LIVING SHORELINES

FROM BARRIERS TO OPPORTUNITIES

A SPECIAL REPORT
BY

RESTORE
AMERICA'S
ESTUARIES

LIVING SHORELINES

FROM BARRIERS TO OPPORTUNITIES

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Living Shorelines Project, MD; image ©Tracy Skrabal

THE BOARD OF DIRECTORS OF RESTORE AMERICA'S ESTUARIES HAS REVIEWED AND ENDORSED THE FINDINGS AND RECOMMENDATIONS OF THIS REPORT

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LIVING SHORELINES: FROM BARRIERS TO OPPORTUNITIES

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I. SUMMARY

As we experience the impacts of climate change, wise shoreline management is critical both to protect property interests and protect estuarine ecosystems. Mounting evidence shows that hardened shorelines management techniques do not function well over time in many settings and that they do real and widespread harm to estuarine ecosystems. In contrast, living shorelines protect ecosystem services and perform better over time in controlling erosion and preventing catastrophic flood and storm damage. Why, then, is there not broad use and support of living shorelines?

To answer this question, Restore America's Estuaries (RAE) empaneled a committee of experts to investigate what institutional barriers are hindering the broader use of living shorelines and to recommend appropriate actions to remove those barriers.

The focus of this report is an assessment of institutional barriers preventing broader use of living shorelines. RAE and the committee believe the scientific benefits and technical merits of using living shorelines are sufficiently explored and documented elsewhere to support their use, when and where conditions are appropriate. The committee started from this point and did not see this report as the vehicle for making the case for the benefits of living shorelines. The committee understands there is more to learn about living shorelines and supports the continued refinement and advancement of research and technical materials related to living shorelines and all shoreline management systems, as well as coastal and estuarine ecosystems.

The audience for this report includes a diverse set of stakeholders: waterfront landowners and users; local, state, and federal government agencies that are or oversee the stewards of estuarine shorelines; appointed and elected officials; the scientific community; Indian Country; businesses that earn revenues from shoreline management activities; education and outreach professionals working in coastal communities; and not-for-profit conservation organizations whose missions relate to maintaining a healthy coastal environment. Strong and ongoing partnerships among these diverse stakeholders will be necessary to forge the progress needed

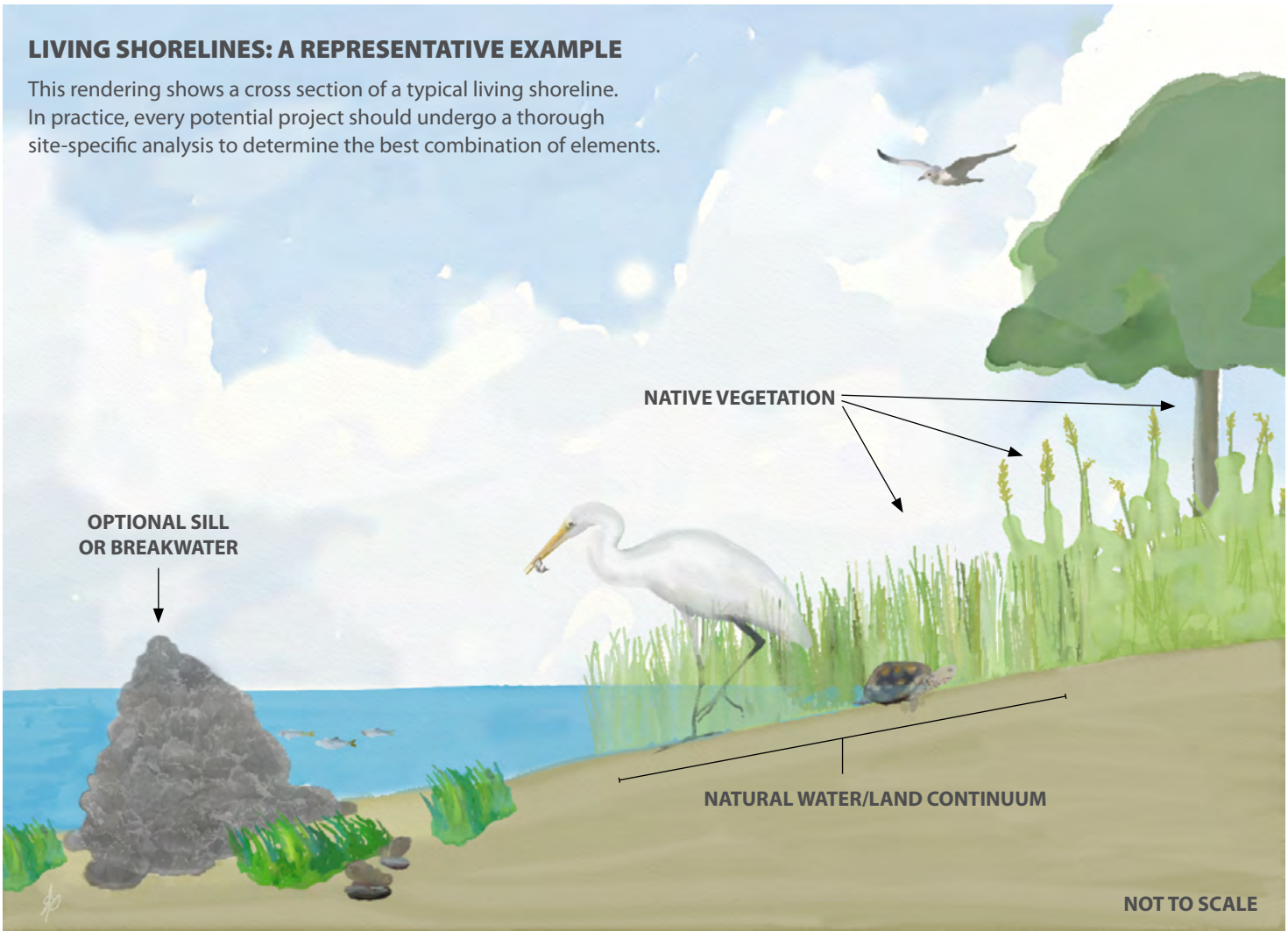
to carry out the report's recommendations. Ultimately, these partnerships will emerge through the persistent and skilled leadership of individual stakeholders such as the not-for-profit organizations whose missions are directly related and dependent upon living shorelines becoming a viable and widespread practice around the estuaries of the U.S.

Recognizing the divergent views on what a living shoreline is, the committee first agreed that there may be different ways to define a living shoreline, but for the purposes of this report, **living shorelines are defined as:**

ANY SHORELINE MANAGEMENT SYSTEM THAT IS DESIGNED TO PROTECT OR RESTORE NATURAL SHORELINE ECOSYSTEMS THROUGH THE USE OF NATURAL ELEMENTS AND, IF APPROPRIATE, MANMADE ELEMENTS. ANY ELEMENTS USED MUST NOT INTERRUPT THE NATURAL WATER/LAND CONTINUUM TO THE DETRIMENT OF NATURAL SHORELINE ECOSYSTEMS.

LIVING SHORELINES: A REPRESENTATIVE EXAMPLE

This rendering shows a cross section of a typical living shoreline. In practice, every potential project should undergo a thorough site-specific analysis to determine the best combination of elements.



ORGANIZATION OF THE REPORT

The majority of this report is organized around three topics necessary to assess the institutional barriers preventing the broader use of living shorelines: background information about the current state of living shorelines use; barriers preventing the broader use of living shorelines; and recommended strategies to overcome the barriers. These topics are intertwined in many cases. As a result, some topics may occur under more than one of these sections.

BARRIERS

After consulting a variety of experts and practitioners experienced in shoreline management issues, the committee concluded that there are three major barriers to the broader use of living shorelines:

- Institutional Inertia

  Familiarity with traditional methods and lack of information about both the shortcomings of those methods and the relative advantages of living shorelines has locked the major shoreline management decision-makers into a business-as-usual routine and impeded needed change in the regulatory system.

- Lack of a Broader Context for Shoreline Management Decisions

  Site-specific decision-making without consideration of system-wide impacts and/or benefits understates the negative cumulative effects of hardening, overlooks many of the greatest values of living shorelines (including mitigation of habitat loss), and imposes the entire shoreline management cost on the shoreline owner rather than spreading it across all of the constituencies benefited by a living shoreline installation.

- Lack of an Advocate

  Many constituencies benefit in different ways from living shorelines, but to date, they do not recognize their common interest and hence have not combined into an effective advocacy force.

RECOMMENDED STRATEGIES

To address the identified barriers, the committee recommends the following four strategies.

STRATEGY 1: EDUCATION AND OUTREACH

The first step necessary to affect all of the other strategies recommended in this report is the development of a broad and common understanding of the efficacy, impacts, and benefits of living shorelines as well as hardened structures. Collecting reliable information, making it generally available, and providing education and training to the various constituencies affected by shoreline management decisions is necessary to overcoming each of the identified barriers and promoting the wider use of living shorelines.

STRATEGY 2: REGULATORY REFORM

Permitting any activity in the coastal area requires regulatory oversight from a number of state, federal, and local agencies. While recognizing the importance of localized permitting in project implementation, the wide range of nuances amongst state and local jurisdictions is beyond the scope of this report. Rather, this report focuses on federal permitting and seeks to identify broad federal-level solutions that can have national impacts. With that in mind, regulatory reform is necessary to assure that all shoreline management permits are equally subject to application and review criteria consistent with the current scientific knowledge about the impacts of these systems. The new permitting program should improve coordination between federal, state, and local regulations, should consistently take into account the cumulative impacts beyond the project site (i.e., upland and system-wide impacts), and should include living shoreline incentives reflective of the system-wide values created.

STRATEGY 3: IMPROVE INSTITUTIONAL CAPACITY

To successfully implement comprehensive regulatory reform and wider use of living shorelines, the capacity of the major constituencies must be improved and

expanded. The current availability of designers, engineers, builders, and regulators sufficiently knowledgeable of living shoreline techniques is not adequate and must be increased, primarily through specialized training.

STRATEGY 4: PUBLIC AGENCIES AS ROLE MODELS – LEAD BY EXAMPLE

Public lands maintained and/or owned by all levels of government are ideal candidates for living shoreline demonstration projects that would raise awareness and acceptance of these techniques. Agency leadership would also be valuable in broadening planning perspectives and working across jurisdictions to collaboratively achieve meaningful regulatory reform.

SUMMARY OF FINDINGS RELATED TO LIVING SHORELINES

Overarching key findings are presented throughout the "Background" and "Barriers" sections of the report, and findings and recommendations are presented specific to each recommended strategy. The overarching key findings are:

KEY FINDING 1: The committee has concluded that living shorelines are the best shoreline management alternative for both the environment and property owners when they are used in the right locations, designed correctly, constructed properly, and maintained appropriately.

KEY FINDING 2: Living shorelines contribute a variety of public values beyond those enjoyed exclusively by the landowner implementing such a project.

KEY FINDING 3: Use of living shorelines by public and private landowners offers a potential significant economic value to achieving local and regional regulatory objectives and/or requirements for protecting and restoring water quality.

KEY FINDING 4: The differing approaches to permitting of shoreline management techniques have led to confusion, inconsistency, and unpredictability, particularly among permittees.

KEY FINDING 5: Waterfront property owners continue to use hardened shoreline protections because they are familiar with those methods, the methods are often easy to permit, and they lack information about both the shortcomings of those methods and the relative advantages of living shorelines.

KEY FINDING 6: Except where states have responded to excessive hardening by advocating changes in permitting systems, the federal regulatory regime has perpetuated the status quo bias in favor of hardening shorelines.

KEY FINDING 7: The negative cumulative effects of hardening are underestimated by site-specific decision-making without considering system-wide impacts.

KEY FINDING 8: Many of the greatest values of living shorelines both to the owner and to the other constituencies utilizing or affected by the estuary are overlooked by site-specific decision-making without considering system-wide benefits.

KEY FINDING 9: Site-specific decision-making without consideration of system-wide values created by living shorelines impedes broader use of living shorelines by imposing the cost on the shoreline owner rather than spreading it across all of the constituencies benefited by a living shoreline installation.

KEY FINDING 10: The existing regulatory schemes fail to adequately consider the system-wide impacts and benefits of shoreline management decisions, perpetuating a bias in favor of hardening.

KEY FINDING 11: System-wide planning tools are necessary for the proper evaluation of individual shoreline management decisions.

KEY FINDING 12: The various constituencies benefited in different ways by living shorelines do not recognize their common interest and hence have not combined into an effective advocacy force.

The specific findings and recommendations for each strategy are:

STRATEGY 1: EDUCATION AND OUTREACH

FINDING S-1.1: A major impediment to effective education about living shorelines is the lack of an authoritative repository of information about the science and technology of shoreline management techniques.

RECOMMENDATION S-1.1.1: The committee supports the establishment of a centralized, reliable (i.e., peer-reviewed) database collecting scientific research on the design, construction, efficacy, and impact of various shoreline management systems as well as a directory of living shoreline sites and qualified designers and contractors [see Improve Institutional Capacity].

RECOMMENDATION S-1.1.2: The committee supports the development of a national level "manual" of living shoreline practices, including such elements as a decision guide for evaluating potential project sites, selecting and designing an appropriate management system, constructing the system, and monitoring and maintaining the system, as well as guidelines for where living shorelines are not appropriate. Such a manual should develop and eventually formalize guidance that can serve as an engineering standards reference for design and construction professionals.

FINDING S-1.2: No entity (i.e., agency, NGO, etc.) currently exists at the national level to implement the education and outreach recommendations made above (development of database, directories, and manual) or to construct and deliver a broad education program targeting shoreline management issues.

RECOMMENDATION S-1.2.1: The committee supports establishment of a *Living Shorelines Academy** as the appropriate vehicle to implement the committee's education and outreach recommendations. The Academy should have a lead organization, but work in cooperation with any other entity undertaking similar tasks on a coordinated basis (i.e., not duplicating work), specifically including:

(1) Build a national repository of peer-reviewed scientific, engineering, and policy materials;

(2) Provide online training and educational materials for the design and implementation of living shoreline projects;

(3) Conduct in-person training through regional workshops and national technology transfer meetings; and

(4) Coordinate the development of training materials and the conduct of information campaigns to assure consistency in message and goals.

STRATEGY 2: REGULATORY REFORM

FINDING S-2.1: Federal and state permitting of hardened shoreline stabilization structures generally, and the Nationwide Permits (NWP) issued by the U.S. Army Corps of Engineers (Corps) in particular, do not adequately consider the state of current science about the cumulative, long-term negative impacts of these structures on aquatic systems and water quality and the relative benefits of softer structures.

RECOMMENDATION S-2.1.1: The committee supports the development of permitting regimes that: reflect current science and engineering for estuarine systems; coordinate federal, state, and local permitting schemes; consider the broader impacts of shoreline management decisions beyond the single parcel being permitted; provide appropriate incentives for better shoreline management; and yield more consistent and predictable outcomes. The committee supports states' use of their Coastal Zone Management Act (CZMA) consistency review authority to restrict the use of

** Since beginning this report project, RAE, working in partnership with its member organizations and key federal agencies, has been awarded a cooperative agreement by the U.S. Environmental Protection Agency to create the national capacity to transfer technology knowledge regarding good stewardship of estuarine shorelines across local, state, and tribal governments, as well as other interested stakeholders including waterfront landowners. To implement this grant, RAE will establish a Living Shorelines Academy.*

NWP 13 as a means to permit hardened shoreline stabilization within state waters, if the project is less than 500 linear feet and uses less than one cubic meter of fill per linear foot (see discussion below in Section IV, H). States may also condition permitting of activities in coastal waters on state water quality certification requirements.

FINDING S-2.2: Living shorelines are generally the least-damaging-to-the-environment alternative and are generally practicable in most estuarine settings.

RECOMMENDATION S-2.2.1: In any permitting scheme, hardened structures should be a last resort, only available if softer methods are known to be ineffective or impractical.

FINDING S-2.3: The current broad application of NWP 13, and in some states regional general permits for bulkheads and riprap, is not consistent with the mandates of the Clean Water Act (CWA) and is not supported by current scientific data.

RECOMMENDATION S-2.3.1: When NWP 13 is next reviewed, the underlying assumptions about secondary and cumulative impacts of hardened structures should be reexamined which, the committee believes, will lead to substantial revisions and adoption of more hierarchical criteria for the evaluation of bank stabilization projects.

