapted to local growing conditions.



Most of the spring plant sales are rain or shine events. Some of them feature only native plants, while others include a variety of plants including native species. Cash & checks are sometimes the preferred payment methods. Click on the links provided for more information about each plant sale.

- **April 21-22 & 28-29** [Virginia Living Museum](#)
- **April 26-27-28** [Hermitage Museum & Gardens](#) *Spring Heirloom Plant Sale*
- **April 28** [John Clayton Chapter Virginia Native Plant Society](#) *in Williamsburg*
- **April 28** [Williamsburg Botanical Garden](#)
- **May 5** [York/Poquoson Master Gardeners](#) *at York Learning Garden & Arboretum*
- **May 5 (Rain date May 6)** [Hampton Master Gardeners](#) *at Bluebird Gap Farm*
- **May 4-5-6** [Norfolk Botanical Garden](#)
- **May 5-6** [Virginia Beach Master Gardeners](#) *at Virginia Beach Farmer's Market*

Learn more about native plants for living shorelines at the CCRM Living Shorelines web site...

[Learn More](#)

[CCRM WEBSITE](#)

[ABOUT CCRM](#)



[JOIN OUR MAILING LIST](#)



[FORWARD TO A FRIEND](#)

This newsletter was funded, in part, by the Virginia Institute of Marine Science and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA17NOS4190152, Task #6 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its subagencies.



CCRM e-News

July 2018

VIMS WORKSHOP JUNE 14, 2018

The annual tidal shoreline management workshop was held June 14th at VIMS. This year's workshop theme was **Shoreline Best Practice Case Studies: What Nature-Based Shorelines Look Like & How They Work**. At least 110 participants attended this event, including representatives from 15 Virginia local governments, state agency staff, non-governmental organizations, marine professionals, and concerned citizens.

The program featured invited speakers directly engaged with the design, installation, and research of living shorelines and other coastal habitat restoration projects. Indoor and outdoor breakout sessions provided hands-on experiences to complement the morning lectures. The combined opportunity to hear about and directly experience shoreline best practices was appreciated by the workshop participants.



One participant said, **the best part of the workshop was "learning about the continued research and seeing real examples [of living shorelines] that are performing"**.

[More Info](#)



photo credit: Virginia Military Institute

CCRM ACCOLADES

CCRM's Director Dr. Carl Hershner was honored with the Erchul Environmental Leadership Award by the Virginia Military Institute's Center for Leadership and Ethics in April 2018. This annual award recognizes a Virginian who has made significant individual efforts to improve the environment. Dr. Hershner has a long track record of public service and dedication to Virginia's coastal and marine environment. Carl requested that his award donation be given to Wetlands Watch, a Norfolk-based non-profit actively involved with CCRM in efforts to improve Virginia's resiliency to sea-level rise and recurrent coastal flooding.

CCRM coastal scientist and policy expert Pam Mason recently received the **2017 VIMS Outstanding Professionals and Professional Faculty Administrator Award**. This award was given to Pam for her work in state, regional, and national coastal resource management circles.

[Read More](#)



WE'VE MOVED

The Center recently moved into new offices at Davis Hall on the VIMS Gloucester Point campus. For the first time in 30 years, all CCRM staff are located together in a modern facility. Davis Hall is a LEED Gold certified building that houses five VIMS departments, including CCRM, Marine Advisory Services, Virginia Sea Grant, Information Technology & Network Services, and the VIMS News & Media Services group.

The new building was named after Professor Donald W. Davis who is recognized as VIMS' 'Founding Father' because he envisioned the need for a state-sanctioned marine lab in 1930. His vision became reality in 1940 with the opening of the Virginia Fisheries Laboratory, the precursor to today's VIMS.

Come visit us in our new location on the second floor of Davis Hall.

[Read More](#)

NEW TMDL SHORELINE MANAGEMENT FACT SHEET

The Chesapeake Stormwater Network recently published a new TMDL Shoreline Management Fact Sheet. Chesapeake Bay states can use qualifying shoreline management practices as part of an overall watershed strategy to meet nutrient and sediment load reduction targets for existing urban development under the Chesapeake Bay Total Maximum Daily Load (TMDL). An updated shoreline management practices expert panel report (May 2018), a training webcast, and other related resources are also available at the Chesapeake Stormwater Network web site.

[Learn More](#)



CCRM STUDENT SPOTLIGHT

A new feature in this issue is a spotlight on research being conducted by CCRM graduate and Ph.D. students. Featured in this edition are two CCRM scientists who recently earned their Doctor of Philosophy degrees at the Virginia Institute of Marine Science, College of William and Mary. Read more about their current research projects on their staff pages.

Fei Ye

Doctor of Philosophy in Physical Oceanography

Advisor: Joseph Zhang

Dissertation title: *Developing Efficient High-Order Transport Schemes for Cross-Scale Coupled Estuary-Ocean Modeling*

Molly Mitchell

Doctor of Philosophy in Marine Science

Advisor: Carl Hershner

Dissertation title: *Impacts of Sea Level Rise on Tidal Wetland Extent and Distribution*

2018 COASTAL WETLAND SCHOLARSHIP WINNERS

The Garden Club of America (GCA) provides an annual award in Coastal Wetlands Studies. This scholarship originated in 1966 when the Rockefeller Fund was established for the purpose of promoting environmental education. The award is a one-year \$5,000 scholarship to support graduate-level field-based research in coastal wetlands. Applications are reviewed by a selection committee of practicing wetland scientists at CCRM. Final award winners are selected by the GCA from the Center's nominees.

Three students were awarded this year's 2018 scholarships. Their coastal wetlands research involves the survival of marsh wetlands under different sea level rise scenarios, a status assessment of an aquatic plant threatened by range contraction, and why some marsh plants are unappetizing to herbivores. Visit the CCRM Garden Club Scholarship web site to learn about the 2018 winners and previous award recipients.

