Living Shorelines – Types, Tools, and Techniques

Webcast sponsored by EPA’s Watershed Academy

Wednesday, May 14, 2014
1:00pm – 3:00pm Eastern

Instructors:
Nancy Laurson, Environmental Protection Specialist, Oceans and Coastal Protection Division, U.S. EPA
Tracy Skrabal, Senior Coastal Scientist and Southeast Regional Manager, North Carolina Coastal Federation
Pam Mason, Senior Coastal Management Scientist, Center for Coastal Resources Management, Virginia Institute of Marine Science (VIMS)
Dr. Danielle Kreeger, Science Director, Partnership for the Delaware Estuary (PDE)

Webcast Logistics

• **To Ask a Question** – Type your question in the “Questions” tool box on the right side of your screen and click “Send.”

• **To report any technical issues** (such as audio problems) – Type your issue in the “Questions” tool box on the right side of your screen and click “Send” and we will respond by posting an answer in the “Questions” box.
Overview of Today’s Webcast

• Introduction
• What is a Living Shoreline?
• Tools and Techniques
• Case Study
  – Mussel Powered Living Shorelines for Salt Marsh Erosion Control

May is American Wetlands Month

Celebrate Wetlands!

- Today’s Webcast
- May 29th webinar hosted by the Association of State Wetland Managers: Stormwater, Wetlands and Low Impact Development; Putting the Landscape to Work For Clean Water
  - http://aswm.org/aswm/aswm-webinarscalls/6313-special-aswm-american-wetlands-month-webinar-may-29-300pm-edt
- To post and view planned activities visit:
  - http://www.epa.gov/owow/wetlands/awm/
Introduction

U.S. Fish & Wildlife Service and NOAA National Marine Fisheries Service - Status and Trends of Wetlands Report*

- 1998 – 2004 lost an average of 59,000 acres in US annually. Majority of loss (82%) occurred in both tidal and non-tidal freshwater wetlands.

Understand Factors Responsible for Loss, Identify and Share Successful Strategies, and Facilitate Federal Collaboration

- Formed Federal Interagency Coastal Wetlands Workgroup
- Conducted Coastal Wetland Reviews - Living Shorelines Identified as a Key Tool

http://www.epa.gov/type/wetlands/cwt.cfm


Living Shorelines: Purpose, Project Methods and Site Considerations

Tracy Skrabal, Southeast Regional Manager tracys@nccoast.org (910) 509-2838

Citizens Working Together for a Healthy Coastal Environment
Living Shorelines- What are they?

Living shorelines are a creative approach to protecting estuarine shorelines from erosion, by using bioengineering or engineered structures to also maintain, restore, or enhance the shoreline's natural habitats. These approaches can include: restoring, enhancing, or protecting existing wetland (marsh) and/or riparian vegetation, construction of a marsh sill (rock, sheetpile, or other materials such as oyster bags), and/or using other engineered structures to maintain, restore, enhance or create a natural shoreline (NC Div. of Coastal Management).

“Non-structural shoreline stabilization project” means a suite of bank stabilization and erosion control measures designed to minimize shoreline erosion, maintain coastal processes, and provide aquatic habitat ....” (Maryland Department of the Environment)

Living Shorelines may include: marsh plantings, shrubs and trees, low profile sills or breakwaters, strategically placed organic material and other techniques that recreate the natural functions of a shoreline ecosystem. (VA CZM)

Bulkhead-Typical Section

Rip-Rap-Typical Section
Functions and Values of Living Shorelines: Productivity

• Salt marsh generates 10 tons organic matter per acre
  - 2 times the yield of a corn field
  - 6 times the yield of a soybean field
  - 10 times the yield of shallow tidal waters
  - 10 times the yield of a mature forest buffer
  - 30 times the yield of open water
  (Clark 1974; Tiner and Burke 1995)

• “...Results show qualitatively that established man-made wetlands have the ability to support the same animal species as natural wetlands. (Roberts 1989)” (Matthews and Minello 1994)

Functions & Values of Living Shorelines: Water Quality

Wetlands help maintain good water quality or improve degraded waters in several ways:

1. nutrient removal and retention,
   - filtration, denitrification,
   uptake/sequestration

2. processing chemical and organic wastes,

3. reducing sediment loads.