FINDING S-2.4: The current mixture of permitting systems across jurisdictions is inefficient and, in many cases, counterproductive to the use of better shoreline management techniques. A clearer system focused on system impacts, both positive and negative, would promote a broader understanding of the principles of sound ecological management of shorelines.

RECOMMENDATION S-2.4.1: Federal, state, and local regulatory agencies should work toward a coordinated permitting system for living shorelines that yields consistent and predictable outcomes, recognizing that states have sovereign jurisdiction over their lands and waters and that this will require voluntary state participation. Possible means of coordination may include regional compacts to address the issues across jurisdictional lines.

FINDING S-2.5: Protection of estuarine and aquatic resources requires decision-making that considers the environmental consequences of cumulative decisions and impacts beyond the boundaries of a permitted project. Approaching management of these resources from an ecosystem rather than political jurisdiction perspective is therefore necessary.

RECOMMENDATION S-2.5.1: The committee supports the development and adoption of estuary-based (or other natural system-based criterion) plans for the regulation and permitting of shoreline management systems. Where necessary, inter-jurisdictional memorandums of understanding (MOUs) for this purpose should be adopted. Regional compacts may also play a role.

FINDING S-2.6: States are well situated to evaluate the cumulative impacts of broad reliance on NWP 13 on their local estuarine systems and curtail the use of hardened structures where appropriate.

RECOMMENDATION S-2.6.1: Recognizing that some states have already taken this step, the committee suggests that all states review and reevaluate the availability of NWP 13 for permitting hardened shorelines in their state waters by utilizing their CZMA authority and/or state water quality standards.

FINDING S-2.7: Because of institutional inertia, incentives are necessary to promote the use of living shorelines. Assessing the value of living shorelines and finding ways to link those values to the constituencies benefited is one method to fund monetary incentives.

RECOMMENDATION S-2.7.1: Regulatory agencies should adopt incentives for the use of living shorelines. Incentives may be administrative, such as preference in processing priority and technical support in design, as well as monetary, such as cost-sharing for design, construction, monitoring, or maintenance expenses.

STRATEGY 3: IMPROVE INSTITUTIONAL CAPACITY

FINDING S-3.1: The design, construction, and

regulatory constituencies involved in shoreline management do not currently have the institutional capacity to implement significantly broader use of living shoreline techniques.

RECOMMENDATION S-3.1.1: The primary tool for increasing capacity in the private sector should focus on education about the techniques of living shorelines, their advantages and efficacy, and the economics of their efficient design and implementation.

RECOMMENDATION S-3.1.2: A course of study for the certification and continuing education of one or more levels of Living Shoreline Professionals should be developed by an entity such as the proposed Living Shoreline Academy.

RECOMMENDATION S-3.1.3: Installation of living shoreline projects should deliberately target the use of volunteers for project implementation both for economic benefits and to provide public education that raises awareness of estuarine functions and values. This involvement, in turn, leads to an expansion of the advocacy base.

RECOMMENDATION S-3.1.4: Education about the techniques of living shorelines, their advantages and efficacy, and the economics of efficient design and implementation is the principal tool for increasing capacity of the existing regulatory staff. The Living Shorelines Academy could provide the basic education elements necessary for this training, by specialty, and then supplemented by hands-on field experience.

RECOMMENDATION S-3.1.5: Regulatory agencies should develop specialized training for their permitting staffs (see full description for details).

RECOMMENDATION S-3.1.6: Regulatory agencies should encourage and cooperate with the development of living shoreline expertise in the private sector as a way to leverage the expertise to increase regulatory capacity.

RECOMMENDATION S-3.1.7: Public and private funding of living shoreline initiatives should give high priority to increasing institutional capacity.

STRATEGY 4: PUBLIC AGENCIES AS ROLE MODELS – LEAD BY EXAMPLE

FINDING S-4.1: Government at all levels can benefit from the broader use of living shorelines and therefore will benefit by being an active advocate for their use.

RECOMMENDATION S-4.1.1: The use of public lands as living shoreline sites should be actively promoted at all levels.

RECOMMENDATION S-4.1.2: The committee recommends that federal, state, and local government agencies adopt formal policies and guidance that promote and support the use of living shoreline management measures on all publicly-owned estuarine shorelines.

Successfully pursuing these strategies will require a vigorous dedication to substantively reforming how we are managing our shorelines. Dedication alone will not be enough. Leadership and coordination of efforts will be necessary to effect change. In the committee's opinion, significant leadership can be provided at this stage by the non-governmental organization (NGO) community working together in a focused way to advance these strategies. It is important that all living shoreline constituencies, public or private, be involved in the effort to bring about the needed reforms to overcome institutional barriers.

Living Shorelines Project, Rivercrest Park, Tampa, FL; ©Thomas Ries.

II. INTRODUCTION

Erosion control, protection from storm and flood damage, and coastal climate change adaptation strategies are addressed differently on a regional basis due to the wide range of biogeophysical factors present. The use of living shorelines is one approach that can be executed very successfully at appropriate locations as a way to address erosion and flood threats, protect habitat and ecosystem services, and help adapt to ecosystem shifts brought about by climate change, especially sea-level rise. The ability to actually implement this strategy locally, regionally, or nationally varies widely due to a number of challenges. In particular, institutional impediments are slowing the use of living shorelines much more than science and engineering uncertainties. To date, much of the work on living shorelines has focused more on the science and evolving engineering practices, and less on what is required from a legal, policy, and administrative standpoint to get living shorelines into everyday practice.

To advance the use of living shorelines, RAE convened a group of experts with the charge to conduct an objective evaluation of institutional barriers to the use of living shorelines, and recommend actions on how they can best be overcome. This process built upon previous efforts and recommendations, particularly those developed at the April 2013 living shorelines meeting at the Smithsonian Environmental Research Center, the federal Interagency Wetlands Working Group, the 2013 Mid-Atlantic Living Shorelines Summit, and the RAE/TCS 2014 National Summit.

The focus of this report is an assessment of institutional barriers preventing broader use of living shorelines. RAE and the committee believe the scientific benefits and technical merits of using living shorelines are sufficiently explored and documented elsewhere to support their use, when and where conditions are appropriate. The committee started from this point and did not see this report as the vehicle for making the case for the benefits of living shorelines. The committee understands there is more to learn about living shorelines and supports the continued refinement and advancement of research and technical materials related to living shorelines and all shoreline management systems, as well as coastal and estuarine ecosystems.

The audience for this report includes a diverse set of stakeholders: waterfront landowners and users; local, state, and federal government agencies that are or oversee the stewards of estuarine shorelines; appointed and elected officials; the scientific community; Indian Country; businesses that earn revenues from shoreline management activities; education and outreach professionals working in coastal communities; and not-for-profit organizations whose missions relate to maintaining a healthy coastal environment. Strong and ongoing partnerships among these diverse stakeholders will be necessary to forge the progress needed to carry out the report's recommendations. Ultimately, these partnerships will emerge through the persistent and skilled leadership of individual stakeholders such as the not-for-profit organizations whose missions are directly related and dependent upon living shorelines becoming a viable and widespread practice around the estuaries of the U.S.

III. COMMITTEE AND PROCESS

A. COMMITTEE MEMBERS

RAE selected a committee of distinguished experts in living shorelines design, policy, and management to act as advisors and authors. A biography of each committee member is attached as Appendix A.

Todd Miller, (Committee Chair), Executive Director and founder, North Carolina Coastal Federation; Chair, Albemarle-Pamlico Estuary Partnership Policy Committee; Board of Visitors, UNC Institute for the Environment; Recipient of the Environmental Law Institute's National Wetlands Community Leader Award; Recognized as a Distinguished Alumnus of UNC Chapel Hill

Tim Dillingham, Executive Director, American Littoral Society; Advisory Committee, Barnegat Bay Partnership; Science and Technical Committee, Barnegat Bay Partnership

Niki Pace, Senior Research Counsel and Adjunct Professor, Mississippi-Alabama Sea Grant Legal at The University of Mississippi School of Law; Chair, Marine Resources Committee, American Bar Association Section of Environment, Energy, and Resources

Thomas Ries, Executive Vice President/Principal Scientist, Scheda Ecological Associates (Tampa, FL); more than 30 years of experience implementing ecological restoration projects inclusive of demo living shoreline projects; Recipient of 2013 National Wetlands Award for Conservation and Restoration from the Environmental Law Institute

Bill Cary, Attorney, Brooks Pierce, Greensboro, NC; Former General Counsel of the NC Department of Environment and Natural Resources

The committee wishes to express its appreciation for the invaluable support and assistance provided by Suzanne Giles Simon, Strategic Program Manager, and Jeff Benoit, President, RAE. The committee is particularly grateful for the time and wisdom contributed by Bill Ross (former Secretary, NC Department of Environment and Natural Resources and Visiting Scholar, Duke University).

COMMITTEE CHARGE

RESTORE AMERICA'S ESTUARIES WILL CONVENE A SMALL TEAM OF EXPERTS IN LIVING SHORELINES POLICY AND MANAGEMENT TO ACT AS ADVISORS AND AUTHORS. THIS TEAM WILL MEET AT LEAST SIX TO SEVEN TIMES, MOSTLY BY PHONE, BUT AT LEAST ONCE IN PERSON. THE TEAM WILL SHAPE THE OUTLINE FOR THE REPORT, IDENTIFY KEY INTERVIEWS, CONDUCT ONE OR MORE SITE VISITS TO DOCUMENT PROBLEMS AND SOLUTIONS, THEN WILL WORK TOGETHER TO DRAFT FINDINGS AND RECOMMENDATIONS. THE TEAM WILL SEEK INPUT FROM OTHERS AT KEY STAGES IN THE PROCESS, ESPECIALLY BY KEY AGENCY REPRESENTATIVES AND OTHER CRITICAL THINKERS.

THE TEAM WILL SELECT THREE TO FOUR SPECIFIC GAPS/OBSTACLES IN THE PRACTICE AND REGULATION OF LIVING SHORELINES THAT HAVE ALREADY BEEN IDENTIFIED THROUGH OTHER FORUMS, AND DEVELOP ACTIONABLE STRATEGIES FOR HOW TO BEST RESOLVE THOSE DEFICIENCIES.

THE FIRST PUBLIC DRAFT WOULD BE PRESENTED FOR DISCUSSION AT THE RAE/TCS NATIONAL SUMMIT. AFTER INPUT AND COMMENT AT THE SUMMIT, THE PAPER WILL BE FINALIZED AND DISTRIBUTED ELECTRONICALLY.

B. PROCESS

The committee exchanged their initial individual observations regarding institutional barriers and opportunities for living shorelines in advance of a one-day retreat, which was hosted at the NC Coastal Federation offices in Wrightsville Beach, NC on June 10, 2014. At that retreat, the team began formulating the Barriers and Strategies discussed in this report. Through a series of teleconferences, the committee pursued fuller development of these report elements, with each member taking a lead on an element and coordinating the development of input and conclusions. The team sought input from others at key stages in the process, especially by key agency representatives and other critical leaders, researchers, and practitioners.

The first public draft was presented for discussion during a dedicated session at the RAE/TCS National Summit on November 3, 2014. After input at the Summit and after a 30-day comment period the paper was finalized and distributed electronically.

IV. BACKGROUND AND CONTEXT

A. IMPORTANCE OF ESTUARIES AND ECOSYSTEM SERVICES

Natural shoreline systems that surround our coastal rivers, creeks, bays, and sounds are among the most productive places in the world for fish and wildlife. They can also be valuable in a real estate and development context. Many estuarine shorelines experience gradual long-term erosion as a result of everyday winds, waves, and sea-level rise, but can also change dramatically in response to storm surges during hurricanes and other strong storms. In addition, natural shoreline systems are subject to man-made alterations such as dredging, placement of fill, and construction of a variety of structures (piers, groins, seawalls, etc.). All of these changes can affect existing living marine systems and processes, collectively known as ecosystem services.

In addition to the economic value of waterfront property for private or commercial uses, shorelines provide a broad array of ecosystem services. Regardless of the shoreline type and setting, shoreline ecosystem services include: terrestrial and aquatic habitat for a wide variety of flora and fauna, nutrient uptake and carbon sequestration, sediment transport and stabilization, wave attenuation, recreation, and the maintenance of biodiversity. One of the critical issues to consider when selecting a shoreline management system is the potential impact on the associated ecosystem services being provided in the affected area. Each time a shoreline is altered by the placement of a shoreline management system, ecosystem services will be impacted – degraded, lost, or possibly enhanced. The trade-off of ecosystem services, such as marsh grass replacing a mudflat, should be considered and evaluated for any proposed shoreline management system. The 2007 report by the National Research Council of the National Academies (NRC) contains a thorough discussion of ecosystem trade-offs and a description of the services provided by each coastal type, see "NRC 2007 Report."[1] Where the project impacts essential fish habitat, regulators already take steps to avoid and minimize the impacted habitat.[2] However, not all projects involve essential fish habitat or other protected habitat.[3] In those cases, the habitat trade-offs should still be taken into consideration. The Tampa Bay Estuary Program has produced a number of exemplary planning

studies over the years to assist in setting priorities for habitat protection and restoration that can be used in part to help evaluate ecosystem trade-offs. The most recent study is the Tampa Bay Estuary Program Habitat Master Plan Update[4], which was completed in 2010.

Salt marshes, mangroves, and seagrasses are also significant carbon sinks, and their destruction releases significant amounts of carbon into the atmosphere. Globally, estimates suggest that 0.15-1.02 Pg (billion tons) of carbon dioxide is being released annually due to destruction or degradation of coastal habitat.[5] Living shorelines provide another way to enhance and restore these valuable habitats, thereby helping to mitigate the effects of climate change via carbon sequestration.

Estuarine ecosystems are particularly vulnerable to the effects of development and shoreline hardening. The management challenge for environmental agencies charged with protecting the health of our estuaries is to find ways to allow property owners to protect their real estate while at the same time minimizing long-term environmental damage to fish, wildlife, and the systems that support them.

B. SHORELINE TYPES

Selection of a shoreline management system is also dependent on the type of shoreline that is sought to be managed. In the NRC 2007 Report[6], the authors grouped shoreline types into three geomorphic categories: beaches and dunes; bluffs; and mudflats and vegetated communities. In 2006, the NC Division of Coastal Management (NC DCM) and a group of expert stakeholders identified eleven different types of estuarine shorelines,[7] the first nine of which are for the most part subsets of the NRC Report's third category (mudflats and vegetated communities): 1) swamp forest; 2) marsh; 3) marsh with oysters; 4) marsh with mud flats; 5) low sediment bank with marsh; 6) low sediment bank with swamp forest; 7) low sediment bank with oysters and submerged aquatic vegetation (SAV); 8) low sediment bank with woody debris; 9) low sediment bank with sand; 10) high sediment bank; and 11) overwash barrier and inlet areas. With the addition of mangroves, the committee believes this is a relatively complete list of the types of shorelines that are being managed for erosion throughout the country.

In addition to shoreline type, another significant factor in evaluating shoreline management options is the extent to which it is sheltered or exposed to significant wind and wave energy. Differences in orientation and fetch between otherwise similar shorelines can require significant differences in appropriate management techniques. Finally, an understanding of the off-shore bathymetry, benthic makeup, and the sediment transport forces at work at a particular site also has significant importance in selection and design of an appropriate management system.

C. TYPES OF SHORELINE MANAGEMENT SYSTEMS

Natural shorelines provide a variety of important ecosystem services, contributing to the health and aesthetics of the entire estuarine system. If those shorelines are considered degraded or threatened by erosion or recurring storm and/or flood events, the first reaction is often a desire to "manage" the shoreline, primarily for the purpose of protecting the adjacent upland property. In some cases, homeowners may simply want to make use of their entire shorefront property as lawn area, improving views, or improving navigational access. Regardless of the reason, there are many options available for landowners to consider, all having varying degrees of impact relative to the natural system. One management option the committee considers the preferred option for many shorelines, is to leave it in its natural state (no action), and may include moving threatened buildings landward (retreat). However, if some other alternative is perceived as necessary or desirable, a variety of options are available. In this report, the discussion of "shoreline management systems" refers to these other options for stabilizing or managing a shoreline, once a "no action" option is deemed not feasible.