[CCRM Research](#)

[Learn More](#)

[CCRM WEBSITE](#) [CCRMPs](#) [LIVING SHORELINES](#) [PUBLICATIONS](#)



[JOIN OUR MAILING LIST](#)



[FORWARD TO A FRIEND](#)

This newsletter was funded, in part, by the Virginia Institute of Marine Science and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA17NOS4190152, Task #6 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its subagencies.



CCRM e-News

September 2018

NEW RIVERS & COAST



The Summer 2018 issue of the Rivers & Coast newsletter is about **Forecasting Coastal Water Levels in Virginia**. Sea level forecast tools available on the AdaptVA.org website that CCRM maintains are described in the new issue. The **VA Sea Level** tool provides an interactive chart that compares sea level forecasts from VIMS, the U.S. Army Corps of Engineers, and the National Oceanic and Atmospheric Administration (NOAA). Suggestions for using these forecasting curves for short and long term infrastructure planning are included. The **VIMS Tidewatch** network is another water level forecast tool explained in this issue, including a new Tidewatch Viewer.

[Read It Here](#)



2018 CATCH THE KING TIDE

King tides are the highest high tides predicted



STORMSENSE AWARD

A Public Sector Government Innovation Award

each year. CCRM is a partner for the 2nd annual Catch the King Tide mapping event that will take place throughout coastal Virginia on **Saturday, October 27**. An organized network of trained citizen scientists will map the location of this extreme high tide event using the *Sea Level Rise* smartphone application.

If you want to join this citizen science effort, first [download the app](#), and then visit the [2018 Catch the King Tide](#) website. This is where you can register for the event, find a training schedule, and keep up with Catch the King Tide news. All volunteers are encouraged to attend at least one training session prior to participating on Oct 27th. CCRM's Derek Loftis serves as the project's science liaison. See his webpage with information about the hydrodynamic models that use the crowd-sourced data, plus the results from last year's mapping event.

[Background Info](#)

was recently granted to the StormSense Project. [StormSense](#) is a network of water-level sensors in the Cities of Newport News, Norfolk and Virginia Beach. The sensors gather data at the street level to enhance emergency response to flooding caused by storm surge, rain, and tides. This new suite of sensors will also be integrated into the VIMS Tidewatch Network to provide 36-hour tidal forecasts at each sensor location.

StormSense is a partnership among VIMS, the three localities, the Commonwealth Center for Recurrent Flooding Resiliency ([CCRFR](#)), and the National Institute of Standards and Technology. CCRM scientist Dr. Derek Loftis is the StormSense Project Manager. Congratulations to the entire team for receiving this award.

[Read More](#)

VIRGINIA CZM PROGRAM

Governor Ralph Northam recently changed how Virginia's Coastal Zone Management Program (CZM) will be administered. In order to make the CZM Program a permanent fixture of Virginia public policy, the Governor prepared and sent a 'transmittal letter' to NOAA. Now each new governor does not have to sign an Executive Order every four years. In order to qualify for this new status, Governor Northam had to approve the Program as state policy, designate a single lead agency to receive and administer implementation grants, certify that necessary authorities are in place, and confirm that the Commonwealth's agencies are organized to implement the Program. The Department of Environmental Quality (DEQ) will continue to serve as the lead agency for the CZM Program network.

Save the Date: The Virginia CZM Program will host the next Virginia Coastal Partners Workshop on **November 14-15, 2018** at DEQ in Richmond, VA. Session topics will focus on the multiple benefits of coastal conservation, including the economic benefits of land conservation and ecotourism, cultural benefits, and benefits of planning for coastal resiliency. Ocean issues are also workshop topics, such as data, offshore energy, and marine debris. Free registration will open soon through the Virginia Coastal Zone Management Program website.

[More Info](#)



CCRM STUDENT SPOTLIGHT

Congratulations to Nicole & Robert, who recently earned degrees in marine science, for their accomplishments and ongoing contributions to the scientific understanding of coastal ecosystems. Read more about each CCRM scientist on their staff pages.

Xun 'Nicole' Cai

Master of Science in Marine Science

- Thesis title: *Impact of Submerged Aquatic Vegetation on Water Quality in Liberty Island, Sacramento-San Joaquin Delta: A Numerical Study*
- Nicole is continuing her studies at VIMS as a doctoral student working with CCRM's [modeling research](#) program.

Robert Isdell

Doctor of Philosophy in Marine Science

- Dissertation title: *Shifting patterns of ribbed mussel distribution and ecosystem services in response to sea level rise*
- Robert now works full-time as a Postdoctoral Research Associate supporting CCRM [coastal ecology research](#) projects.

[CCRM Research](#)

BUILDING A RESILIENT VIRGINIA - 2 NOV

Registration is now open for the Virginia Coastal Policy Center's 6th annual conference on November 2, 2018 at the William & Mary School of Education in Williamsburg, Virginia.

The featured speakers include:

- The Honorable Matt Strickler, Virginia Secretary of Natural Resources,
- Senator Monty Mason and
- Delegates David Bulova, Keith Hodges, and Christopher Stolle.

Panelists from VIMS, Virginia Sea Grant, coastal planning district commissions, and nonprofit organizations are on the program.

Representatives from Louisiana's Water Institute of the Gulf, the LSU Coastal Sustainability Studio, and the Baton Rouge Area Foundation will also participate sharing their own experiences and lessons learned in coastal resilience.

[Learn More](#)

[CCRM WEBSITE](#) [CCRMPs](#) [LIVING SHORELINES](#) [PUBLICATIONS](#)



JOIN OUR MAILING LIST



FORWARD TO A FRIEND

This newsletter was funded, in part, by the Virginia Institute of Marine Science and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA17NOS4190152, Task #6 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its subagencies.