(Tiner and Burke 1995)
Functions and Values of Living Shorelines:

Habitat Enhancement:

• 80% of America’s breeding bird population rely on wetlands (Kesselheim and Slattery 1995)

• Nearly all of the 190 species of amphibians in N.A. depend on wetlands for breeding (Hammer 1997)

Diverse Ecosystem

• More than half of the commercially useful fish depend on the coastal marshes as spawning beds, hatcheries, nurseries or feeding grounds (Tiner and Burke 1995; Kesselheim and Slattery 1995, Adams et. al. 1987)

Functions and Values of Living Shorelines:

Shoreline Stabilization

Results showed that *Spartina alterniflora* marshes significantly reduced wave height and erosional energy.

Wave height was reduced by:
- 50% within the first 5m of marsh
- 95% after crossing 30m of marsh (Knutson et al. 1982)

The reduction in wave height (wave attenuation) and thus the severity of the impact at the upland bank is a function of:

• Interaction with the bottom
• Interaction with the sill structure
• Interaction with marsh vegetation
Effect of Sea Level Rise on Living Shorelines

Current

Effect of Sea Level Rise on Living Shorelines

+2 feet
Living Shorelines- Combining Erosion Control with Restoration Goals

- No Action
- Relocation of Threatened Structures
- Non-Structural Stabilization Measures (Slope Grading, Marsh Creation, Bio-Engineering, beach nourishment)
- Combination Approaches (Sills, Stone containment cells, etc. with plantings)
- Hardening Structures (Groins, Revetments, Gabions, Bulkheads)

Beach Nourishment and/or Marsh Planting

Cape Lookout Lighthouse

Harkers Island, NC
Hybrid Living Shoreline Projects

- Riprap revetment
- Low-profile sill

North Carolina Coastal Federation
Stone Containment Structures

Oyster Shell Patch Reefs/ Sills

North Carolina Coastal Federation
Carrot Island- NC NERRS- Rachael Carson Reserve

Vertical Wall Sills/Marsh Plantings

From Spencer M. Rogers, Jr., N.C. Sea Grant
CAMP LEACH - 5 YEARS
2 YEARS AFTER REMOVAL
Edenhouse living shoreline project

Roanoke Island Festival Park - Manteo, NC
After Restoration

Bogue Sound

Offshore Breakwaters

Stormwater Wetland

Reef Balls

Oyster Shell Bag Sill

Stone Sill
Morris Landing Preserve - Oyster bags/domes

Morris Landing - Oyster Domes, Oyster Bags, Vertical Sill
Living Shorelines: Programs, Tools and Context: the “Small” and “Big” Picture
Pam Mason

EPA Webinar
May 14, 2014
Program Options to Promote LS

- General / Streamlined Permits
- Permit Fee Waivers
- Compensation Waivers
- Subaqueous Royalty Waivers
- Tax Assessment Reduction
- Cost Share
- Low Impact Development Credit
- Subdivision Ordinance Addition
- Design/ Build
- Technical Assistance
- Demonstration