Hundreds of miles of shoreline are stabilized each year throughout the U.S. by owners of estuarine waterfronts trying to prevent their property from washing away. Historically, the preferred response to erosion has been to "harden" the shoreline for most types of estuarine shorelines, using bulkheads, revetments, and similar engineered structures that typically form a fixed delineation or barrier in the water/land continuum that

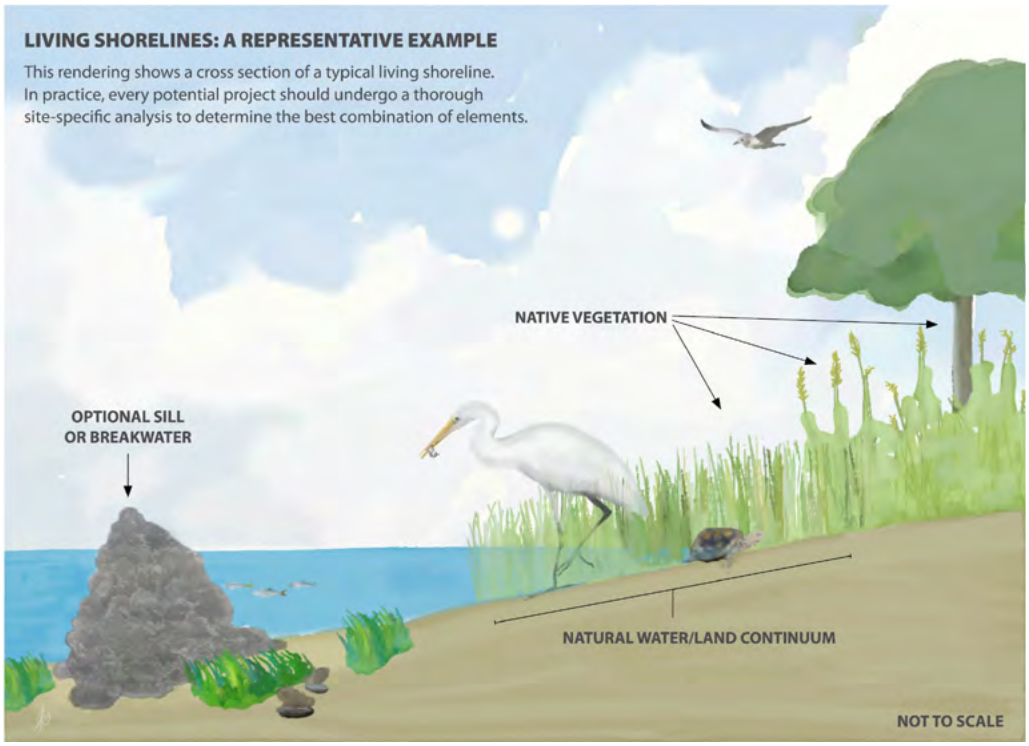
would otherwise be the natural, shifting shoreline. These systems, to the layperson's eye, appear to provide solid, enduring protection. Their impacts on the surrounding ecosystems—positive or negative—are not self-evident. Researchers from UNC-Chapel Hill and NOAA recently found that nearly 12,500 miles, approximately 14 percent, of U.S. shoreline have been hardened, 66 percent of which is along the south-Atlantic and Gulf coasts.[8] The report points out that these coasts contain most of the U.S. salt marshes and are also most vulnerable to sea-level rise, storm events, and future development, as per an analysis on the physical characteristics of the shoreline, storm frequency, and current population growth rates. The UNC report is the first analysis to quantify the total amount of hardened shoreline in the U.S. and to determine the vulnerability of salt marsh to future coastal development and sea-level rise.

An alternative to hardened shoreline management structures is the use of natural or "soft" systems, sometimes in combination with manmade, engineered elements designed to reintroduce natural systems that will provide land protection functions and reduce adverse impacts to terrestrial and aquatic ecosystems. These softer systems include, for example, a gamut of options ranging from replanting fringe marshes to refilling and planting a depleted marsh together with construction of a protective sill (typically made of rock, shell, or wood) to absorb wave energy. Many of these approaches leave intact the natural, shifting character of the natural water/land interface.

Collectively, these shoreline management systems are often referred to as "living shorelines." The committee recognizes that there is no uniform definition of a living shoreline. For example, in the State of Washington, the term "soft shoreline stabilization" is used as guidance to implement the 1972 Shoreline Management Act[9]. Some assert that introducing any engineered structure that includes manmade elements is not a "true" living shoreline.

Others feel that any shoreline management that is not exclusively dependent on hardening and instead attempts to reintroduce otherwise lost ecosystem services is a living shoreline. The committee has selected an approach that allows for the use of manmade elements that are designed to protect the natural functions of a living shoreline as well as the high ground real estate itself. A management system that breaks the water/land continuum is not considered a living shoreline by the committee. This choice is based on the belief that any manmade break in the water/land continuum will eventually become a de facto hardened structure functioning essentially like a bulkhead or revetment. **Therefore, this report's definition of a living shoreline is:**

ANY SHORELINE MANAGEMENT SYSTEM THAT IS DESIGNED TO PROTECT OR RESTORE NATURAL SHORELINE ECOSYSTEMS THROUGH THE USE OF NATURAL ELEMENTS AND, IF APPROPRIATE, MANMADE ELEMENTS. ANY ELEMENTS USED MUST NOT INTERRUPT THE NATURAL WATER/LAND CONTINUUM TO THE DETRIMENT OF NATURAL SHORELINE ECOSYSTEMS.



There is a broad array of shoreline management strategies for estuaries. There are generally eight different types of shoreline management methods recognized. The NC DCM report, p. 5-1,[10] summarized these methods in Table 1.11.[11]

STRUCTURE TYPE	ALIASES	TYPICAL CONSTRUCTION MATERIALS	CHARACTERISTICS	EROSION CONTROL PURPOSES
Land Planning			Live with/plan around existing conditions	Leave the land in its natural state.
Vegetation Control	Wetland or Upland Plantings	Wetland or Upland Vegetation	Planting, replanting, or conserving existing vegetation	Create buffer to dissipate wave energy.
Beach Fill	Beach Nourishment	Sediment/sand similar to the native beach	Placing sand on shoreline	Acts as a sacrificial erosive barrier.
Sills	Marsh Sill, Wooden Breakwater, Wave Board	Timber, rock, concrete pieces, vinyl	Parallel and close to shore, low elevation associated with wetland vegetation	Reduces wave energy on the shoreline. Traps sediment landward to rebuild/protect wetlands.
Groins	Jetties	Timber, rock, concrete, vinyl	Perpendicular to shore	Trap sand on the updrift side to build out the upland.
Breakwaters	Wave Attenuator	Timber, rock, concrete	Shore parallel, larger and further offshore than sills	Reduces wave energy on the shoreline. Trap sand between the shore and breakwater.
Sloped Structures	Riprap, Revetment, Sloped Seawall	Concrete, rock	Watertight or porous, sloped against a bank	Protect land from erosion and absorb wave energy without reflecting waves.
Vertical Structures	Bulkhead, Seawall, Gravity Wall	Timber, steel, rock, concrete	Watertight, vertical, parallel to shore	Hold back land.

Table 1. Shoreline management methods.

A particularly useful discussion of shoreline management systems is also presented in the 2012 report, Restore-Adapt-Mitigate: Responding to Climate Change through Coastal Habitat Restoration.[12] A separate document, *Natural and Structural Measures for Shoreline Stabilization*,[13] also presents a continuum of techniques.

D. SELECTION OF APPROPRIATE SHORELINE MANAGEMENT SYSTEM

Selection of the most appropriate management system begins with a site analysis to evaluate the type of shoreline, the amount of energy that a particular shoreline experiences, the sediment transport forces at work, the type and location of ecological resources, and the nature of adjacent land uses. Selecting and designing the most appropriate shoreline management system and elements must consider these factors as well as how each possible management option will be impacted by them, and how each option will itself impact the site's ecosystem.[14] Recent research has demonstrated, for example, that "over-designing" a living shoreline system can actually damage the existing natural elements (e.g., by limiting flow against the shore to the point that temperature in the marsh is increased and dissolved oxygen is decreased).[15] Similarly, placing a living shoreline in a high energy environment without proper sheltering elements can lead to a complete failure of the system.[16] Long-term success requires monitoring and maintenance. This is true for all types of shoreline stabilization including traditional bulkheads as well as living shorelines.

The NC DCM 2006 report referenced earlier[17] recommends specific stabilization techniques for each shoreline type studied. The committee reviewed these recommendations, and believes they provide a good

framework for evaluating what type of shoreline stabilization is most appropriate for various shoreline types throughout the nation, and thus demonstrates the inherent complexity in utilizing living shorelines. Table 2,[18] based on the NC DCM report, ranks appropriate shoreline stabilization methods.

	SWAMP FOREST	MARSH	MARSH WITH OYSTERS	MARSH WITH MUDFLATS	LOW SEDIMENT BANK WITH MARSH	LOW SEDIMENT BANK WITH SWAMP FOREST	LOW SEDIMENT BANK WITH SAND	LOW SEDIMENT BANK WITH WOODY DEBRIS	LOW SEDIMENT BANK WITH OYSTERS/ SAV	HIGH SEDIMENT BANK	OVERWASH BARRIER/ INLET AREAS
Land Planning	1	1	1	1	1	1	1	1	1	1	1
Vegetation Control	2	2	2	2	2	2	3	2	2	3	2
Beach Fill	3	3	NR	NR	NR	NR	2	NR	NR	2	2
Sills	4	4	3	3	3	3	5	3	3	5	4
Groins	5	5	4	4	4	4	4	NR	NR	4	3
Breakwaters	6	6	NR	NR	4	4	6	NR	NR	6	5
Sloped Structures	4-toe only NR-other	4-toe only NR-other	3-toe only NR-other	3-toe only NR-other	3-toe only 4-other	3-toe only 4-other	7	4	4	7	6
Vertical Structures	NR	NR	NR	NR	4	4	8	5	5	8	7

Table 2. Ranking of shoreline stabilization methods by habitat type. Least potential adverse impact to the existing system is lowest ranking (1). Option with the greatest potential adverse impact ranks highest (8). NR indicates not recommended.

In the lower latitudes (below 32°), mangrove trees are effective plants to help stabilize the banks while still providing habitat for a diverse array of species,

including birds, mammals, crustaceans, and fish. In addition, they preserve water quality and reduce pollution by filtering suspended material and assimilating dissolved nutrients. Mangrove trees are the foundation of a complex marine food chain.

Another approach is the "Decision Tree for Undefended Shorelines and Those with Failed Structures," discussed below in the "Trends in Shoreline Management" section. The committee likewise concluded that this approach is useful, especially for newcomers to living shorelines in these locales.

E. IMPACT OF SHORELINE MANAGEMENT SYSTEM ON ESTUARINE SYSTEM

Scientific and engineering research[19] and monitoring comparing hardened structures with living shorelines over time demonstrates these important but not widely known consequences flowing from the choice of shoreline management systems:

- Living shorelines are often more effective over time in preventing erosion caused by everyday weather, boat waves, and long-term sea-level rise than hardened structures.
- Living shorelines are often more effective in preventing catastrophic storm damage than hardened structures.
- Hardened structures usually have significant adverse effects on the adjacent aquatic and terrestrial ecosystems and the ecosystems services they supply. Living shorelines avoid many of these adverse effects.
- While living systems over time can grow stronger through natural processes, hardened structures often deteriorate and may, if not maintained, ultimately fail.

Research supporting these conclusions has been presented at numerous scientific forums and in scientific papers as well as agency monitoring reports. In addition, many of the committee's members have extensive hands-on experiences and knowledge regarding estuarine shoreline stabilization practices, including directly installing projects themselves. Over the past decade, they have reviewed a wide array of shoreline management projects and studies, participated in dozens of agency and scientific monitoring efforts, and attended numerous conferences, workshops, workgroups, and agency briefings that have examined the effects of various shoreline management alternatives.

KEY FINDING 1: The committee has concluded that living shorelines are the best shoreline management alternative for both the environment and property owners when they are used in the right locations, designed correctly, constructed properly, and maintained appropriately.

The committee believes that for the vast majority of shorelines, there is now a very strong and compelling scientific and engineering case for using living shorelines instead of bulkheads or other hardened methods of stabilization. Only the minimum necessary hardening should be allowed and should be considered the exception rather than the norm.

F. POTENTIAL IMPACT OF SEA-LEVEL RISE

Sea level is rising and will continue to do so in the next century.[20] As it does, the natural shoreline will be reconfigured and new erosion threats will emerge. The response to these threats will have a significant impact on the health of estuaries. Allowing marshes to migrate will not only protect the remaining land but will help ensure the health of the shifting estuarine ecosystem. Attempting to stabilize the existing shoreline configuration through hardening will only delay the inevitable and will also significantly degrade the aquatic and adjacent terrestrial habitats in the interim. The Corps has promulgated Regulation No. 1100-2-8162, December 31, 2013, "Incorporating Sea-Level Change In Civil Works Programs," to incorporate "the direct and indirect physical effects of projected sea-level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining Corps projects and systems of projects."[21]

Recent research indicates that sea-level rise threatens not only high-value property but, in certain areas, particularly vulnerable populations, such as the poor and elderly.[22] That research mapped areas of the U.S. where natural coastal systems currently defend property and

people and where simply maintaining existing natural systems can be effective in combating sea-level rise: "The number of people, poor families, elderly, and total value of residential property that are most exposed to hazards can be reduced by half if existing coastal habitats remain fully intact." Id.

The President's Climate Action Plan[23] calls for federal and local agencies to make "climate-resilient investments"[24] and "improve our natural defenses against extreme weather, protect biodiversity and conserve natural resources in the face of a changing climate, and manage our public lands and natural systems to store more carbon."[25] Living shorelines address and advance realization of all of these goals.

G. ECONOMICS OF SHORELINE MANAGEMENT SYSTEMS

Hardened structures typically have well-defined immediate cost parameters that are readily understood. What is less recognized is the hidden cost to the landowner due to the gradual failure of such a system over time. These failures result not only in replacement expense, but frequently the loss of significant land, such as when a bulkhead collapses. The economic impact of ecosystem degradation is recognized in principle but, to the committee's knowledge, has not yet been quantified and documented. For example, while one bulkhead on one small lot may have a de minimis impact on the adjacent estuary, significant hardening of the entire estuary, as is now occurring in some locales, has a demonstrable impact on the health of that system[26] such that commercial and recreational fisheries will be impacted.[27] These economics are currently ignored.

Living shoreline costs and values are more complex. Because of the wide array of living shoreline types, it is not practical to attempt to calculate a "standard" linear foot cost of living shoreline technique for comparison to bulkhead or revetment costs. Nevertheless, efforts to estimate these costs have been made (Table 3).

NONSTRUCTURAL (PLANTING GRADING/FILL)	HYBRID (MARSH + SILL)	BREAKWATERS (OFFSHORE)	STRUCTURAL (REVETMENT)	LOCATION	DATE
$100-200	$250-$400	$450-$600	$500–$1,200	Maryland	circa 2014
$100-225	$250-$700	$450-$1,000	$500-$1,500	Delaware Estuary	circa 2012
$45+	$120-$395	$125-$200	$115-$285 (low energy)	Northern Gulf of Mexico	circa 2008
$50 - $100	$150-$300	$350-$500	$500-$1,000	Maryland	2007
$45+	$100+	$150-$250	$115-$1,200	Florida	2008

Table 3. Cost Estimates for Shoreline Management Approaches (average cost per linear foot).[28]

KEY FINDING 2: Living shorelines contribute a variety of public values beyond those enjoyed exclusively by the landowner implementing such a project.

Of greater long-term significance is the value of living shorelines. It is widely recognized, although difficult to quantify with precision, that aesthetics greatly affect property values and hence the tax base. Just as a suburban lot with mature trees is more valuable than one without, so a waterfront lot with natural wetlands and shorelines may be more aesthetically pleasing and hence potentially more valuable. This is a value of direct benefit to the property owner and, indirectly, to the property taxing authority, as well as to nearby property owners and recreational users.

Other values generated by healthy estuaries do not directly benefit the owner but are nevertheless significant in making management decisions. The value of healthy fisheries is significant to recreational and commercial fishers and the consuming public. Habitat protection and restoration improves the recreational value of the system to the public. Trapping and preserving carbon in healthy wetlands benefits the public as well by mitigating effects of climate change.