Forecasting Coastal Water Levels in Virginia

Living in coastal Virginia requires an awareness of water and the constantly changing levels of the ocean, Bay, and rivers that surround the area. Increases in sea level and intense rainfall events are causing ever more frequent flooding with growing impacts on roads, homes, and businesses. As a result, people are learning to monitor current and future conditions in order to inform decisions about both daily activities and longer term planning.

There are an ever increasing number of resources available to residents and government officials, providing information on projected water levels in the near term (the next several days) and over longer terms (the next several decades to the end of the century). Unfortunately, these sources do not always seem to be saying the same thing. The Virginia Institute of Marine Science (VIMS) is tasked with providing information and advice to the Commonwealth on such matters, and we have developed tools to forecast both short term and longer term water levels in our coastal region. The output of these tools is available on the AdaptVA.org website that we maintain.



Figure 1. ADAPTVA is a gateway to information on climate adaptation. The web portal focuses on the physical and social vulnerabilities by integrating the best available science, legal guidance, and planning strategies. Visitors will find legal and policy resources, stories that explain adaption through maps and pictures, a searchable web catalogue, and mapping tools that address short and long-term predictions for rising water levels.

This issue of Rivers & Coast provides an introduction to two sea level forecast tools located under the Forecasts tab on AdaptVA.org – “VA Sea Level” and “Tidewatch”



Photo 1. Flood waters washed out a road on the Eastern Shore of Virginia.

Rivers & Coast is an annual publication of the Center for Coastal Resources Management, Virginia Institute of Marine Science, College of William & Mary. This publication is distributed electronically. If you would like to be added to or removed from the e-mailing list, please send correspondence to:

Rivers & Coast/ CCRM
 P.O. Box 1346
 Gloucester Pt., VA 23062
 (804) 684-7380
dawnf@vims.edu

CCRM Director: Dr. Carl Hershner

Contributing Authors:

Carl Hershner
 Molly Mitchell

Layout: Dawn Fleming

Editors: Karen Duhring, Pam Mason

Graphs Credit: David Malmquist,
 VIMS News & Media

Photo Credit:

Photo 1 - Robert Isdell, Jr.
 Photo 2 - Derek Loftis
 Photo 3 - Donglai Gong
 Photo 4 - VIMS

This report was funded, in part, by the Virginia Institute of Marine Science and by the Virginia Coastal Zone Management Program of the Department of Environmental Quality through Grant #NA17NOS4190152 - Task 6 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management, under the Coastal Zone Management Act, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies or DEQ.



Printed on recycled paper



Virginia Sea Level Rise Forecasts

The three most commonly used sea level rise projections for Virginia have been developed by VIMS, the US Army Corps of Engineers (USACE), and the National Oceanic and Atmospheric Administration (NOAA). They differ in the way available information is considered, the time periods they address, and the portrayal of future uncertainty. What they have in common is a consistent recognition that sea level is rising, that the rate of rise is accelerating, and that planning for the future requires a consideration of risk.

Sea level rise projections from all three sources are shown in the image below for the tide gauge at Sewells Point in Norfolk, Virginia (*Figure 2*). The graphs in this report are generated by selecting curves in an ADAPTVA interactive tool, find it here: http://adaptva.org/info/virginia_sea_level.html

- **VIMS Sea Level Rise Report Cards (1969–2050)** this forecast analysis only runs out to 2050 because it is based on the observed water level record and extrapolation of the detected water level trend to the end of the century becomes very uncertain. **orange curve**
- **USACE Sea Level Change Curve Calculator (1992–2100)** using forecast models with global sea level trends and local land level changes, these scenarios are generally the lowest of the three sources, with the USACE Intermediate scenario tracking below the VIMS analysis. **green curves**
- **NOAA Global and Regional Seal Level Rise Scenarios (2000–2100)** using forecast models based on global and regional factors affecting relative sea level including polar ice melting, results in a very wide range significantly exceeding all USACE scenarios, with the NOAA Intermediate trend tracking above the VIMS analysis. **purple curves**

More information about each approach is provided on the following pages.

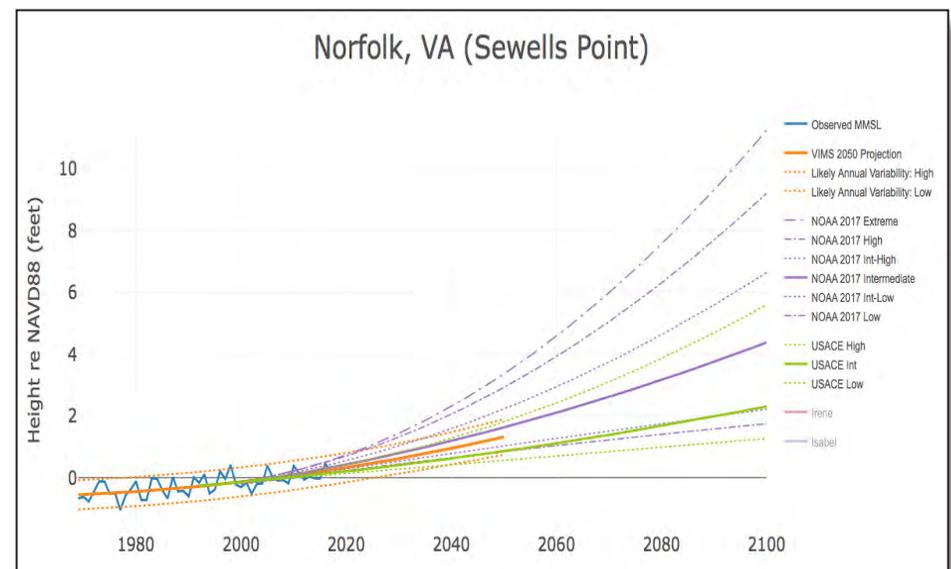


Figure 2. Multiple sea level rise projections allow comparisons between curves. Different curves can be used for different flood risk tolerances.