### Jurisdictions Promote Living Shorelines

<table>
<thead>
<tr>
<th>Area</th>
<th>Implementation/ Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approach</strong></td>
<td>State(s) using Approach</td>
</tr>
<tr>
<td><strong>State Legislation</strong></td>
<td>Maryland, Connecticut</td>
</tr>
<tr>
<td><strong>State Regulation to prefer natural shorelines</strong></td>
<td>Alabama, N.C.</td>
</tr>
<tr>
<td><strong>General Permit</strong></td>
<td>North Carolina, Virginia (under dev.)</td>
</tr>
<tr>
<td><strong>Exemption from state permit</strong></td>
<td>Northwest Florida</td>
</tr>
<tr>
<td><strong>Design Assistance</strong></td>
<td>Maryland, Maryland Dept. of the Environment (MDE)</td>
</tr>
<tr>
<td><strong>Cost-share/low-no interest loans</strong></td>
<td>North Carolina, Texas, Maryland</td>
</tr>
<tr>
<td><strong>Water Quality Revolving Loan - Nonpoint control</strong></td>
<td>Maryland, Maryland Water Quality Financing Administration (MWQFA), a unit within MDE</td>
</tr>
<tr>
<td><strong>Permit fee waiver</strong></td>
<td>Maryland, Maryland Department of the Environment</td>
</tr>
<tr>
<td><strong>Tax Incentives</strong></td>
<td>Oregon, Virginia, Virginia Department of Fish and Wildlife, Virginia Localities</td>
</tr>
<tr>
<td><strong>Permitting preference</strong></td>
<td>Fairfax County, Virginia, Fairfax Co. Wetlands Board, Dept. of Planning and Zoning</td>
</tr>
</tbody>
</table>
Partnership Implementation Initiatives

<table>
<thead>
<tr>
<th>Where</th>
<th>Who- Lead</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco Bay</td>
<td>The Watershed Project</td>
<td>Project Design/Build</td>
</tr>
<tr>
<td>North Carolina</td>
<td>NC Coastal Federation</td>
<td>Design/ Build Financial Assistance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conservation Community Conservation Assistance Program (CCAP)</td>
</tr>
<tr>
<td>Maryland/ Virginia</td>
<td>Chesapeake Bay Trust</td>
<td>Grant Program</td>
</tr>
<tr>
<td>National: Ches. Bay, Gulf Fund, Sandy Recovery</td>
<td>National Fish and Wildlife Foundation</td>
<td>Grant Program</td>
</tr>
<tr>
<td>Delaware Estuary/ DELSI</td>
<td>Partnership for the Delaware Estuary</td>
<td>Design/ Build</td>
</tr>
<tr>
<td>Hudson River Sustainable Shorelines</td>
<td>Hudson River NERR</td>
<td>Design/ Build</td>
</tr>
<tr>
<td>Alabama and Mississippi</td>
<td>Funded by: Gulf of Mexico Alliance</td>
<td>Guidelines/ Training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partners including academia, state agencies, Estuary programs and NERR</td>
</tr>
</tbody>
</table>

Virginia’s Living Shorelines

- Living Shorelines Act 2011
- VIMS/ CCRM
  - GIS Shoreline Model
  - Training
    - Scientific Research
    - Permit Guidance
Virginia’s Living Shorelines Mandates

- Living Shorelines Mandate 2011
- General Permit for living shorelines to be developed & implemented
- Integrated guidance for tidal shoreline management
- Comprehensive Coastal Resource Management Guidance to be developed for each tidewater Virginia locality

VIMS Center for Coastal Resource Management LS Tools and Projects

- Shoreline Management Model
  - Identifies preferred options for all shoreline settings based upon sustainability and ecosystem services
- Contractors Training Education Modules / Workshop
- Design Manual
- Living Shorelines Website
- Living Shorelines monitoring project
  - Compares LS to conventional and natural shorelines for benthic production
  - Assess nutrient load reductions
Shoreline Management Model (SMM)

- Geo-spatial model that delivers ecosystem-based erosion control options for tidal shorelines
- Uses a knowledge-based decision tree that has been modeled in ArcGIS using Model Builder
- Requires information about onsite conditions
- Output is scaled to property-level decisions
- Delivered to the end user in map format
  