KEY FINDING 3: Use of living shorelines by public and private landowners offers a potential significant economic value to achieving local and regional regulatory objectives and/or requirements for protecting and restoring water quality.

Another value to the broader public is the potential for protection of water quality. Erosion is a part of natural shoreline ecosystem processes, but it can also be one of the greatest sources of fine sediment and turbidity in a watershed. Living shorelines represent a water quality best management practice that reduces sediment and nutrient pollution loads while preserving and/or enhancing ecosystem services, inclusive of adjacent seagrass beds.[29]

The Chesapeake Bay Program's Expert Panel on Shoreline Management (Panel) has completed an extensive review of recent and relevant shoreline management practice research on the ability of wetlands to reduce sediment and nutrient pollution.[30] In their effort to reduce the total maximum daily load (TMDL)[31] of sediments and nutrients into the Chesapeake Bay, the Panel looked at the role of wetlands in:

- Preventing erosion and associated near-shore sedimentation, which results in nutrient and sediment loading reductions;
- Denitrification via the vegetative removal of nitrogen;
- Removing sediment from the water column and trapping it through accretion, which results in sediment and nutrient reductions; and
- Vegetative uptake of nutrients utilizing above and below ground nutrient cycles (Marsh Redfield Ratio).

The Panel has developed a series of protocols for calculating the nutrient and sediment reductions resulting from the use of living shorelines in shoreline management strategies. Based on their work, the Panel found that using wetlands in a living shoreline erosion control design provided significant reductions of both sediment and nutrients and resulted in a cost-effective water quality enhancement.

H. REGULATORY OVERVIEW

Permitting any activity in coastal waters will require permits from federal agencies, state agencies, and in some cases local governments as well. There is wide variation in permitting practices across the U.S. Because this report is a national review, the committee has placed greater emphasis on the federal regulatory system. However, a general discussion of state regulatory authority is included, along with local government examples as well. In addition, the ability of state agencies to condition or veto federally-administered permits using authorities granted to them by CZMA and CWA are examined.

KEY FINDING 4: The differing approaches to permitting of shoreline management techniques have led to confusion, inconsistency, and unpredictability, particularly among permittees.

1. FEDERAL

Most activities in waters of the U.S.[32] will require a permit from the Corps, which is responsible for issuing

permits pursuant to the Rivers and Harbors Act of 1899 and the Federal Water Pollution Control Act of 1972 ("Clean Water Act" or "CWA"). Although the Corps and U.S. Environmental Protection Agency (EPA) share certain administrative responsibilities under the CWA, the Corps is the lead permitting entity for activities taking place in wetlands (§ 404 permits) while the EPA oversees water quality permitting under other provisions of the CWA. The EPA does hold veto authority over Corps issued § 404 permits but this authority has been rarely used.

In general,[33] the Corps regulates the deposition of "dredge or fill" material into navigable waters and the excavation of material from the bottom of such waters by requiring a permit. There are two types of permits[34]: General Permits and Individual Permits. General Permits may be either NWPs or Regional General Permits (RGP), and generally allow a project which meets certain defined criteria to proceed without an individualized assessment of the project, so long as certain notifications and assurances are provided (and, in some cases, Corps confirmation that work may proceed). An Individual Permit, which is necessary if the applicant does not qualify for a General Permit, requires a more lengthy application process that includes a particularized assessment of the project and the opportunity for public notice and comment.

Of particular significance to shoreline management is NWP 13, for "Bank Stabilization" activities to prevent erosion. If the project is less than 500 linear feet and uses less than one cubic meter of fill per running foot, the applicant may proceed without notifying the Corps (unless the project is in a wetland or special aquatic site). This is the authorization for many bulkhead and other hardened projects. Another important General Permit for shoreline restoration is NWP 27, for Stream and Wetland Restoration Activities. Use of this NWP requires much more Corps notification and oversight. It is frequently used as part of wetland mitigation projects and has been used to permit living shoreline installations in some jurisdictions.

Regional general permits are similar to NWPs but are designed for a specific geographic area. The type of activity allowed and conditions required for RGPs will depend on the district. RGPs can be used to permit localized projects with minimal environmental impacts that are not already allowed under an existing NWP. To that end, RGPs for living shoreline activities have been developed and issued for the AL and MS coasts by the Mobile District Office. In many instances, RGPs can ultimately become NWPs thus allowing these activities to be performed beyond the original specific geographic area.

In coastal states, NWPs are reviewed for consistency with state coastal programs through the CZMA. During the review, states may object to the use of certain NWPs in their jurisdiction. States may also place conditions on the use of NWPs within the state. These conditions afford states the opportunity to ensure that use of NWPs in their state waters meet the needs and objectives of the state's coastal management policy. In addition, states may also place water quality conditions on permitted activities based on their authority to implement the CWA within their states.[35]

2. STATE

State permitting provides another layer of oversight for shoreline stabilization projects. States regulate coastal activities through environmental permitting programs, which may include specific requirements for coastal activities and shoreline management. These programs may further condition reliance on Corps NWPs or RGPs, or may deny Section 401 water quality certification or CZMA consistency concurrence. Shoreline stabilization activities usually trigger state environmental permitting because of concerns to water quality and wetlands. Each state program is unique and requires familiarity with the regulations of that state. State policies can be narrower than federal policies, meaning that a project may qualify for a federal permit from the Corps but not satisfy the state permitting requirements. This scenario can cause confusion among permit applicants that do not realize both state and federal permits are necessary.

State environmental permitting may be issued separately from or in conjunction with Corps permitting. In some states, the state permitting agency and the Corps designate a particular entity to be the lead coordinating agency, as in Florida. Under this model, the applicant may submit one joint permit application

to the designated lead agency. This joint-permitting approach may alleviate some confusion among applicants mentioned previously. Though a joint application is used, both federal and state agencies will review the application. In other states, however, Corps and state permitting operate independently of each other, requiring separate permit applications and review for all activities.

Along with state environmental permitting requirements, activities taking place on state-owned submerged lands may require additional permissions. States generally own title to coastal water bottoms where shoreline stabilization projects are sited. State property boundaries are usually tied to a calculated tidal datum, often either the mean high water line or the mean low water line. Activities that place materials on the water bottoms, like living shorelines, may require approval by the state agency in charge of managing state lands. Terminology varies by state and permission may be called a lease, easement, or license depending on the locale. Some states, like CT, do not have separate regulatory programs for leasing submerged lands but, instead, incorporate this review into the state environmental permitting process.

3. LOCAL

Local government land-use authority provides a final level of review in many counties and municipalities. Local jurisdictions may adopt land use restrictions designed to protect the public health and safety, including environmental protections.[36] Coastal localities can use this authority to guide the type of shoreline management structures installed within their communities.

Using this authority, Kent County, MD adopted a shoreline policy that requires property owners considering installation of hardened shoreline armor to demonstrate that a living shoreline would be inappropriate for that site.[37] Similar measures have been adopted by Brevard County, FL[38] and Fairfax County, VA.[39] The Hawaiian counties of Honolulu and Kaua'i have also used local authority to protect natural shorelines.[40]

I. TRENDS IN SHORELINE MANAGEMENT

Separately, some states have developed tools to help landowners, designers, and constructors choose among the wide variety of shoreline management options in light of the known conditions at the project site even where living shorelines are not the regulatory preference. Many of the state agency websites[41] include materials designed to educate the public about shoreline management issues and living shorelines. An example of one such tool is the "Decision Tree for Undefended Shorelines and Those with Failed Structures" developed by the Center for Coastal Resources Management, Virginia Institute of Marine Science at William & Mary (VIMS).[42] This decision tree is driven by the principle of integrated shoreline management, based on the concept that all elements of the shoreline should be considered simultaneously when making a decision. Similarly, see the "Homeowners Guide to Permitting Living Shorelines in Mississippi and Alabama."[43] NGOs are likewise contributing to these efforts.[44]

As shoreline development has increased, the cumulative effect in some geographic areas reached proportions that resulted in a reassessment of the regulatory scheme enabling what many believed was a perilous course. Maryland is a prime example. In response to the artificial stabilization of 1,000 miles of the Chesapeake Bay's 7,000 mile coastline, MD passed the Maryland Living Shoreline Act of 2008, which enacted a statutory presumption in favor of living shorelines and mandates their use, unless they cannot adequately address the owner's legitimate needs.[45] In response, the design and contracting community has become knowledgeable in the elements and functions of living shoreline systems and can assist the owner in understanding different approaches to protecting property and the dependent ecosystems. Unfortunately, this regulatory change is being driven at the state level. In states that have not mandated a living shoreline preference, living shorelines are much less prevalent.

V. BARRIERS

A. SUMMARY

Despite their advantages, the use of living shorelines is still relatively rare except where the local or state regulatory regime places a compelling preference on their use. One research team summarized the array of barriers faced by living shoreline proponents in NC as follows: "The greatest barrier…is the lack of understanding by the public and policy makers in regard to potential adverse effects of bulkheads, existing policy frameworks, and public sentiment."[46]

The committee reviewed existing literature and reached out to a broad spectrum of individuals involved in shoreline management to identify the most significant barriers to a broader use of living shorelines and strategies for addressing these barriers. The committee has grouped these observations into three major institutional barriers, discussed separately below.

- Institutional Inertia

  Familiarity with traditional methods, lack of information about both the shortcomings of those methods and the relative advantages of living shorelines, and the inherent complexity of designing for a wide variety of shoreline types and conditions have locked the major shoreline management decision makers into a business-as-usual routine and impeded needed change in the regulatory system.

- Lack of a Broader Context for Shoreline Management Decisions

  Site-specific decision-making without consideration of system-wide impacts and/or benefits understates the negative cumulative effects of hardening, overlooks many of the greatest values of living shorelines (including mitigation of habitat loss), and imposes the entire shoreline management cost on the shoreline owner rather than spreading it across all of the constituencies benefited by a living shoreline installation.

- Lack of an Advocate

  The various constituencies that receive benefits in different ways by living shorelines do not

recognize their common interest and hence have not combined into an effective advocacy force.

In addition to these institutional barriers, there are a number of "tactical" problems facing the design, permitting, and installation of a living shoreline, such as the current complex and variable permit regimes. The committee does not minimize the significance of these problems by not identifying them as separate barriers but instead believes that effectively addressing the broad institutional barriers listed above will lead naturally to resolving many of these more tactical problems.

The committee discussed how best to address each barrier with a specific recommended strategy and concluded that the barriers and their possible solutions are interrelated and best addressed by strategies that simultaneously considers all of the major identified barriers. Therefore, the barriers stated below do not have separately recommended strategies. Rather, the recommended strategies discussed later will address each of the barriers, where relevant.

B. INSTITUTIONAL INERTIA

KEY FINDING 5: Waterfront property owners continue to use hardened shoreline protections because they are familiar with those methods, the methods are often easy to permit; and they lack information about both the shortcomings of those methods and the relative advantages of living shorelines.

The major participants involved in choosing among shoreline management alternatives can be grouped into two broad groups: 1) property owners, engineers, and installers/contractors who propose a shoreline management system; and 2) regulators who respond to, and ultimately decide on, the appropriateness of the proposal. The former group has largely become accustomed to the traditional way of addressing erosion/storm protection problems – hardening. "Bulkheads are well-liked by coastal property owners and their potential impacts are not well understood."[47] In addition to this group not understanding the adverse ecological impacts of hardening the shoreline, both groups are likely to not be aware of the recent research showing the greater long-term benefits offered by natural systems in preventing shoreline erosion and storm and/or flood damage.[48]

Lacking both information about the true efficacy of hardening (or, more accurately, the lack thereof) as well as the relative ecological advantages of softer alternatives, neither group has a perceived need to change course. Without a perceived need to change, there is an inherent bias against the adoption of new methods (e.g., living shorelines).

The VIMS hosted a wetland workshop in 2014 focused on living shorelines and asked participants to comment on challenges and solutions to living shoreline implementation. Many complained that shoreline hardening was preferred due to psychological inertia. That is, when a neighboring property has a hardened approach, such as a bulkhead or rip rap, the perception is that a similar treatment is needed.

Another significant contributing factor to the preference for hardening is the variability of shoreline types and conditions. Compared to hardened structures, the design and construction of living shorelines are more site specific and must take into account the local ecosystems and how they will impact and be impacted by the specific proposed stabilization methods. A one-size-fits-all solution is not appropriate, making the task of overcoming the hardened structure inertia all the more difficult.

The lack of designers and contractors experienced in living shoreline techniques further restricts the options available to many landowners and thus constitutes a substantial technological form of inertia. This problem is further exacerbated by the absence of recognized regional or national engineering standards for living shorelines.[49] While the Corps has published the Coastal Engineering Manual[50] for structural coastal erosion control projects, and ASCE7[51] provides design code for coastal buildings, there is no comparable standard or guidance for living shoreline constructed elements.[52] Design professionals and constructors, naturally concerned with functional success and liability potential where standards are disputed, tend to default to known and established methods (i.e., hardening). Finally, a contractor's lack of experience and the absence of accepted design and construction standards can artificially inflate the cost of living shorelines: new contractors understandably build in larger contingency fees when trying new, unfamiliar methods.

KEY FINDING 6: Except where states have responded to excessive hardening by advocating changes in permitting systems, the federal regulatory regime has perpetuated the status quo bias in favor of hardening shorelines.

In certain geographic regions, the regulatory system has the effect, regardless of the regulators' intent, of perpetuating a significant bias in favor of hardening and against living shorelines. For example, in the Corps' Norfolk, Baltimore, and Philadelphia Districts, the time needed to obtain a permit for a marsh sill (approximately 60 days) compares favorably with the time needed for a bulkhead permit (approximately 90 days).[53] However, in the Wilmington, NC District, where the time needed for a marsh sill is also approximately 60 days, a bulkhead permit, including both state and federal processes, can be obtained in only one or two days.

It is important to note that federal and state regulatory programs do not dictate to landowners that they should or must protect their property, or that a certain type of project must be proposed and implemented. The regulatory agencies are not allowed to favor certain projects over others, including different types of bank stabilization. These agencies must evaluate effects of proposed activities under existing statutory authorities. Any federal or state agency that administers the requirements of the federal CWA is responsible for ensuring that the best practical environmental alternative is selected that accomplishes the purposes of the proposed project.

C. LACK OF A BROADER CONTEXT FOR SHORELINE MANAGEMENT DECISIONS

KEY FINDING 7: The negative cumulative effects of hardening are underestimated by site-specific decision-making without considering system-wide impacts.

Erosion and storm risks are addressed and shoreline management decisions are made piecemeal, looking only at the property owner's particular site. Stabilization projects are designed, permitted, and constructed on an ad hoc basis without consideration of systemic influences and cumulative impacts of this and other erosion controls in existence and likely to be installed in the same estuarine system. "Although loss of small parcels of shoreline habitat from hardening may not have a large impact on the ecosystem, the cumulative impact of the loss of many small parcels will at some point alter the properties, composition, and values of the ecosystem. In addition, the economic, recreational, and aesthetic properties of the shoreline will be altered, with potential loss of public use, access, and scenic value."[54]

KEY FINDING 8: Many of the greatest values of living shorelines both to the owner and to the other constituencies utilizing or affected by the estuary are overlooked by site-specific decision-making without considering system-wide benefits.

Decision-making without consideration of the broader context also fails to consider the multiple values created by living shorelines and overlooks their systemic advantages, both to the landowner and to other users of the estuary. (See IV, G, above). System-wide planning is also a vehicle for living shorelines to provide mitigation for unavoidable habitat loss elsewhere in that system.

Living Shorelines Project at NC Aquarium at Pine Knoll Shores; ©Tracy Skrabal

KEY FINDING 9: Site-specific decision-making without consideration of system-wide values created by living shorelines impedes broader use of living shorelines by imposing the cost on the shoreline owner rather than spreading it across all of the constituencies benefited by a living shoreline installation.

Because the broader system values contributed by living shorelines are not widely recognized by the decision-makers, the cost of shoreline management is not shared

with those constituencies directly benefitting from the use of living shorelines. As long as there remains a disconnect between these values, the constituencies being benefited, and the cost being imposed on the individual landowner managing his/her small piece of the shoreline, a significant obstacle will remain to the broader use of living shorelines and the healthier ecosystems they support.

KEY FINDING 10: The existing regulatory schemes fail to adequately consider the system-wide impacts and benefits of shoreline management decisions, perpetuating a bias in favor of hardening.