VIMS Sea Level Rise Report Card for Norfolk, Virginia

The VIMS Sea Level Report Cards are “...(u)pdated by the Virginia Institute of Marine Science each year as annual tide-gauge data become available, they display recent sea-level trends and project sea-level height to the year 2050 for 32 localities along the U.S. East, Gulf, and West coasts... (The) report cards have 3 components: the 2050 projection, recent trends in the rates of sea-level change, and an explanation of processes affecting sea level at each locality.” (from the Sea Level Rise Report Card website at: <http://www.vims.edu/research/products/slrc/>) For Virginia, data from the tide gauge at Sewell’s Point is used to develop the projection reported on the AdaptVA website.

The **orange linecurve** (Figure 3) represents projected mean sea level (or the average sea level for the year). It is based on a trend analysis of recorded water levels at the Sewells Point, Norfolk tide gauge between 1969 and 2017. Because the tide gauge is recording water levels immediately next to the land, changes in water level include sea level rise, land subsidence and other important drivers in a single record. The extension of the trend into the future gives projected water levels assuming that sea level drivers continue to follow the same patterns. The projection only goes out to 2050 because of the likelihood that patterns controlling sea level rise (and therefore, sea level rise trends) will change in the future. This analysis is updated annually and therefore the projection will change slightly

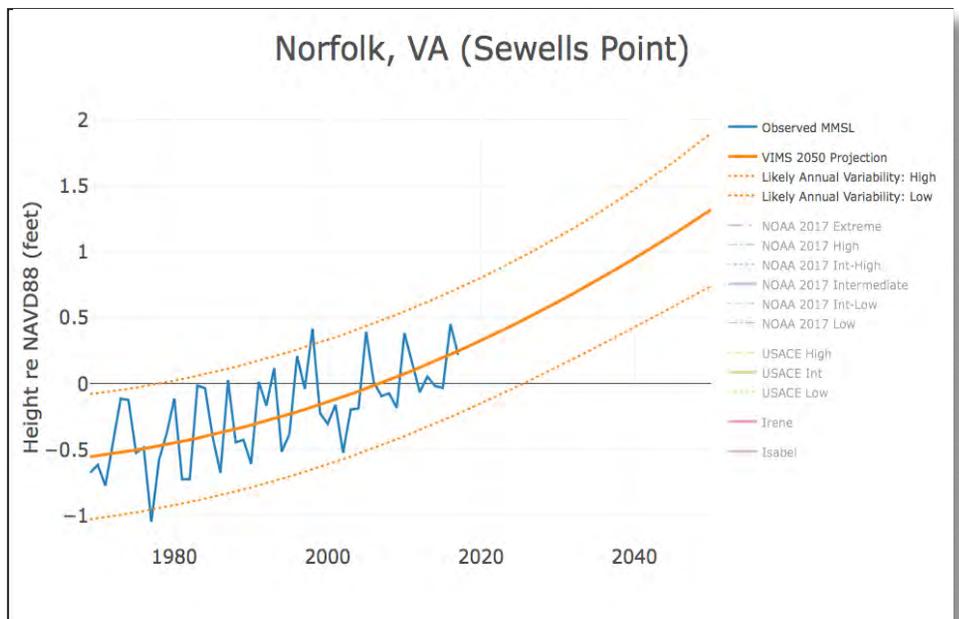


Figure 3. Observed water levels from the Sewells Point gauge and a sea level rise projection curve based on those water levels.

over time with shifts in sea level. A history of these changes can be found here: <http://www.vims.edu/research/products/slrc/localities/norfolkva/index.php> (under “Year to Year trends”).

The Basic Steps of the VIMS Trend Analysis

1. *Verified water level data is downloaded from NOAA's website (www.tidesandcurrents.noaa.gov);*
2. *Water level records are averaged over each month to reduce the impact of weather-driven variations (e.g., storm surges) on the trend analysis.*
3. *Analysis is done by fitting a quadratic curve using a statistical technique called “least squares regression” which mathematically creates a line that best fits the observed data.*

For more details, see the report associated with this analysis “Anthropocene Sea Level Change: A History of Recent Trends Observed in the U.S. East, Gulf, and West Coast Regions.” See the report, <https://doi.org/10.21220/V5T1TT>

The **dotted lines** are an estimate of the expected annual variability of water levels based on monthly variations. However, water levels rise and fall above the average daily (these are the high and low tides) and water levels are higher in some months than in others. These dotted line curves capture expected variation due to daily and monthly tidal cycles on an annualized basis. They do not capture storm surge, so that must be an additional consideration when flood resiliency is critical for an area or a piece of infrastructure.

NAVD88 (North American Vertical Datum 1988) is a land-based elevation datum. It is the elevation datum typically used for houses and roads. Since NAVD88 is land-based, it doesn't change as sea level rises.



Photo 2. Cars on flooded roads in Norfolk, Virginia during Tropical Storm Hermine.

US Army Corps of Engineers Sea Level Change Curve Calculator

The Corps developed and has periodically revised a sea level rise calculator. The most recent version, USACE Sea Level Change Curve Calculator (2017.55), is available on line and can be used for many of the NOAA tide gauges as well as other locations. The calculator incorporates both global sea level trends and local land level changes and is currently based on a 1992 starting point for analysis. The calculator returns projections for High, Intermediate, and Low scenarios. These curves range from a straight-line trend analysis of water level records (lowest projection) to several modeled projections based primarily on the National Research Council 2012 report and consideration of more recent Intergovernmental Panel on Climate Change (IPCC) global climate modeling (Figure 4).