  Example from Virginia Beach, Virginia
Living Shoreline Practices:
Involve Marsh, Beach and/or Riparian Buffer Maintenance, Enhancement, Restoration or Creation
<table>
<thead>
<tr>
<th>Shoreline BMP Treatment Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of Special Concern</td>
<td>Examples include marinas, dredged canals</td>
</tr>
<tr>
<td>Forest Management</td>
<td>Improve forest condition by pruning and removing dead matter</td>
</tr>
<tr>
<td>Grade Bank</td>
<td>Reduce slope steepness for wave run-up and improved stability for vegetation growing conditions</td>
</tr>
<tr>
<td>Land Use Management</td>
<td>Modify upland uses; relocate or modify infrastructure</td>
</tr>
<tr>
<td>Enhance Riparian/Marsh Buffer</td>
<td>Preserve/Enhance vegetation stabilization potential from the marsh to within 100 feet of the bank.</td>
</tr>
<tr>
<td>Enhance Riparian/Marsh Buffer or Beach Nourishment</td>
<td>Enhance the buffer if needed. If buffer does not require enhancement then nourish the beach</td>
</tr>
<tr>
<td>Enhance/Maintain Beach</td>
<td>Preserve existing beach</td>
</tr>
<tr>
<td>Enhance/Maintain Marsh</td>
<td>Preserve and enhance marsh vegetation for wave attenuation</td>
</tr>
<tr>
<td>Enhance/Maintain Riparian Buffer</td>
<td>Preserve existing vegetation within 100 feet of bank</td>
</tr>
<tr>
<td>Maintain Beach OR Offshore Breakwaters with Beach Nourishment</td>
<td>Preserve the beach through beach nourishment option. If additional protection is required use offshore breakwaters with beach nourishment</td>
</tr>
<tr>
<td>Plant Marsh with Sill</td>
<td>Existing or planted marsh protected by a low revetment placed offshore of the marsh</td>
</tr>
<tr>
<td>Widen Marsh</td>
<td>Increase marsh width to improve wave attenuation</td>
</tr>
<tr>
<td>Widen Marsh/Enhance Buffer</td>
<td>Expand the cross shore width of the riparian and/or tidal marsh vegetation through planting</td>
</tr>
<tr>
<td>Beach Nourishment</td>
<td>Place sand on beach to increase beach width</td>
</tr>
</tbody>
</table>

Example Locations
Online Training: Living Shoreline Design - A class for marine contractors

- **Module 1 -- Ecosystem Services**
  Goal: Explain how a living shoreline project can enhance ecosystem function in the Chesapeake Bay, and contrast this with impacts associated with traditional shoreline projects.

- **Module 2 -- Site suitability**
  Goal: Determine which types of shoreline projects are suitable for different shoreline types (e.g., sandy vs. marshy shorelines and low- vs. high-energy shorelines).

- **Module 3 -- Design Criteria**
  Goal: Learn the design criteria necessary to construct a successful living shoreline project

http://www.ccrm.vims.edu/education/ls_design_class/index.html

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Living Shorelines Context: Integrated Coastal Management

- **Water Quality Programs**
  – Total maximum daily loads

- **Habitat**
  – Tidal wetlands sustainability
  – Corridors: greenways/ blueways
  – Aquatic fauna: forage, nursery, refuge

- **Coastal communities resilience**

- **Open space**
Smaller Scale | Larger Scale
--- | ---
Site specific erosion control | Sediment budgets
Sediment trapping | Sediment availability
Primary Production | Non-vegetated and shallow water primary production
Denitrification | Water Quality Improvement/ Bay TMDL
Nutrient removal/ provision | Coastal eutrophication
Wetland creation | Cumulative Watershed restoration
Carbon sequestration | Climate change
Storm risk reduction | Coastal resilience/ wetland sustainability

Larger Scale Programs

- **Sustainability/ Coastal Resilience**
  - North Atlantic Comprehensive Coastal Study (Sandy): Nature and Nature-Based features
  - SAGE: Systems Approach to Geomorphic Engineering - Grey-Green solutions to shorelines

- **Flood Insurance**
  - CRS – Community Rating System

- **Habitat Restoration**
  - Green/ Blue ways: Corridors State Wildlife Plans
Water Quality

TMDL: Sediment and Nutrient Load Reductions
Chesapeake Bay Program BMP Verification Panel: Shoreline Erosion
Model- CBP Water Quality Model
Credits- Load reduction credits
  • Sediment load reduction
  • Denitrification
  • Sediment accumulation
  • Initial uptake

Contact Info

Pam Mason
Center for Coastal Resources Management
mason@vims.edu
www.vims.edu
Questions
Why Are We Interested in Living Shorelines?