The existing piecemeal approach to shoreline management is exacerbated by the regulatory system in place. "The current permitting system fosters a reactive response to the problem of erosion on sheltered coasts. Decision-making is usually parcel-by-parcel … with inadequate attention to the cumulative effect of individual decisions."[55]

The Corps is responsible for considering the cumulative and secondary effects of those activities it regulates[56], including other effects in a watershed's or region's aquatic environment.[57] Regulatory agencies have to respond to proposals from project proponents. The Corps and other regulatory agencies should welcome discussions of how information can be shared with these groups to foster their consideration of living shoreline options, especially through non-regulatory estuary-based planning processes that help to identify best practices before permit applications are submitted.

KEY FINDING 11: System-wide planning tools are necessary for the proper evaluation of individual shoreline management decisions.

The impact of climate change further highlights the importance of appreciating a broader context. One of the key findings of the 2012 National Climate Assessment's Report was: "Although adaptation planning activities in the coastal zone are increasing, they generally occur in an ad hoc manner and at varied spatial scales dictated by on-the-ground needs and adaption drivers in the particular area. Efficiency of adaptation can be improved through integration into overall land-use planning and ocean and coastal management."[58] Unanswered by that report is how to effectively integrate land-use planning and ocean and coastal management.

New tools will be necessary to implement broader context planning. As mentioned earlier, many states are developing tools to help landowners, designers, and constructors make better decisions about what techniques are appropriate for a particular site's characteristics. Similar tools that address not only a site's immediate and nearby characteristics but also consider system-wide functions are necessary to further broaden the planning vision. For example, the Comprehensive Coastal Resource Management Portal[59] developed by the VIMS provides links to guidance, data, and area planning tools at the local level for Tidewater localities.

D. LACK OF AN ADVOCATE

KEY FINDING 12: The various constituencies benefited in different ways by living shorelines do not recognize their common interest and hence have not combined into an effective advocacy force.

Change does not occur because it should. Newton's first law of motion applies equally to complex social and economic systems: "Every body persists in its state of being…except insofar as it is compelled to change its state by force impressed."[60] The forces of change likewise do not coalesce spontaneously when the need arises. Individuals, whether motivated by self-interest or a sense of higher duty, rarely effect change individually. A community of effort bound together by common interests is usually necessary.

Currently, there is no well-defined living shoreline community. This is because, in large part, the community of interest that in fact exists is not recognized. The appropriate use of living shorelines will benefit not only the specific property owner installing the system (a fact many owners are not aware of) but also the entire estuary-dependent community in a variety of ways, many of which are likewise not widely recognized outside the scientific community. There has been little or no public recognition of these common interests and hence no coalescence of a living shoreline advocacy community.

VI. RECOMMENDED STRATEGIES

A. SUMMARY

The institutional barriers to living shorelines are themselves inter-related, and so overcoming them naturally calls for strategies and tools that recognize and address these commonalities. The committee concluded that the tools best suited for addressing the identified barriers are naturally organized into four broad strategies, discussed in more detail in the following sections.

STRATEGY 1: EDUCATION AND OUTREACH

The first step necessary to affecting all of the other strategies recommended in this report is the development of a broad and common understanding of the efficacy, impacts, and benefits of living shorelines as well as hardened structures. Collecting reliable information, making it generally available, and providing education and training to the various constituencies affected by shoreline management decisions is necessary to overcome each of the identified barriers and promoting the wider use of living shorelines.

STRATEGY 2: REGULATORY REFORM

Regulatory reform, particularly at the federal level, is necessary so that all shoreline management permitting is subject to the same, hierarchical evaluation criteria, and should include abandonment of traditional "cookie cutter" solutions (e.g., NWPs) that do not adequately consider the factors required by the CWA. The new permitting program should coordinate federal, state, and local regulations, should evaluate project impacts beyond the project site (i.e., system-wide), and should include living shoreline incentives reflective of the system-wide values created. Such a permitting system would deliver more consistent and predictable outcomes.

STRATEGY 3: IMPROVE INSTITUTIONAL CAPACITY

To successfully implement comprehensive regulatory reform and wider use of living shorelines, the capacity of the major constituencies must be improved and expanded. The current availability of designers, constructors, and regulators sufficiently knowledgeable of

living shoreline techniques is not adequate and must be increased, primarily through specialized training.

STRATEGY 4: PUBLIC AGENCIES AS ROLE MODELS – LEAD BY EXAMPLE

Public lands at all level of government are ideal candidates for living shoreline demonstration projects which would raise awareness and acceptance of these techniques. Agency leadership would also be valuable in broadening planning perspectives and working across jurisdictions to collaboratively achieve meaningful regulatory reform.

Living Shorelines Project at the Edenhouse Boat Ramp, Edenton, NC; ©Tracy Skrabal

B. STRATEGY 1: EDUCATION AND OUTREACH

There is a significant gap between the established science of living shorelines and the public and regulatory perception of the efficacy and environmental impact of shoreline management systems–both hardened systems and living shorelines. A better and broader understanding of living shorelines, including their functions, benefits, and design elements, is critical to overcoming each of the barriers identified above. A successful education and outreach strategy would address the following aspects:

- Institutional inertia is rooted in outdated and largely erroneous assumptions about the functionality and impact of hardened structures. Education is the first, necessary step in changing course.
- Generally, erosion control planning is rooted in a lack of information about the true broader context and the impact of shoreline processes and management within the entire estuary. Planners, designers, owners, contractors, and regulators need a broader context to make well informed decisions.
- Effective advocacy for living shorelines requires informed constituencies.

An effective education campaign is also a critical element in each of the other recommended strategies discussed below:

- Regulatory reform must start with a better understanding of the true environmental impact of hardened structures and the relative benefits of living shorelines.
- Increasing institutional capacity requires educating each affected institution.
- Government leadership through example requires a comprehensive understanding of the issues and opportunities so that the use of limited public resources can be targeted to advance the overall planning goals.

1. Targets for Education and Outreach

The following constituencies could all benefit from a better understanding of the function and benefits of living shorelines and additional education about hardened shorelines, including their lack of efficacy and adverse impact on ecosystem services:

- General public, especially shoreline owners and recreational users of estuarine systems;
- Congressional leadership;
- Regulatory agency leadership;
- Regulatory agency permit staff;
- State and local water quality agencies;
- Designers, landscape architects and consultants;

- Marine contractors and their suppliers, including those that provide stone, wetland plants, and constructed elements such as domes and coir logs;
- Scientific community;
- Commercial and recreational fishing interests;
- Real estate interests, including agents and developers;
- State and federal wildlife agencies pursuing ecosystem-wide habitat protection and resilience; and
- Educational institutions at all levels that benefit from outdoor research and educational opportunities.

2. Subject Matter

FINDING S-1.1: A major impediment to effective education about living shorelines is the lack of an authoritative repository of information about the science and technology of shoreline management techniques.

RECOMMENDATION S-1.1.1: The committee supports the establishment of a centralized, reliable (i.e., peer reviewed) database collecting scientific research on the design, construction, efficacy, and impact of various shoreline management systems, as well as a directory of living shoreline sites and "qualified" designers and contractors [see Improving Institutional Capacity].

RECOMMENDATION S-1.1.2: The committee supports the development of a national level "manual" of living shoreline practices, including such elements as a decision guide for evaluating potential project sites, selecting and designing an appropriate management system, constructing the system, and monitoring and maintaining the system, as well as guidelines for where living shorelines are not appropriate. Such a manual should develop and eventually formalize guidance that can serve as an engineering standards reference for design and construction professionals.

Each of these constituencies has particular educational needs. For example, the marine contractor industry needs to understand ways in which living shorelines can be installed profitably and in a manner consistent with the regulatory environment. Regulators need more robust, current research information about the adverse cumulative impacts of currently-permitted hardened structures along with more detailed information on living shoreline success stories. The scientific community needs to publicize more broadly the emerging findings supporting the broader use of living shorelines. The public needs a better understanding of the efficacy and impacts of all systems, hard and soft. The following subjects apply to some or many of the identified constituencies:

- Long-term efficacy of hardened structures as shoreline management systems, especially with respect to severe storm events;
- Long-term changes to and degradation of aquatic systems caused by hardened structures;
- Ecosystem services and benefits of living shorelines for landowners and the environment;
- Erosion control and storm and flood protection benefits of living shorelines;
- Living shoreline types and appropriate selection;
- Factors affecting living shoreline design;
- Cost factors, including design and construction, maintenance, and replacement, especially comparing hardened and living systems over time;
- Cost incentives;
- Socioeconomic benefits created by living shorelines (e.g., aesthetic, ecological, water quality);
- Environmental interdependency of wetlands and their adjacent riparian buffers;
- Information on maintenance costs and requirements, including invasive species control and eradication, and expectations of wetland changes over time with maturation;

- Effect of projected sea-level rise on wetlands, especially for those with structures that would limit or slow landward migration;
- Directory of qualified contractors and design professionals;
- Directory of demonstration sites;
- Other regulatory programs impacted by living shorelines, such as those related to flood prevention, erosion control, and water quality;
- Transitioning living shorelines to adjacent hardened structures; and
- Replacing dilapidated and/or failing structures with living shorelines.

3. Education and Outreach Methods

FINDING S-1.2: No entity (i.e., agency, NGO, etc.) currently exists at the national level to implement the education and outreach recommendations made above (development of database, directories, and manual) or to construct and deliver a broad education program targeting shoreline management issues.

RECOMMENDATION S-1.2.1: The committee supports establishment of a *Living Shorelines Academy** as the appropriate vehicle to implement the committee's education and outreach recommendations. The Academy should have a lead organization, but work in cooperation with any other entity undertaking similar tasks on a coordinated basis (i.e., not duplicating work), specifically including:

(1) Build a national repository of peer-reviewed scientific, engineering, and policy materials.

(2) Provide online training and educational materials for the design and implementation of living shoreline projects.

(3) Conduct in-person training through regional workshops and national technology transfer meetings.

(4) Coordinate the development of training materials and the conduct of information campaigns to assure consistency in message and goals.

The committee believes an education and outreach campaign should include these elements:

- Survey of existing education programs to learn what strategies have proven effective in changing behaviors;
- Web presence for master database, directories, and manual referenced above;
- Web-based interactive training, modeled on the EPA Water Quality Standards Academy;
- Videos that show what living shorelines are, how shoreline management systems (hard and soft) impact an estuary, and how hardened structures fail;
- Demonstration projects so all constituencies can see living shoreline projects in place and learn from their peers;
- Professional outreach targeted to the particularized need of each constituency to customize the delivery of needed information;
- General information campaign targeted to the estuary-using public, including social media elements;
- Targeted regional information campaigns, based on results of regional social marketing research of perceived local barriers, including rural and low income landowners;

** Since beginning this report project, RAE, working in partnership with its member organizations and key federal agencies, has been awarded a cooperative agreement by the EPA to create the national capacity to transfer technology knowledge regarding good stewardship of estuarine shorelines across local, state and tribal governments, as well as other interested stakeholders including waterfront landowners. To implement this grant, RAE will establish a Living Shorelines Academy Achieving these recommendations will require organizational leadership and program funding.*

- Existing entities delivering wetland or living shoreline outreach and re-message, using results of social marketing research;
- Outreach to local media encouraging them to report on living shoreline projects, especially those involving public projects or community and volunteer participation;
- Development of living shoreline "branding" logos and catch-phrases to build regional and national awareness;
- Development of materials demonstrating the values of living shorelines to each major stakeholder group; and
- Coordination of outreach strategies for similarly interested NGOs by region and/or specific subject.

Although numerous organizations work on various living shorelines activities, these activities are occurring mostly at local or state levels. The Living Shorelines Academy should reach out to and engage the diversity of stakeholders that are already involved, or who should be involved, in managing and protecting the economic and environmental values of our nation's estuarine shorelines to bring these efforts together and integrate them at the national level. The Academy should be built upon these local and regional efforts, including, but not limited to: the NRC study entitled "Mitigating Shore Erosion along Sheltered Coasts"[61]; the 2013 Smithsonian Environmental Research Center workshop on living shorelines; results from the Mid-Atlantic Living Shorelines Summit[62]; and numerous local initiatives in NC, VA, DE, NJ, AL, and elsewhere. Groups and agencies that have experience in living shorelines (e.g., VIMS,[63] Gulf of Mexico Alliance (GOMA),[64] Governors South Atlantic Alliance (GSAA),[65] Southern Environmental Law Center (SELC),[66] Sea Grant,[67] National Estuary Programs (NEPs),[68] the National Estuarine Research Reserves (NERRS)[69]) need to become part of the support network for this online site to provide the information it will need to function. Coordination of an overall education plan by the Academy would also assist federal, state, and NGO grant sources in targeting their grants appropriately with a deliberate, coordinated plan to address the existing barriers to living shorelines.

The Academy should incorporate opportunities for voluntary restoration and protection of estuarine shorelines. It should address this need by:

- Providing targeted online and in-person outreach and training for key citizen and non-profit organizations on the benefits of voluntary wetland restoration, protection, and improvement activities to help overcome barriers in carrying out these types of activities;
- Developing work groups, processes, and mechanisms to enhance collaboration efforts with multiple parties, including land trust organizations, state wildlife agencies, local governments, Indian Country, agriculture agencies, etc.; and
- Improving approaches to reduce shoreline hardening and enhance coastal resiliency using nature-based solutions such as coastal marsh restoration or living shorelines.

In addition, the Academy should seek to enhance the regulatory programs that govern the use of estuarine shorelines throughout the nation by:

- Providing technical assistance and training to non-federal stakeholders on the CWA section 404 permitting process related to living shorelines with materials developed in consultation with state and federal regulators;
- Improving the efficiency of coordinating wetland protection and enhancement across regulatory agencies and levels of government focused on living shorelines;
- Developing educational tools and procedures to help state, tribal, and local government programs to fill the gaps in federal protection on the basis of their own priorities;
- Developing tools and guides to incorporate the use of living shorelines into broader watershed planning and watershed management goals and to

reflect on the contribution of living shorelines to the broader aquatic ecosystem; and

- Supporting a sustained discussion forum on the use of living shorelines under state, tribal, and local CWA section 401authority.

Key steps to ensure the long-time success and usefulness of the Academy include:

- Develop an ongoing source of funding to run the Academy. User fees should be charged for some aspects of the services provided as a way to continue to operate the site in perpetuity;
- Establish a team of professionals dedicated to administering the program;
- Maintain an up-to-date Academy portal with: searchable databases of peer-reviewed and "gray" literature, and professional listings; capacity for training modules that will include, at a minimum, key concepts, supplemental topics, "current news" and archived webcasts; and a living shorelines project map organized by state with descriptions and images;
- Plan and host regional in-person "classroom academies" with partner organizations or government agencies around the country on a periodic basis;
- Organize and host national living shorelines technology transfer meeting; and
- Continue regional Living Shoreline Summits based on the model of the 2013 Mid-Atlantic Living Shorelines Summit to promote the advancement and sharing of knowledge and innovation in the use of living shorelines.

The Academy addresses a major gap in existing environmental management efforts in many states where extremely valuable natural habitat is being degraded by ill-conceived shoreline management practices such as vertical bulkheads. In addition, it will help waterfront landowners appreciate that living shorelines enhance the economic value of their shorelines by providing a good management strategy that accommodates both their landowner activities and the natural values of waterfront habitat. Getting the Academy operational and working will represent a huge step forward in addressing the education and outreach needs identified by the committee for living shorelines. Creating the site and then getting it used as a meaningful and evolving resource for the living shoreline community is essential for developing financial support from users that will eventually be needed to maintain the Academy long term.

C. STRATEGY 2: REGULATORY REFORM

1. GENERAL

In many jurisdictions, property owners can readily obtain permits for installing bulkheads while permitting living shorelines remains an ongoing challenge. This permitting preference for hardened structures exists because of outdated assumptions about the long term efficacy and environmental effects of shoreline management systems—hard and soft. Scientific and engineering advances have outpaced our regulatory programs. Both state and federal systems need to reform shoreline permitting so that, at a minimum, "all estuarine shoreline stabilization structures are subject to comparable application and evaluation processes."[70] Federal, state, and local regulation should be coordinated for consistency and predictability and should consider system-wide impacts beyond the parcel being permitted. Finally, incentives for living shorelines should be developed that promote the goals of sound estuarine management and recognize the broader system values created by living shorelines.