The calculator and details on the methods used to produce these projections can be found here: http://corpsmapu.usace.army.mil/rccinfo/slc/slcc_calc.html

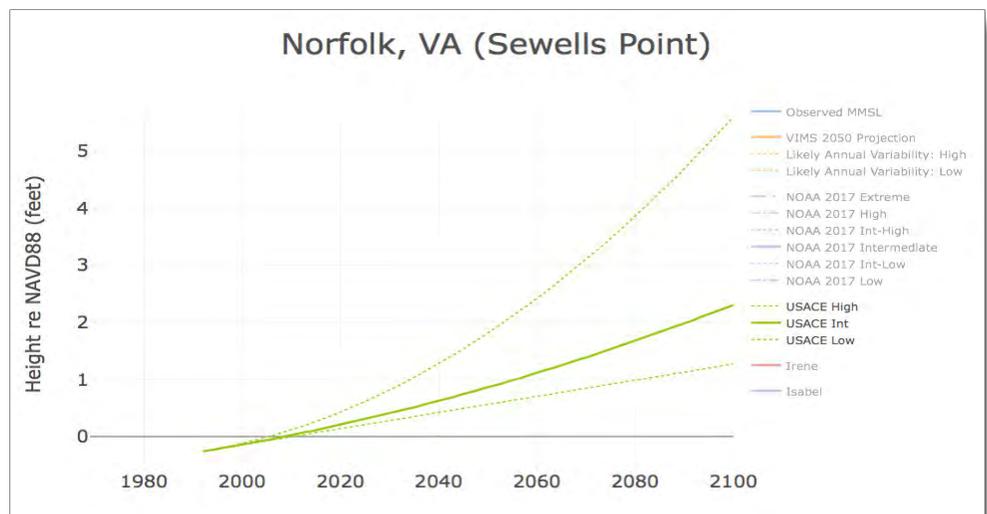


Figure 4. U.S. Army Corps of Engineer's sea level rise projection curves for Norfolk, VA – as viewed here: http://adaptva.org/info/virginia_sea_level.html



Photo 3. Nuisance flooding from a high tide inundates a parking lot at Gloucester Point Beach Park.

- Global mean sea level (GMSL) has risen by about 7-8 inches (about 16-21 cm) since 1900, with about 3 of those inches (about 7 cm) occurring since 1993 (very high confidence).
- Human-caused climate change has (1) made a substantial contribution to GMSL rise since 1900 (high confidence), and (2) contributed to a rate of rise that is greater than during any preceding century in at least 2,800 years (medium confidence).
 - 4th National Climate Assessment, U.S. Global Change Research Program

NOAA Global and Regional Sea Level Rise Scenarios for the United States

The scenarios developed by NOAA in 2017 represent an update to the information available on global mean sea level and then integrate regional factors affecting relative sea level for the entire U.S. coastline. One of the significant outcomes of the NOAA analysis was a recommendation based on the most recent scientific literature on polar ice cap melting. In light of this information the group developing

the report recommended raising the “extreme” scenario used in the Third National Climate Assessment (Parris, et al. 2012) from a 2100 value of 2.0 meters (6.5 feet) to 2.5 meters (8.2 feet). They also recommended raising the “low” scenario to a value of 0.3 meters (1 foot) in 2100. When combined with the local regional subsidence rates and the effects of changes in regional ocean circulation, the

result in Virginia is a range of potential outcomes in 2100 from an “extreme” of 10.5 feet to a “low” of 1.8 feet.

The NOAA report identifies six scenarios (extreme to low) in an effort to inform planning by governments, businesses, and individuals. The six scenarios were developed by simply dividing the 2100 range using 0.5 meter increments starting from the top value of 2.5 meters. Acceleration curves from the present to those end points were then fitted and the group developed probability and certainty estimates associated with each curve (*Figure 5*).

These estimates can be accessed on the US Army Corps of Engineers sea level rise calculator webpage (*link on Page 4*). Details on the methods used to produce these projections can be found here: https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

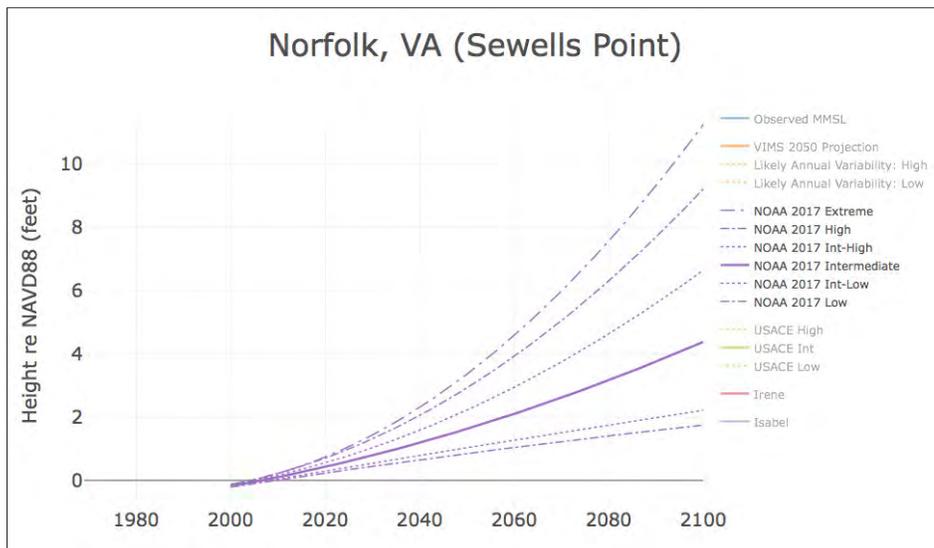


Figure 5. NOAA’s sea level rise projection curves for Sewells Point tide gauge – as viewed here: http://adaptva.org/info/virginia_sea_level.html

“Localized projections of sea-level rise are needed to guide the regional planning and adaptation measures that are being pursued with increasing urgency in many coastal localities.”