2012 State of the Estuary Report

Rapid loss of acreage and degraded wetland health

Losing an acre per day (1996-2006)
Most tidal wetlands are moderately or severely stressed

http://delawareestuary.org/technical-report/delaware-estuary-basin
Living Shorelines

**Definition:**
A living shoreline is a method of shoreline stabilization that protects the coast from erosion while also preserving or enhancing environmental conditions.
**The Delaware Estuary Living Shoreline Initiative (DELSI)**

- **Biological Tactic**
- **Low Energy**
- **Natural Materials**
- **Naturally Resilient Ecological Relationships**

**Principle: Shellfish as Natural Erosion Control**
- In Gulf and Southeast US, fringing oyster reefs absorb wave energy and trap sediments
- Oyster reefs also create habitat, filter water, and recycle nutrients

**South Carolina**

**Delaware Estuary**

No mid-intertidal oyster reefs in Delaware Bay (yet)
NJDEP had banned oyster restoration in closed waters

*Courtesy L. Coen, SCORE*
Ribbed Mussels: An Alternative To Oysters
(for intertidal zone)

Similar ecological services
- Stabilize sediments
- Water filtration
- Nutrient cycling
- Sediment deposition

Not harvested
- No poaching concerns
- No human health risk

Mutualism with Spartina
- “Fertilize” sediments
- Facilitate levees
- Nutritional connection to Spartina

Bind to Roots with Byssus!

Natural Materials

Ribbed Mussels

Spartina

Wooden Stakes

COIR Logs, Mats

Oyster Shell Bags
PDE/Rutgers Example: Greening of Rip Rap

April 2010

Coir mat to provide support for coir logs, shell bags
Coir logs secured using wooden stakes & coir twine

Shellbags are placed to “soft armor” logs
June 2010

Salvage available *Spartina* / ribbed mussel clumps
Spartina alterniflora plugs also planted into coir logs

June 2011

April 2010
September 2011 (after Hurricane Irene)

November 2012 (after Hurricane Sandy)

DelawareEstuary.org

- Practitioners Guide
- Outreach Products
- Videos
The Delaware Estuary Living Shoreline Initiative (DELSI)

Summary

Current Efforts:
- Demo Sites
- Hybrids that Pair Mussel-Plant Tactic with Breakwaters
- Monitoring Standards

May 2010

June 2010

June 2011

- Stems/Slows Erosion
- Needs Long-term Maintenance
- Enhances Fish, Bivalves
- Promotes Water Quality

The Delaware Estuary Living Shoreline Initiative (DELSI)

Dozens of pilot projects have been conceptualized
Actual projects, monitoring, science needed in DE, NJ and PA

Fortescue, NJ
St. Jones
Camden
Gandy’s Beach, NJ
Murderkill River
Money Island

May 2010
June 2010
June 2011
Hybrid Living Shoreline at Mispillion River, DE

Considerations

What are the Goals?

Tactics and project designs need to be tailored to local site conditions

Permitting varies by state, agency
Monitoring will Strengthen Success

Legend
- Green: Sampling Plots
- Yellow: Control Areas
- Blue: Transects
- Brown: Logs

For More Info

Website
www.DelawareEstuary.org

Contact Email:
Dkreeger@DElawareEstuary.org
Speaker Contact Information

Nancy Laurson
Environmental Protection Specialist
Oceans and Coastal Protection Division, US EPA
(202) 566-1247
Laurson.Nancy@epa.gov

Dr. Danielle Kreeger
Science Director
Partnership for the Delaware Estuary (PDE)
Drkreeger@DEIawareEstuary.org

Tracy Skrabal
Senior Coastal Scientist and Southeast Regional Manager
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(910) 509-2838
tracys@nccoast.org

Pam Mason
Senior Coastal Management Scientist
Center for Coastal Resources Management, VIMS
(804) 684-7158
mason@vims.edu

Participation Certificate

If you would like to obtain participation certificates type the link below into your web browser:


You can type each of the attendees names into the PDF and print the certificates.
Questions