FINDING S-2.1: Federal and state permitting of hardened shoreline stabilization structures generally, and the NWPs issued by the Corps in particular, do not adequately consider the state of current science about the cumulative, long-term negative impacts of these structures on aquatic systems and water quality and the relative benefits of softer structures.

RECOMMENDATION S-2.1.1: The committee supports the development of permitting regimes that: reflect current science and engineering for estuarine systems; coordinate federal, state, and local permitting schemes; consider the broader impacts of shoreline management decisions beyond the single parcel being permitted; provide appropriate incentives for better

shoreline management; and yield more consistent and predictable outcomes. The committee supports states' use of their CZMA consistency review authority to restrict the use of NWP 13 as a means to permit hardened shoreline stabilization within state waters. States may also condition permitting of activities in coastal waters on state water quality certification requirements.

Reformation of the regulation of shoreline management is directly related to overcoming each of the barriers identified in this report:

- Reliance on the existing regulatory systems in the face of contrary scientific evidence is the primary manifestation of institutional inertia impeding the broader use of living shorelines.
- The current regulatory scheme, by focusing on only the parcel at hand, is fatally flawed. Only by reforming how regulatory decisions are made can the appropriate consideration of a broader ecosystem context be brought to bear on shoreline management decisions.
- The variability of shorelines dictates that blanket reliance on NWPs is no longer defensible and that a more site-specific, hierarchical regulatory inquiry be the basis for permitting whether incorporated into a revised NWP or in a series of RGPs.
- By reforming the regulatory system to one that is more comprehensible to the public and directly responsive to the goals of environmentally sound management of estuarine resources, we can help assure the emergence and coalescence of effective advocacy for living shorelines.

Reformation of the regulatory system is also a critical element in accomplishing each of the other recommended strategies discussed in this report:

- Regulatory reform will promote a better understanding of the true environmental impact of hardened structures and the relative benefits of living shorelines by focusing the permitting process on those issues. Providing incentives for living shorelines will likewise be a powerful education and outreach tool.
- Successful regulatory reform will be dependent on increasing the institutional capacity of both the regulatory entities and the professionals that directly interface with them.
- To achieve a permitting scheme that addresses the full array of shoreline management issues in a broader planning context and does so in a coordinated way at the federal, state, and local levels will require government agencies at all levels to collaborate and lead by example.

With these broad parameters for regulatory reform in mind, the following are the committee's specific findings and recommendations for elements of needed regulatory reform.

2. SYSTEM PREFERENCE

FINDING S-2.2: Living shorelines are generally the least damaging to the environment alternative and are generally practicable in most estuarine settings.

RECOMMENDATION S-2.2.1: In any permitting scheme, hardened structures should be a last resort, only available if softer methods are shown to be ineffective or impractical.

The EPA developed CWA § 404(b)(1) guidelines, which establish the environmental criteria for evaluating a project under the federal wetlands permitting program.[71] The § 404(b)(1) guidelines require the selection of a practical alternative that is the least damaging to the environment. Since it is now clear that living shorelines are generally the least damaging management

Living Shorelines Project at the Edenhouse Boat Ramp, Edenton, NC; ©Tracy Skrabal

alternative, hard stabilization should not be used if living shoreline methods are practical; that is, they provide equal or better erosion control and are cost-effective, considering the real total cost over time.

3. USE OF NWP 13 AND RGPs

FINDING S-2.3: The current broad application of NWP 13 and, in some states RGPs for bulkheads and riprap, is not consistent with the mandates of the CWA and is not supported by current scientific data.

> RECOMMENDATION S-2.3.1: When NWP 13 is next reviewed, the underlying assumptions about secondary and cumulative impacts of hardened structures should be reexamined which, the committee believes, will lead to substantial revisions and adoption of more hierarchical criteria for the evaluation of bank stabilization projects.

It is important to note that the purpose of the existing NWP 13 is to protect land on which residences, infrastructure, and other features are located. The Corps regulations at 33 CFR 320.4(g)(2) recognize that a riparian landowner has a conditional right to protect his or her property from erosion, and because of this right, applications to erect protective structures will usually receive favorable consideration. NWP 13 may be currently used in appropriate cases to authorize the construction of hardened structures or living shoreline projects. Under Section 10 of the Rivers of the Harbors Act, the Corps is responsible for evaluating effects of proposed activities to ensure that the navigable capacity of waterways is not impaired. Under Section 404 of the CWA, the Corps is also responsible for ensuring that discharges of dredged or fill material do not result in substantial degradation of waters or result in any other restrictions on discharges as enumerated in the 404(b)(1) Guidelines, including the restriction prohibiting activities that do not reflect the least environmentally-damaging alternative. When general permits are developed, they are evaluated for compliance with the Section 404(b)(1) Guidelines; if particular activities comply with the terms and conditions of the issued general permit, a project specific determination of that activity's compliance with the Guidelines is not required.

The current over-reliance on federal NWPs and RGPs, especially NWP 13 for bank stabilization, to permit hardening projects is no longer sound. Given the variability and site-specific nature of developing management measures, permitting authorities should not allow sweeping, widespread use of NWPs. At the very least, RGPs should be used in circumstances that have similar estuarine characteristics and conditions. The Corps previously concluded that the hardening activities authorized by NWP 13, as well as in some states their RGPs for bulkheads and riprap, have minimal environmental effects, both cumulatively and individually. However, current science[72] shows that the cumulative effects of hardening our shorelines have documented detrimental effects to our estuarine systems and water quality, which the current broad use of NWP 13 fails to take into consideration. Based on this evidence, a challenge to NWP 13 was recently filed in federal court by three conservation NGOs (Appendix B). This suit could materially affect the living shorelines community.[73]

For these reasons, use of NWP 13 in its current form for estuarine bank stabilization, as well as closely aligned regional permits in some Corps Districts, should be revisited. In some districts, such as the Jacksonville District, small living shorelines projects are being authorized under the NWP 13. These activities should still be allowed. NWPs have been renewed every five years since their inception in 1977.[74,75] The current NWPs expire on March 18, 2017. The Corps will begin the process to propose either new, reissued, and/or modified NWPs in 2015 and it encourages public comment. The living shorelines community has a valuable opportunity and role to play in ensuring that NWPs are used in ways to encourage environmentally-sound shoreline management.

The next NWP renewal process provides an opportunity to raise awareness of these issues through targeted outreach campaigns led by the NGO community. The NGO community will be well poised to provide informed commentary and rationale for revising NWP 13 during the review process. As other constituencies become better informed about the impacts of hardened structures and the benefits of living shorelines, those constituencies should likewise make themselves heard in the review

process. The committee believes that review of NWP 13 should lead to a more hierarchical approach. This approach includes a NWP that contains different levels of review tied to site conditions and design elements, or a series of RGPs responsive to conditions typical in a particular area. In the interim, states should also consider using their coastal consistency review authority under the CZMA and their water quality certification authority under the CWA to restrict or condition the use of federal NWPs for shoreline stabilization in bays and estuaries within their respective jurisdictions.

In addition to use of NWP 13 to authorize the construction of bulkhead and hardened projects, NWP 13 is also used in many Districts to authorize the use of living shoreline projects in appropriate circumstances when those projects have no more than minimal adverse effects and are not contrary to the public interest. The Corps understands that living shoreline projects can provide bank stabilization and use of this NWP in appropriate cases ensures efficient and effective verification of these projects. The preamble of the NWPs recognizes that bioengineered techniques can slow erosion rates and have beneficial effects on habitat for macroinvertebrates and fish. Also, in addition to use of NWP 27 for wetland mitigation projects, Corps Districts have verified some living shoreline projects under this permit, in appropriate circumstances where rehabilitation or enhancement of tidal wetlands occurs, along with a net increase in aquatic resource functions.

In addition to the Mobile District's RGPs in AL and MS, a number of other Districts have developed general permits in collaboration with stakeholders in their areas of responsibility that are specific to living shorelines and bioengineered stabilization and/or restoration projects. These general permits are tools that allow for efficient and effective decision-making on living shoreline projects that are based on regional resources and needs. Specifically:

- The Baltimore District has developed a state programmatic general permit in cooperation with MD Department of the Environment following public notice and comment, which provides for verification of bioengineered projects, provided all terms and conditions including impact thresholds are met.
- In VA, the Norfolk District recently modified a RGP after advertising the proposal on public notice and collaborating with the VA Marine Resources Commission, NOAA, Department of Environmental Quality, VIMS, and Local Wetland Board members. The RGP now provides opportunity for verification of living shoreline projects provided terms and conditions are met, including specific limitations on total fill area and total wetland impacts, which were established based on regional considerations.
- In SC, the Charleston District issued an RGP in 2013 following coordination with the public and agencies, specifically for oyster reef restoration and/or creation projects sponsored by SC Department of Natural Resources. Projects could include commercial and recreational harvesting, research, and/or ecological purposes, where ecological purposes may include oyster reef restoration for the purpose of shoreline and marsh stabilization. The RGP can be used to authorize the use of living shoreline projects that meet the terms and conditions of the permit.

These select examples of permitting tools that are available to regulate the use of living shoreline projects highlight the success of agencies working together with stakeholders to develop general permits that are based on regional needs, regional aquatic resources, and local and state programs.

4. COORDINATED PERMITTING

FINDING S-2.4: The current mixture of permitting systems across jurisdictions is inefficient and, in many cases counter-productive, to the use of better shoreline management techniques. A clearer system focused on system impacts, both positive and negative, would promote a broader understanding of the principles of sound ecological management of shorelines.

RECOMMENDATION S-2.4.1: Federal, state, and local regulatory agencies should work toward a coordinated permitting system for living shorelines that yields consistent and predictable outcomes, recognizing that states have sovereign jurisdiction over

their lands and that this will require voluntary state participation. Possible means may include regional compacts to address the issues across jurisdictional lines.

Current regulatory schemes do not adequately acknowledge or even attempt to coordinate with other important and directly-related executive and legislative priorities. For example:

- Executive Order 13508: Chesapeake Bay Protection and Restoration.[76] This initiative has many components directly related to living shorelines, including developing better shoreline management techniques and protecting the health of this unique estuarine system.
- Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance.[77] While this initiative is primarily focused on clean and sustainable energy, it also directs agencies to "promote pollution prevention and eliminate waste by…appropriate landscape management practices" and "advance regional and local integrated planning by…coordinating with regional programs for federal, state, tribal, and local ecosystem, watershed, and environmental management".
- Executive Order 13547: Stewardship of the Ocean, Our Coasts, and the Great Lakes.[78] This EO is directly focused on the health of coastal communities and endorses the use of ecosystem-wide planning tools.
- Executive Order 13554: Gulf Coast Ecosystem Restoration Task Force.[79] This EO was issued after the blowout and explosion of the mobile offshore drilling unit Deepwater Horizon. It established a Gulf Coast Ecosystem Restoration Task Force to coordinate intergovernmental efforts, planning, and the exchange of information in order to better implement Gulf Coast ecosystem restoration and facilitate appropriate accountability and support throughout the restoration process.
- The President's Climate Action Plan.[80] This plan outlines actions the Obama administration will take using existing authorities to reduce carbon pollution, increase energy efficiency, expand renewable and other low-carbon sources, and strengthen resilience to extreme weather and other climate impacts.
- Executive Order 13653: Preparing the U.S. for the Impacts of Climate Change.[81] This EO directs U.S. federal agencies to take steps that will make it easier for communities to strengthen their resilience to extreme weather and to prepare for other impacts of climate change.
- Report of the Interagency Task Force on Carbon Capture and Storage.[82] This report recommends the development of a comprehensive and coordinated federal strategy to speed the commercial development and deployment of clean coal technologies.
- Final Recommendations of the Interagency Ocean Policy Task Force.[83] This report establishes U.S. National Ocean Policy.
- National Ocean Policy Implementation Plan.[84] This plan provides a blueprint for the dozens of federal agencies with responsibilities related to ocean, coastal, and Great Lakes resources, with the broad goals of increasing interagency cooperation, enhancing marine ecosystem health, and reducing ocean user conflicts.

Each of these documents lends support to the principle that shoreline and estuarine health are linked and should be managed holistically. The current permitting of shoreline management systems should incorporate these calls for change in the way these resources are managed.

To be successful, the coordinated federal and state regulatory permitting system that currently exists needs to evolve to reflect the latest and most up-to-date science and technology. During the NWP renewal process, new standards should be adopted to make sure that they will result in the routine and widespread use of living shoreline type stabilization measures in locations

where such measures are found to be equally or more economical, practical, and effective than traditional hard stabilization methods.

This coordination across agencies can be accomplished in several ways. At the federal level, the possibility of an MOU between the many agencies affected by living shoreline issues (e.g., EPA, Corps, Department of Defense (DOD), Department of the Interior, Department of Commerce, etc.) should be explored. This approach is especially critical in light of the other federal priorities described above which are currently unaddressed in shoreline permitting. At the state-federal interface, many jurisdictions have already implemented a joint-permitting process for shoreline projects as a means to coordinate project review. States should also work with federal regulators to develop RGPs for living shorelines installations.

Living Shorelines Project, Bay Front Park, Sarasota, FL; ©Thomas Ries

With respect to coordinated permitting, the existing differences in permit systems and approaches are based on a variety of reasons, including: differing statutory authorities, roles, and responsibilities of involved agencies; differences in aquatic resources; and differences in the nature of the living shoreline projects themselves. With respect to the latter, the committee acknowledges that variability of site conditions and the necessary differences in living shoreline projects to respond to site conditions is an obstacle to implementing these projects. One of the ways to respond to this obstacle is through the development of permitting tools based on regional needs and considerations, as has been done in a number of districts/states as described above (e.g., the RGPs in the Mobile, Baltimore, Norfolk, and Charleston Districts). In many Corps Districts where general permits have not been developed specific to living shorelines, NWPs 13, NWP 27, or other general permits have been demonstrated to be an appropriate way to regulate living shoreline projects. One coordinated permit system specific to living shorelines that incorporates all federal, state, and local requirements across the country is probably not feasible due to the numerous obstacles described above. Continued use of existing permit mechanisms, and refinement of existing permit tools as needed to respond to new science or other information would be more effective and efficient than one national permit system. The most critical component of whatever permitting process is implemented is that it consistently results in the selection of the shoreline management alternative that is practical, effective, and minimizes adverse environmental consequences.

It is important to also note that the level of permitting required for a living shoreline project will be determined based on the extent of the work that is subject to Corps control, and the effects of fill in wetlands and public trust waters. Pre-application coordination with the appropriate Corps District can be helpful in providing assistance to a project proponent in understanding what information needs to be submitted and the evaluation that will likely be required. In many Corps districts, if a living shoreline project would meet the terms and conditions of a general permit, like NWP 13, NWP 27, or some other regional or programmatic general permit, then review and verification can occur efficiently, provided all necessary information is received and any required consultations under other federal laws are completed. If the activity exceeds the terms and conditions of a general permit, then a more rigorous review is required so that the full extent of the effects of the activity can be evaluated. In some cases, living shoreline projects propose large amounts of fill material being placed

considerable distances from the shore, and the effects of this material on factors like navigation, essential fish habitat, endangered species, water quality, wetlands and/or historic properties will need to be taken into consideration as appropriate based on the project specific effects.

5. DEVELOPMENT OF REGIONAL OR ESTUARY-BASED SHORELINE MANAGEMENT PLANS

FINDING S-2.5: Protection of estuarine and aquatic resources requires decision-making that considers the environmental consequences of cumulative decisions and impacts beyond the boundaries of a permitted project. Approaching management of these resources from an ecosystem rather than political jurisdiction perspective is therefore necessary.

> RECOMMENDATION S-2.5.1: The committee supports the development and adoption of estuary-based (or other natural system-based criterion) plans for the regulation and permitting of shoreline management systems. Where necessary, inter-jurisdictional MOUs for this purpose should be adopted.

A regional or estuary-based shoreline management plan is, in the committee's opinion, the best overall strategy. It addresses the deficiencies discussed above inherent in the current myopic site-specific permitting approach, which understates the broader negative impacts of hardening and the values created by living shorelines beyond the specific site. A regional or estuary-focused approach provides greater planning flexibility where habitat loss is unavoidable by using living shorelines as a vehicle to deliver mitigation benefits. Consideration of a system-wide context will not always favor living shorelines. At certain sites, consideration of the site characteristics and other existing shoreline management systems, especially on neighboring parcels, may lead to concluding that little habitat and erosion control improvement can be realized with a living shoreline. In such a case, it is better to direct those resources to the area of the estuarine system that can best be benefitted by living shorelines.