– John Boon, VIMS emeritus professor



Photo 4. VIMS Eastern Shore Lab, flooded during the 2015 Nor’easter.

“Virginia is among the states most vulnerable to the impacts of a warming climate. Sea level rise and coastal flooding, more frequent and severe weather events, drought and increased heat are all threats to the quality of life and economic success of all Virginians.”

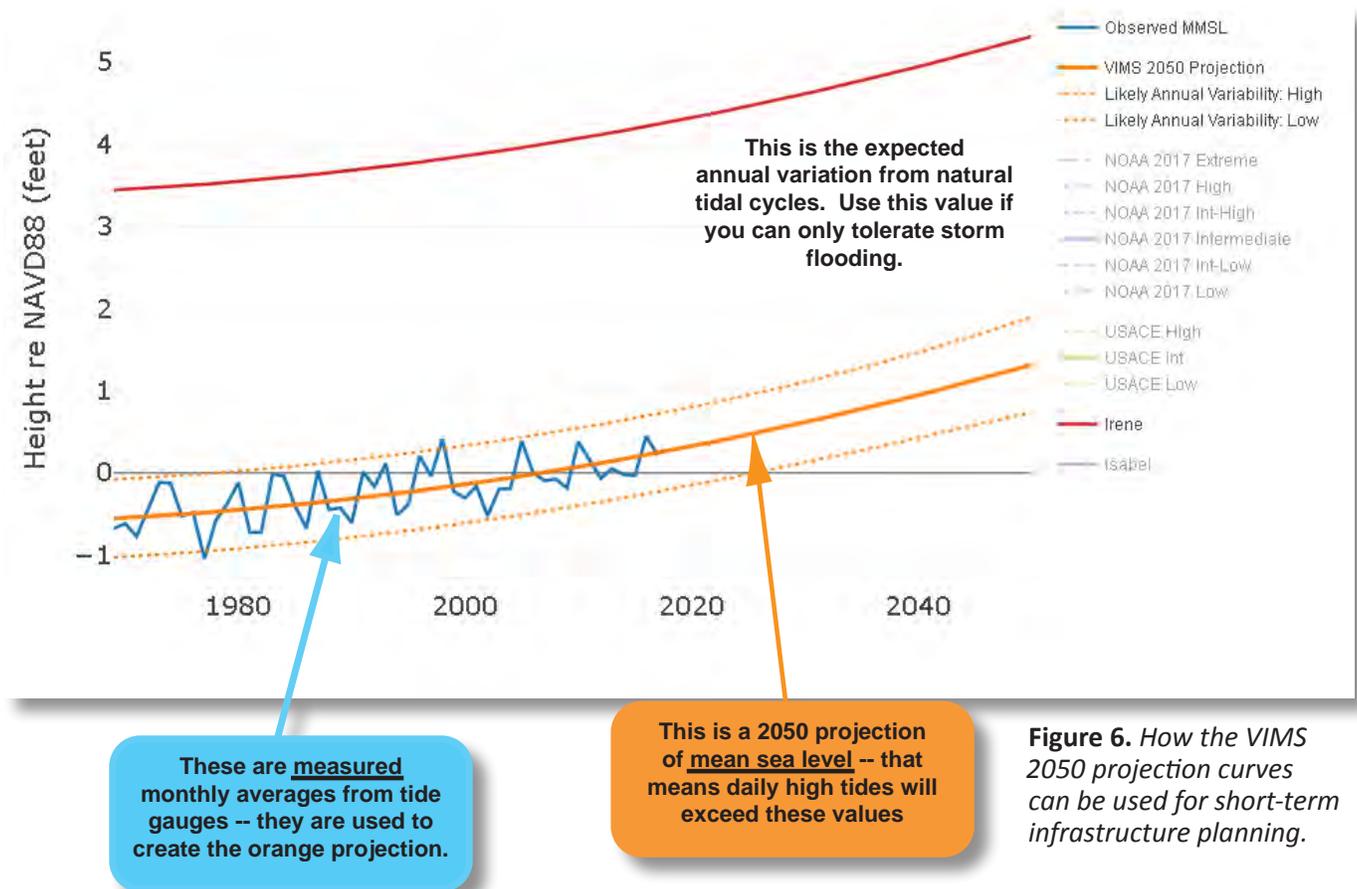
– Ralph Northam
Governor of Virginia

How Do We Use These Curves for Planning?

The most critical aspect of planning for flood resilience for infrastructure is to determine (1) the expected lifespan and (2) the risk tolerance.

The 2050 projection (**orange curve**) is ideal for projects with short life spans (e.g., less than 30 years).

- All infrastructure should be constructed at elevations above the projected mean sea level for 2050.
- Infrastructure that can tolerate moderate flooding (e.g., some roads) can be constructed in elevations between the orange curve and the orange dotted lines.
- Infrastructure that can tolerate only occasional flooding (due to storm events) should be built at elevations above the upper dotted line.
- Infrastructure that cannot tolerate flooding should include consideration of storm surges, by adding 3+ feet to the elevation of the dotted line (similar to water levels from Hurricane Irene in 2011). Additional flood proofing measures should be considered for this type of critical infrastructure.



For projects with long life spans (> 30 years), all of the 2100 projection curves (**green and purple**) should be considered (see Figure 7, Page 7). Since all projections are considered equally likely at this time, curves should be selected based on risk tolerance. Similar to the VIMS 2050 projection levels, consideration should be given to tide range, annual variability of water levels and storm surge, however, these are not explicitly shown for the Corps and NOAA curves.