Estuary-based planning would extend across jurisdictions, thereby encouraging cooperative management at the federal, state, and local levels. This holistic approach would provide ample opportunity to coordinate permitting. It would provide a centralized information hub for shoreline management information within the region. It could build upon an inventory of all the natural assets, including fisheries, flood control, and water quality, which are associated with shorelines. All of the benefits, and all of the challenges, of watershed-based permitting for stormwater laid out in the 2008 National Research Council Report[85] apply equally to regional shoreline permitting.

The committee would like to see states and local governments develop regional or estuary-based shoreline management plans that help identify the preferred shoreline management option in advance of any permitting processes. The committee realizes this approach is an ambitious undertaking. It is unrealistic to believe that a regional shoreline management planning system can be accomplished by a strictly top-down federal mandate. However, other cooperative management programs may serve as a model (e.g., the Mid-Atlantic Fishery Management Council, which recommends fishery management measures affecting 13 species in the waters off the Atlantic coast from NY to northern NC). Federal regulatory support for state and local initiatives will promote the implementation of comprehensive estuarine shoreline management programs. The goal of comprehensive planning must be pursued through building a constituency and educating the stakeholders about the long-term economic and ecological advantages of protecting an estuary through coordinated shoreline management.

Success of this management approach would be dependent on voluntary participation by the various jurisdictions. Smaller-scale shoreline management plans like those undertaken in WA and the VIMS Comprehensive Coastal Resource Management Portal[86] may provide a starting point to work towards larger regional plans.

6. ENCOURAGE STATE REGULATORY LEADERSHIP TO PROMOTE LIVING SHORELINES

FINDING S-2.6: States are well situated to evaluate the cumulative impact of broad reliance on NWP 13 on their local estuarine systems and curtail the use of hardened structures where appropriate.

> RECOMMENDATION S-2.6.1: Recognizing that some states have already taken this step, the committee suggests all states review and reevaluate the availability of NWP 13 for permitting hardened shorelines in their state waters, utilizing CZMA and/or state water quality standards.

The committee encourages states to use their existing regulatory authority to promote the use of living shorelines over hardened structures where appropriate. Several states have already embraced this approach of discouraging hardened structures. For example, as increased amounts of shoreline became hardened in MD, and the negative impacts to fisheries and estuarine ecosystem services became apparent, MD rejected the ease of access to hardened structures otherwise available under NWP 13. In response, the Corps cooperated in developing regional or general permits that favored living shorelines and made living shorelines more attractive and hardened shorelines harder to obtain without sacrificing appropriate review of living shoreline projects.

7. LIVING SHORELINE INCENTIVES

FINDING S-2.7: Because of institutional inertia, incentives are necessary to promote the use of living shorelines. Assessing the value of living shorelines and finding ways to link those values to the constituencies benefited is one method to fund monetary incentives.

> RECOMMENDATION S-2.7.1: Regulatory agencies should adopt incentives for the use of living shorelines. Incentives may be administrative, such as preference in processing priority and technical support in design, as well as monetary, such as cost sharing for design, construction, monitoring, or maintenance expenses.

The committee also encourages the development of positive incentives for the use of living shorelines. Some states have developed RGPs for living shorelines, albeit without restricting the use of bulkheads. Although bulkheads are still permitted, property owners seeking living shorelines now have an easier permitting process, meaning that permitting living shorelines becomes less of a barrier.

Other more direct incentives are also being developed. MD and VA have studied and are now on the verge of approving a system under which TMDL credits will be granted for the permitting of living shoreline projects, recognizing the water quality benefits of living shorelines.

Living shoreline permit applications could be given time preferences such as expedited treatment, longer permit terms, and phased development. As institutional capacity is increased at the regulatory agencies, application technical assistance (e.g., project design) could be offered. Considering the growing body of data about the superior performance of living shoreline structures in storm and flood events, it is logical to develop incentives for landowners to use living shorelines. One example could be Federal Emergency Management Agency recognizing living shorelines and estuary-wide planning systems as a factor on its Community Rating System, a decision which could result in lowering insurance rates.

Any environmental benefits of living shoreline projects will be considered during the evaluation of permit applications. However, such benefits do not eliminate the responsibility of regulatory agencies to conduct a complete evaluation of the project, which may include consultations with other federal and state agencies under the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, the National Historic Preservation Act, or other laws, and evaluations of effects to navigation, wetlands, and other relevant public interest review factors. Regulatory agencies generally do not have authority to provide design or construction advice since they should be focused on the review of applications, and the evaluation of effects of proposed activities on resources subject to their control and responsibility. It is important for non-regulatory agencies and other organizations to provide this form of assistance to the regulated community.

Financial incentives should be developed based on identifying and, where possible, quantifying the ecosystem services provided by living shorelines. This evaluation should lead to shifting some of the cost of living shorelines, likely through regulatory schemes,

to the constituencies benefited by those services. Water quality improvement projects should recognize the pollution abatement values provided and hence the cost savings afforded by living shorelines installations and subsidize those installations accordingly. This cost sharing is being justified in some areas of Chesapeake Bay as part of efforts to comply with TMDL nutrient reduction targets.

Living shorelines are not only necessary to protect our estuaries; they are a proven, valuable tool in restoring systems that have been degraded. Without incentives—whether regulatory or financial—for broader use of living shorelines, it will be difficult to implement the number of living shoreline projects necessary in some locales to make meaningful progress toward ecosystem restoration.

D. STRATEGY 3: IMPROVE INSTITUTIONAL CAPACITY

FINDING S-3.1: The design, construction, and regulatory constituencies involved in shoreline management do not currently have the institutional capacity to implement significantly broader use of living shoreline techniques.

The variability of shorelines and the challenges presented by system-wide evaluation of the impacts and benefits of various management options requires a body of trained and knowledgeable professionals to design, construct, and permit shoreline management systems that are effective and that protect and maximize the values of that estuarine system. Increasing the capacity of the shoreline constituencies, primarily through education, will likewise support the changes necessary for meaningful regulatory reform and will promote broader advocacy for living shorelines. The primary constituencies facing capacity challenges are the design/build private companies and the regulatory agencies on all levels.

1. PRIVATE SECTOR CAPACITY

> RECOMMENDATION S-3.1.1: The primary tool for increasing capacity in the private sector should focus on education about the techniques of living shorelines, their advantages and efficacy, and the economics of their efficient design and implementation.

Education carries the added benefit of promoting broader knowledge of living shorelines among waterfront landowners, who often turn first to the private-sector professionals for shoreline management advice. All of the subjects listed in the earlier section on recommended education and outreach should be included. Targets for this education include design and landscape architect professionals, constructors, plant suppliers, and construction materials suppliers. In addition, a better understanding of the economics of living shorelines and the potential for jobs related to their design, construction, monitoring, and maintenance should promote a broader support in the private and public sectors.

As discussed earlier, the committee believes that the RAE Living Shoreline Academy is the best suited institution to take the lead in developing a comprehensive education program tailored to each of the affected private sector constituencies. In addition, the committee supports encouraging higher-education institutions to incorporate the growing body of scientific knowledge about living shorelines in undergraduate and graduate curricula related to environmental science, marine science, landscape design and architecture, water and wetlands science, and conservation.

> RECOMMENDATION S-3.1.2: A course of study for the certification and continuing education of one or more levels of Living Shoreline Professionals should be developed by an entity such as the proposed Living Shoreline Academy.

In addition to basic, broader education, the committee believes that the capacity of both private and public sector institutions can be increased by specialized training leading to professional certifications similar to those recognized in related fields (e.g., master gardener, wetlands delineation scientists, master naturalists). For example, completion of a basic (e.g., four-day workshop) course in design, construction, and monitoring for functional analysis could result in the designation of Living Shoreline Professional in Training, which would lead, with additional documented work experience, to Living Shoreline Professional Certification. Maintenance of a directory of such certified professionals could expand the use of living shoreline techniques.

Such professionals would maintain their currency through

continuing education and re-certification programs. Continued education should focus on the full array of knowledge and skills that regulators and contactors will need to plan, design, permit, build, and maintain shoreline projects. Included in this training should be guidance on business models contractors can use that provide an ongoing client relationship with shoreline property owners to help to ensure long-term maintenance of projects.

> RECOMMENDATION S-3.1.3: Installation of living shoreline projects should deliberately target the use of volunteers for project implementation both for economic benefits and to provide public education and expansion of the advocacy base.

Finally, the private sector capacities can be increased by partnering with NGOs and other volunteers. The examples of NGOs providing volunteer labor and lowering construction costs for living shoreline projects are myriad. By utilizing these resources, the economics of living shoreline projects are enhanced while providing significant public education and expansion of advocacy base opportunities.

Rock Ponds Restoration, Tampa Bay; ©Peter Clark

2. PUBLIC SECTOR CAPACITY

> RECOMMENDATION S-3.1.4: Education about the techniques of living shorelines, their advantages and efficacy, and the economics of efficient design and implementation is the principal tool for increasing capacity of the existing regulatory staff. The Living Shorelines Academy could provide the basic education elements necessary for this training, by specialty, and then supplemented by hands-on field experience.

> RECOMMENDATION S-3.1.5: Regulatory agencies should develop specialization training for their permitting staffs.

- Regulatory agencies should designate adequately trained staff to handle estuarine shoreline permit applications. At least some staff members should become certified professionals in estuarine shoreline management methods using the continuing education and certification courses that have been recommended as part of the Living Shoreline Academy.
- Web-based permit application tools and permit databases need to be used to enable applicants to use a structured process to identify the best bank stabilization option for their site, and to help regulators evaluate permit applications and periodically check up on permitted sites to ensure proper maintenance.
- Some fast-track permit review times are recommended for projects that use conventional and proven living shoreline designs.
- Site inspections and monitoring should occur when regulators are out in the field reviewing other new permit applications to the extent practical.
- Permits for the construction of all estuarine shoreline stabilization projects should have a renewal date of at least ten years to ensure that sites are reevaluated based upon current shoreline conditions.
- As state agencies develop the needed expertise, they should affirmatively offer that expertise to local agencies also involved in permitting decisions, especially concerning their authority to require landowners to justify hardened projects.

Regulatory agencies face a number of capacity problems. The use of less-standardized permitting processes will increase the regulatory workload. As a result, agencies will need a workforce with specialized skills in areas such as:

- Initial design approval, because living shorelines are necessarily site specific;
- Consideration of system-wide impacts and benefits; and
- Monitoring of completed living shorelines to ensure proper maintenance and long-term efficacy of the structure as well as advancing the science of living shorelines.

The committee surveyed 13 states[87] to try to better understand their regulatory structures, staffing, and permit loads related to all types of estuarine bank stabilization projects. Some states handle permits for estuarine shoreline stabilization in the same manner that they regulate all coastal development projects, while several have designated staff that specialize in estuarine shoreline management. All states surveyed have worked out a joint permit program that satisfied both federal (CWA) and state regulatory requirements. Every state surveyed except NC requires detailed permit applications for all types of estuarine shoreline bank stabilization projects (NC is the only state that does not have a permit application for hard stabilization general permits). Except for NC (which issues general permits for hard stabilization without a waiting period), the time it took to process complete permit applications ranged from a couple of weeks to more than a year. While all states surveyed consider the number of permit applications they review for estuarine bank stabilization to be significant each year, the actual number of permits issued varies quite dramatically from about 75 permits a year to 1,000s. The number of regulatory staff in place to handle permit applications varies based upon the number of applications received each year.

Based upon this survey and its experiences with planning, designing, permitting, and building living shoreline projects, the committee recommends that regulatory agencies increase their capacity by two methods:

- Improve the capacity (i.e., skill set) of the existing staff; and
- Improve the efficiency of the current staff by specialization and task standardization.

RECOMMENDATION S-3.1.6: Regulatory agencies should encourage and cooperate with the development of living shoreline expertise in the private sector as a way to leverage the expertise to increase regulatory capacity.

Regulatory programs are experimenting with partnering with the private sector, especially in those circumstances where specialized knowledge is important and the private sector is motivated to cooperate in exchange for more predictable permitting processes. For example, the NC Inactive Hazardous Sites Branch allows the use of private Registered Environmental Consultants to implement and oversee voluntary remedial actions at low-priority sites.[88] The state agency retains the right to spot audit individual projects. This approach helps increase the overall capacity of the agency.

The committee considered and rejected recommending some level of similar partnering with private sector constituencies as a formal part of the permitting process. However, with the development and certification of Living Shoreline Professionals, the capacity of the regulatory agencies could be significantly expanded by reasonable and judicious reliance on the expertise already engaged by the landowner in the design and construction of the project. Accordingly, these agencies should actively promote all education efforts targeted at the private sector constituencies, especially programs that focus on the requirements of the permitting process. The committee is not recommending outsourcing the permitting function to the private sector—just the judicious recognition of the value of their efforts in a more complex regime.

3. TARGETED CAPACITY FUNDING

RECOMMENDATION S-3.1.7: Public and private funding of living shoreline initiatives should give high priority to increasing institutional capacity.

Capacity demands, and their related education demands, are among the most immediate challenges to wider use of living shorelines. While funding demonstration living shoreline projects is beneficial on a number of fronts, there should also be a targeted effort to utilize funds to

expand institutional capacities. The education and outreach strategy discussed above has many elements that will naturally improve institutional capacity. In addition, where funding for a living shoreline installation is sought, preference should be given to projects that incorporate training and educational elements targeted at local design and construction professionals as well as the public.

E. STRATEGY 4: PUBLIC AGENCIES AS ROLE MODELS - LEAD BY EXAMPLE

FINDING S-4.1: Government at all levels can benefit from the broader use of living shorelines and therefore will benefit by being an active advocate for their use.

As discussed earlier, current research demonstrates the many benefits to clean water and healthier estuarine ecosystems flowing from the use of living shorelines instead of continued hardening. The values generated for the public–clean water, healthy fisheries, superior recreational resources, improved property values and tax base–all should be of significant importance to government at all levels. In addition, the use of living shorelines as a method of complying with TMDL mandates (as is about to happen in MD and VA) is an example of a direct benefit to the public agencies charged with achieving compliance with the CWA, and therefore of direct economic benefit to the taxpayers of that jurisdiction. Government support for living shorelines could also encourage new and innovative designs and techniques for using living shorelines.

Fish Camp in the Fog, MD; ©Kent Eanes

RECOMMENDATION S-4.1.1: The use of public lands as living shoreline sites should be actively promoted at all levels.

A living shoreline project on public lands where erosion stabilization is necessary and where a bulkhead or revetment would otherwise be installed offers an opportunity to be a role model in advancing awareness of and knowledge about living shorelines. Installation of living shoreline projects can frequently involve the use of volunteers, and local governments, military installations, and NGOs can work together to coordinate these efforts. DOD facilities are already under mandates to assess and plan for the effects of climate change, and coastal facilities thus provide a natural vehicle for living shoreline demonstrations and innovation.

A good model for how government agencies can serve as a role model in advancing better environmental stewardship is how the federal government promotes the use of Low-Impact Development (LID) practices for federal construction projects. Beginning in the George W. Bush Administration, the DOD adopted a formal policy, which resulted in a LID design manual,[89] that required the use of LID measures when practical in all DOD-related construction projects. Congress then enacted the Energy Independence and Security Act of 2007 that expanded this LID mandate to any federal land-development projects. Until passage of the Act, most federal construction projects relied on old-fashioned stormwater measures that most stormwater experts agreed are not fully adequate to protect the nation's water resources.[90] Once the federal government became a role model in how to use LID, this method of stormwater management became a much more commonplace development practice for private developers, cities, and state government agencies as well.

RECOMMENDATION S-4.1.2: The committee recommends that federal, state, and local government agencies adopt formal policies and guidance that promote and support the use of living shoreline management measures on all publicly-owned estuarine shorelines.

This should include parks, refuges, military bases and training grounds, and any other publicly-owned

waterfront property. The policy should reflect how best to manage an estuarine shoreline based upon the types of shoreline in public ownership.