- For infrastructure that can tolerate some flooding, a moderate projection can be used.
- For infrastructure that cannot tolerate flooding, one of the higher curves should be used.
- In addition, an adaptation plan, including a plan for financing necessary adaptations, should be adopted in case the future water levels exceed the projections.

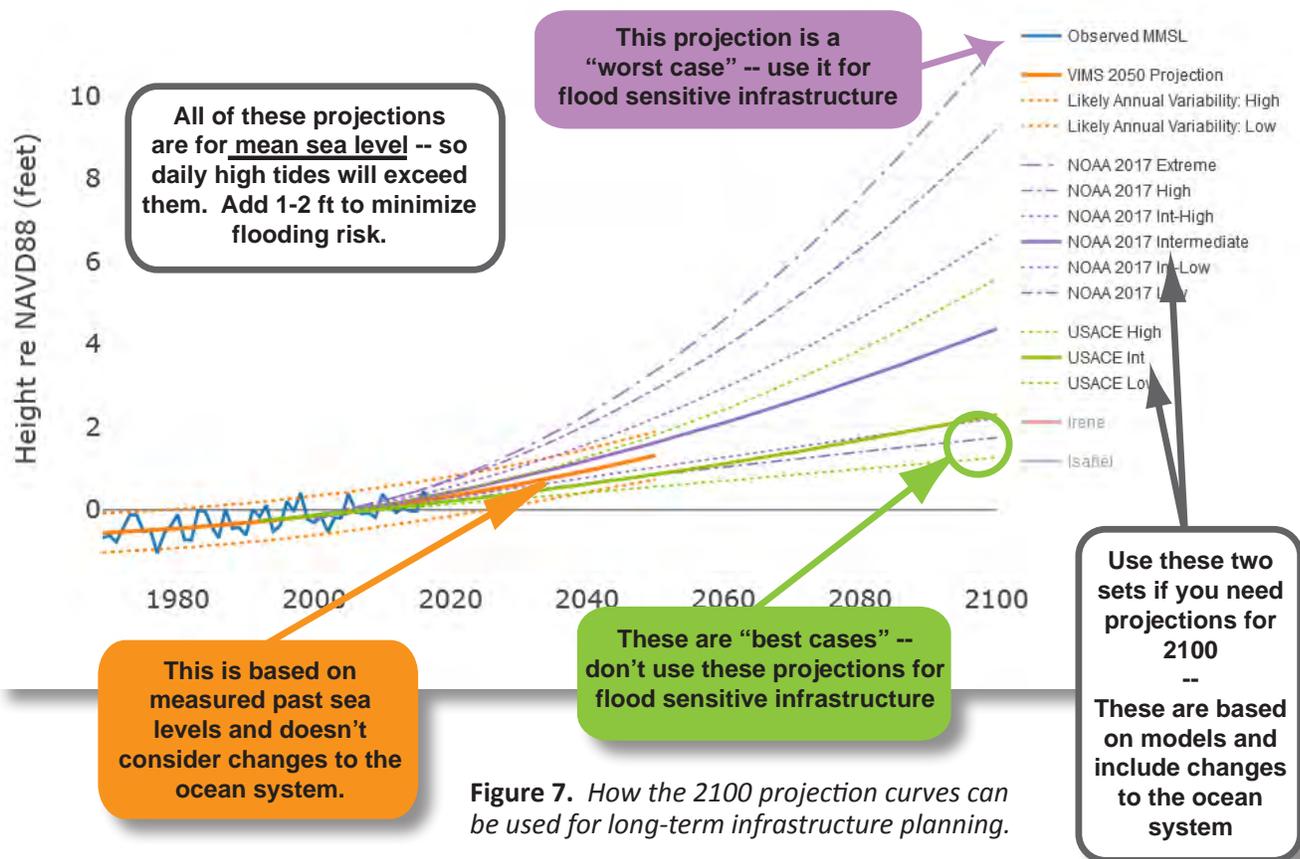


Figure 7. How the 2100 projection curves can be used for long-term infrastructure planning.

Tidewatch

Knowing where sea level is headed over the next several decades can be critical for informed planning and long-term risk reduction. Developing community resilience also requires attention to short-term risks and water level awareness which is a critical element in coastal Virginia. As everyone who lives here knows, the tides rise and fall twice each day in Virginia. We have a relatively small tide range (difference between the high and low tides), but we also can have a rather impressive water level response to storms.

Under the influence of the sun and the moon, high tides occur in Virginia around 700 times every year. This astronomical forcing generally does not raise the water above an elevation of about 2 feet relative to the NAVD88 landbased datum. When storms, and particularly sustained winds, cross the region, water levels can be driven to much higher levels. When we look back over the last 19 years (a period of analysis which encompasses all of the various alignments of the sun, earth, and moon) there have been over 13,000 times when the water has come up and receded. Of those events, water levels at Sewells Point were higher than 2 feet NAVD88 545 times, which is about 30 times per year on average. These are the events that cause flooding that affects life in coastal Virginia (Figure 8).

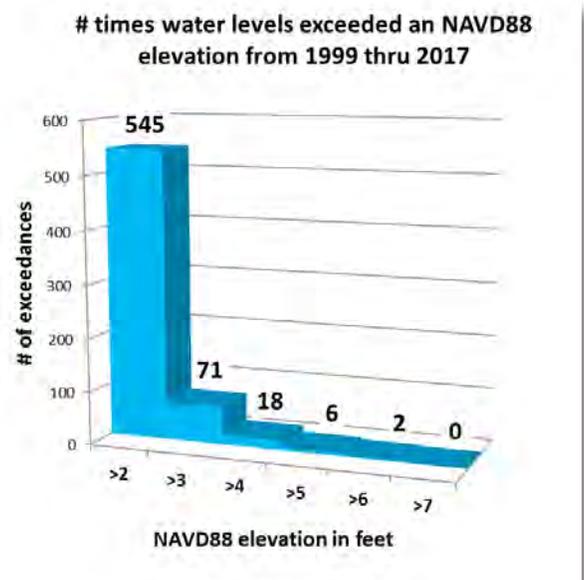


Figure 8. This graph shows the number of times that water levels have exceeded different elevations over the most recent 19-year period.

Tidewatch, con't

Knowing when these events will occur and how high they will be is very useful information. The VIMS Tidewatch network is a continuously updated forecast of water levels at an expanding number of tide gauge locations in Virginia. Predictions of water levels over the next 36 hours are based on an analysis of recent water levels at each tide gauge combined with storm surge forecasts. The analyses are updated every 12 hours and the plots available online show:

- NOAA tide predictions based solely on astronomical forcing **blue line**
- Observed tide **solid red line**
- Predicted tide for next 36 hours **dotted red line**
- The Residual or difference between the astronomical prediction and the observed/forecast tide **solid green line & dotted green line**

A recent example of a Tidewatch plot from the Sewells Point tide gauge shows the tides during this period were running about 1 foot above the astronomical predictions (Figure 9). Explanations of the methods and additional background material are available on the VIMS Tidewatch website <http://www.vims.edu/bayinfo/tidewatch/index.php> or through the Forecast tab on the AdaptVA.org website.

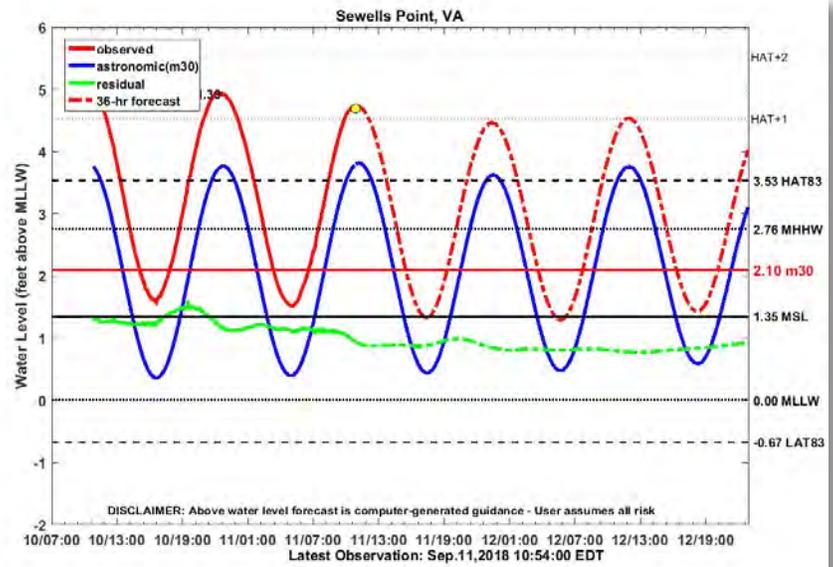


Figure 9. A graph from the VIMS Tidewatch network, which forecasts water levels 36 hours in advance (the red dotted line).

Another tool on the website is a Tidewatch Viewer. This interactive map viewer currently shows water level forecasts throughout Hampton Roads, but will eventually cover more areas in coastal Virginia. Instead of just providing information for the predicted water levels at tide gauge locations, this viewer uses the SCHISM model to predict water levels throughout the Chesapeake Bay. SCHISM is a very sophisticated hydrodynamic model developed by Dr. Joseph Zhang at VIMS. It can use wind predictions from NOAA to simulate the movements of water throughout the Bay, its tributaries, and the coastal ocean in three dimensions. This allows estimation of water levels everywhere in coastal Virginia.

The viewer combines the model's output with detailed topographic information to predict how normal tides and storm tides will move on and off the land surface (Figure 10).

The Tidewatch Viewer also provides a 36 hour forecast that is updated every 12 hours. It can be found on the AdaptVA website at: <http://adaptva.org/info/forecasts.html>

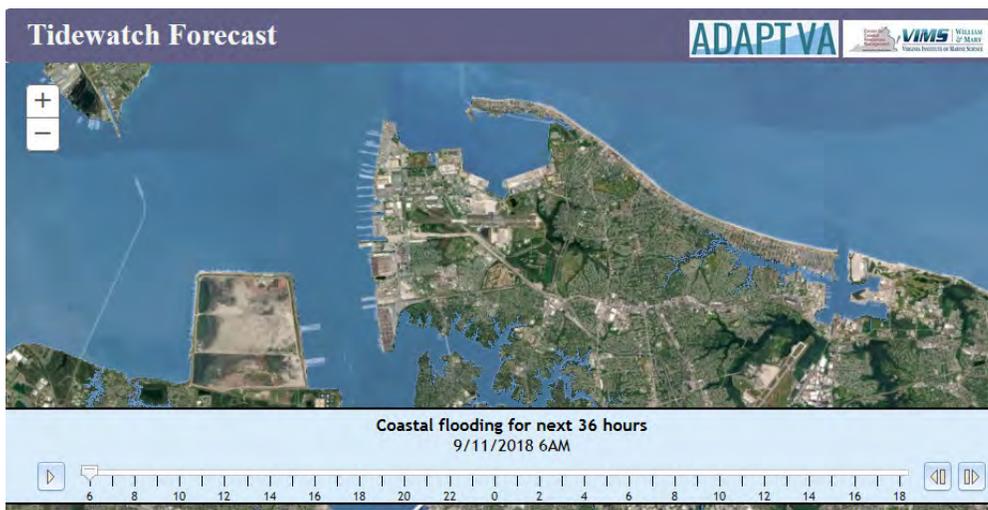


Figure 10. The Tidewatch Forecast is a viewer that shows water level forecasts for the next 36 hours. Clicking through the timeline allows you to see water levels shift with the tides by the hour.