To help advance this recommendation, the committee further recommends that:

- The Southeast Regional Partnership for Planning and Sustainability (SERPPAS)[91] continue its leadership role in promoting the use of living shorelines on military installations in the Southeastern U.S. SERPPAS should work with its principals to devise recommended living shoreline management policies for its participating partners. In keeping with the leadership role that DOD played in promoting the use of LID, the goal should be to explore encouraging similar leadership by DOD on the use of living shorelines on all military installations when they are the best practical environmental alternative.
- GOMA, NEPs, NERRS, and GSAA should continue their advocacy of living shorelines. In particular, the GSAA efforts to develop and host a South Atlantic Living Shoreline Summit modeled on the 2013 Mid-Atlantic Summit should be pursued and supported. GOMA is currently developing its next five-year action plan which includes support and consideration for living shorelines.
- RAE and its member organizations should draft model policies that can be used by federal, state, and local government agencies, as well as NGOs, Indian Country, and private companies in managing shorelines they own.
- Many NEPs take an active role implementing living shoreline demonstration projects within their regions as alternative shoreline stabilization options. These are excellent examples of how local actions can be used to encourage improvements to shoreline management strategies and should be highlighted by EPA and NEP partners.
- Extension professionals with organizations like Sea Grant should continue their education and outreach efforts on living shoreline science, engineering, and regulation for a range of audiences.
- Living shoreline projects undertaken by public agencies and NGOs should be viewed as excellent opportunities for experimentation and innovations and provide the opportunity to test out new techniques. Innovation and testing should be encouraged on these types of shorelines.
- Public agencies also are important data sources for developing comprehensive data repositories, such as maps, shoreline characterizations, and planning tools. All shorelines managed by government agencies and NGOs should be entered into the Living Shoreline Academy database and, where appropriate, made available for viewing by the public as a way to help spread awareness of living shoreline management practices.
- Living shoreline projects undertaken on shorelines owned by public entities and NGOs government should be used for hands-on training opportunities for regulators and contractors whenever possible. The Academy should attempt to provide a list of upcoming projects that are going to be constructed so that stakeholders can ask to observe these ongoing projects if they are interested in doing so.
- Local governments should set a goal of constructing a living shoreline demonstration project in each of its major watersheds.

VII. CONCLUSION

Promoting the broader use of living shorelines is critical for the preservation and restoration of the health of our estuaries. It is now also clear that living shorelines offer significant advantages to property owners and all users of the estuary and these advantages were not widely recognized in the past. The institutional barriers that have slowed the use of living shorelines can be overcome by the strategies recommended in this report – education, regulatory reform, building capacity, and government agencies acting as role models. The goals of each of these strategies should also inform the public and private funding decisions supporting living shorelines so that funding systematically advances the overall goal of promoting wider use of living shorelines.

Successfully pursuing these strategies will require a vigorous dedication to substantively reforming how we are managing our shorelines. Dedication alone will not be enough. Leadership and coordination of efforts will be necessary lest the energy needed to effect change is dissipated. In the committee's opinion, significant leadership can be provided at this stage by the NGO community working together in a focused way to advance these strategies. RAE is well positioned to provide leadership on the education front through the inauguration of the Living Shorelines Academy. SERPPAS, GSAA, GOMA, NEPs, NERRS, and others are well situated to advance the strategy of public agencies acting as role models. All NGOs involved with shoreline issues can provide leadership in helping to develop and seek funding for targeted projects that increase capacity as well as broaden public knowledge of living shoreline benefits. All living shoreline constituencies must be involved in order to bring about the needed reforms to overcome the institutional barriers.

VIII. APPENDICES

APPENDIX A

COMMITTEE MEMBERS

Todd Miller – Executive Director, North Carolina Coastal Federation (Chair) *toddm@nccoast.org*

Todd founded the NC Coastal Federation in 1982 and it now has 23 staff, 3 offices, a multi-million dollar budget, and more than 16,000 members and supporters. In 2013, he was selected as a distinguished alumnus of the University of North Carolina at Chapel Hill from which he holds an undergraduate and master's degree. Todd received The Old North State Award from the governor in 2007 and the National Wetlands Community Leader Award from the Environmental Law Institute in 2012. Todd currently serves on the Board of Visitors for the UNC Institute for the Environment as well as the chair of the Policy Committee for the Albemarle-Pamlico Estuary Partnership.

Tim Dillingham – Executive Director, American Littoral Society *tim@littoralsociety.org*

Tim has led the American Littoral Society since 2003. Long interested and involved in the management of estuaries, Tim started his career developing Special Area Management Plans in coastal Rhode Island, and served as a marine resources policy specialist for the state's Coastal Resources Management Council. Currently, he serves on the Advisory and Science and Technical Committees of the Barnegat Bay Partnership, and has served as gubernatorial appointee to the Highlands Water Protection and Planning Council, where he chaired the Council's Natural Resources subcommittee during the development of the Regional Master Plan required under New Jersey's Highlands Act.

Niki Pace – Senior Research Counsel/Adjunct Professor, Mississippi-Alabama Sea Grant Legal Program *nlpace@olemiss.edu*

Niki is Senior Research Counsel for the Mississippi-Alabama Sea Grant Legal Program at The University of Mississippi School of Law. She provides research and outreach to the Gulf Coast community on topics such as resilience, sustainable coastal development, and

climate adaptation. She engages coastal residents on a range of issues including shoreline management, flood insurance, and working waterfronts. Ms. Pace holds an adjunct professor appointment with the University of Mississippi School of Law where she teaches courses in land use, energy, climate, and oil and gas. Niki earned her J.D. (2002) and LL.M. in Environmental & Natural Resources Law (2008) from Lewis & Clark Law School. She received a B.S. in Geology and Certificate in Environmental Planning & Policy from the University of Southern Mississippi.

Thomas Ries – Executive Vice President/Principal Scientist, Scheda Ecological Associates *tries@scheda.com*

Tom has more than 30 years experience working with Florida ecosystems, specializing in habitat restoration, seagrass and vegetative mapping, and biotic sampling and analysis. He has designed or assisted in the implementation of more than [90] habitat restoration projects in this region, including living shoreline protection alternatives. Many of these projects have won regional awards for environmental excellence. Tom received the 2013 National Wetlands Award for Conservation and Restoration from the Environmental Law Institute.

Bill Cary – Brooks Pierce *bcary@brookspierce.com*

Bill has more than 35 years of experience representing businesses in a wide range of commercial and litigation issues, including environmental, general business litigation, and employment law. Most recently, (during an extended leave from his law firm), he served as the General Counsel of the NC Department of Environment and Natural Resources. Bill currently supports the Living Shorelines workgroup of the Southeast Regional Partnership for Planning and Sustainability, a unique six-state partnership comprised of state and federal agencies that promotes collaboration in making resource-use decisions supporting conservation of natural resources, working lands, and national defense. He also works in support of the living shoreline initiatives being pursued by the Governors' South Atlantic Alliance.

APPENDIX B

NWP 13 LITIGATION

On behalf of the National Wildlife Federation, the Ogeechee Riverkeeper, and the Savannah Riverkeeper, the Southern Environmental Law Center filed suit October 10, 2014 in the U.S. District Court for the District of Columbia (1:14CV1701-JDB) challenging the reissuance in 2012 of NWP 13, primarily on the grounds that the permitted hardened structures "cause significant environmental damage" (Complaint ¶ 1) and the Corps "failed to adequately evaluate the environmental impact of the approximately 17,500 projects to be authorized under the permit in violation of the Clean Water Act (CWA), the Rivers and Harbors Appropriation Act (RHA), the National Environmental Policy Act (NCPA), and the Administrative Procedure Act (APA)." (Complaint ¶ 2). In particular, focusing on impacts on the Georgia coast, the Complaint alleges that the Corps failed to evaluate the cumulative and continuing impacts of prior and future permitted hardened structures (as well as the effects of sea level rise) causing: erosion in front of and downstream of such structures; destruction of riparian vegetation; destruction of fish and wildlife habitat; and harm to endangered and threatened species.

The lawsuit seeks a declaration that the issuance of NWP 13 violated the CWA, the RHA, NEPA, and the APA, and should therefore be vacated. The suit also seeks to vacate the authorization of a specific, identified project ("Bull River Bulkhead") and the award of costs and attorneys' fees. Litigation could take 6-12 months or more.

IX. ENDNOTES

[1] National Research Council of the National Academies, *Mitigating Shore Erosion Along Sheltered Coasts* (2007), pp 80-91.

[2] Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C.§ 1801 et seq.

[3] Such as habitat protections for threatened or endangered species under the Endangered Species Act.

[4] Tampa Bay Estuary Program. *Tampa Bay Estuary Program Habitat Master Plan Update* (2010). Available at tbeptech.org/TBEP_TECH_PUBS/2009/TBEP_06_09_Habitat_Master_Plan_Update_Report_July_2010.pdf.

[5] Linwood Pendleton et al., *Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems* (2012).

[6] NRC report, p. 21.

[7] The North Carolina Estuarine Biological and Physical Processes Work Group, North Carolina Department of Coastal Management, *Recommendations for Appropriate Shoreline Stabilization Methods for the Different North Carolina Estuarine Shoreline Types* (2006), available at http://portal.ncdenr.org/c/document_library/get_file?uuid=7a9230cb-ed99-4324-b9fe-3243a9b78c95&groupId=38319.

[8] Rachel K. Gittman, et al., Presentation at the 99th ESA Annual Meeting, "Prevalence and Impending Ecological Consequences of Shoreline Hardening along U.S. Coasts (August 15, 2014), http://eco.confex.com/eco/2014/webprogram/Paper50391.html.

[9] K. Gianou, *Soft Shoreline Stabilization: Shoreline Master Program Planning and Implementation Guidance* (Shorelands and Environmental Assistance Program, Washington Department of Ecology, Olympia, WA, 2014). Publication no. 14-06-009.

[10] See endnote 7, above.

[11] This array is very similar to the NRC 2007 Report, which put erosion control systems into the following broad categories: (1) manage land use; (2) vegetate; (3) harden; (4) sills; (5) trap or add sand; (6) composite systems; (7) headland control; and (8) nontraditional and innovative methods. Pp. 45-67.

[12] B.A. Needelman, S. Crooks, C.A. Shumway, J.G. Titus, R.Takacs, and J.E. Hawkes. *Restore-Adapt-Mitigate: Responding to Climate Change through Coastal Habitat Restoration.* Restore America's Estuaries, Arlington, VA, 2012). Available at https://www.estuaries.org/restore-adapt-mitigate-responding-to-climate-change-through-coastal-habitat-restoration.

[13] Systems Approach to Geomorphic Engineering, *Natural and Structural Measures for Shoreline Stabilization,* (2014). Available at http://coast.noaa.gov/digitalcoast/_/pdf/living-shoreline-brochure.pdf.

[14] The NRC 2007 Report addresses in detail the many factors impacting a shoreline and the ecosystem services each shoreline type provides.

[15] "Key Messages," 2013 Mid-Atlantic Living Shorelines Summit, p. 2.

[16] Apollo Beach, Tampa Bay. Subsequent installation of breakwater protections led to a successful, sheltered living shoreline.

[17] See endnote 7, above.

[18] *Id.,* p. 8-2.

[19] C.A. Currin, et al., *Developing Alternative Shoreline Armoring Strategies: The Living Shoreline Approach in North Carolina* (2010), available at http://pubs.usgs.gov/sir/2010/5254/pdf/sir20105254_chap10.pdf.

[20] *Climate Change 2013: The Physical Science Basis, Summary for Policymakers,* IPCC Working Group I, (September 27, 2013), available at http://www.climatechange2013.org/report/.

[21] See https://corpsclimate.us/ccaceslcurves.cfm for a brief description of this and the previous rule.

[22] Katie K. Arkema, et al., "Coastal Habitats Shield People and Property from Sea-level Rise," *Nature Climate Change,* 3: 913 – 918, (2013).

[23] Executive Office of the President, *The President's Climate Action Plan,* (2013). Available at https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf.

[24] *Id.,* p. 12-13.

[25] *Id.,* p. 15.

[26] C.A. Currin, et al., *Developing Alternative Shoreline Armoring Strategies: The Living Shoreline Approach in North Carolina,* (2010), available at http://pubs.usgs.gov/sir/2010/5254/pdf/sir20105254_chap10.pdf.

[27] S.J. Jordan, L. M. Smith, and J. A. Nestlerode, "Cumulative Effects of Coastal Habitat Alterations on Fishery Resources: Toward Prediction at Regional Scales," *Ecology and Society* 14(1): 16 (2008). Available at http://www.ecologyandsociety.org/vol14/iss1/art16/.

[28] "Living Shoreline Implementation: Challenges and Solutions," Rivers & Coast (newsletter of the Center for Coastal Resources Management), Vol. 9, No. 2 (Summer 2014). Available at http://ccrm.vims.edu/publications/pubs/rivers&coast/RC914.pdf.

[29] However, using living shoreline erosion control techniques can also result in ecosystem tradeoffs, so implementation should be undertaken responsibly and in a way that minimizes impacts.

[30] Urban Stormwater Work Group, Chesapeake Bay Partnership, *Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects,* (April 15, 2014).

[31] When a waterbody is listed as impaired under Section 303(d) of the CWA, the TMDL "is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards." www.epa.gov/polwaste/tmdl/.

[32] The definition of "waters of the U. S." has been the subject of much litigation and is currently the subject of proposed additional rulemaking by the U.S. EPA and the U.S. Army Corps of Engineers. 79 Fed. Reg. 22188 (April 21, 2014). For the purposes of this report, the Committee assumes that any application of living shorelines will occur in a jurisdictional water of the U.S.

[33] A detailed explanation of the regulatory schemes described is beyond the purpose of this report. For a more detailed explanation of these Acts, see 2007 NRC Report, pp. 104-08.

[34] 33 CFR 325.5.

[35] Most states have assumed authority to implement the CWA within their state. CWA allows states to restrict and/or condition activities as needed to achieve water quality compliance with CWA § 401. In practice, conditions and/or restrictions vary significantly by state and water body.

[36] The 10th Amendment of the U.S. Constitution gives states authority to adopt laws for the betterment of the public health, safety, morals, and general welfare (known as state police power). States delegate this authority to local governments through zoning enabling statutes. Local authority will vary based on the scope of the state enabling statutes.

[37] Kent County, MD, Code § 6-3.10.

[38] Brevard County, FL, Code § 62-3661.

[39] Fairfax County, VA, Code Ch. 116.

[40] Honolulu County, HI, Code § 23-1.8; Kaua'i County, HI, Code § 8-27.2.

[41] http://www.dnr.state.md.us/ccs/livingshorelines.asp; http://www.dep.state.fl.us/northwest/Ecosys/section/living_shorelines.htm; http://portal.ncdenr.org/web/cm/estuarine-shoreline-stabilization.

[42] Available at ccrm.vims.edu/decisiontree/decisiontree_manual.pdf. See also, *Decision Tree for Currently Defended Shorelines,* Virginia Wetlands Report, Vol. 26, Issue 1 (Spring 2011).

[43] Chris Boyd and Niki Pace, *Homeowners Guide to Permitting Living Shorelines in Mississippi and Alabama,* Mississippi-Alabama Sea Grant Consortium and Mississippi-Alabama Sea Grant Legal Program, MASGC-10-008-04. Available at masglp.olemiss.edu/living_shorelines.pdf.

[44] Examples of NGO documents include: *Living Shorelines for the Chesapeake Bay Watershed,* Chesapeake Bay Foundation; *Living Shorelines: A Natural Approach to Erosion Control,* Galveston Bay Foundation; Living Shorelines webpage, NC Coastal Federation, (http://www.nccoast.org/how-we-work/restore-preserve/living-shorelines/).

[45] U.S. Army Corps of Engineers, Baltimore District, *Chesapeake Bay Shoreline Erosion in Maryland: A Management Guide,* (2010), available at http://dnr.maryland.gov/CoastSmart/pdfs/CBSE_mguide.pdf.

[46] J. Fear and C. Currin, *Sustainable Estuarine Shoreline Stabilization: Research, Education and Public Policy in North Carolina,* NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology, Final Report (October 31, 2008), "[P]otentially, the results of this work could be applied anywhere bulkheads are found." Id., p. 2.

[47] Id.

[48] R. Gittman, A. Popowich, J. Bruno, C. Peterson, "Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane," Ocean & Coastal Management, (September 2013). Available at http://www.mobilebaynep.com/images/uploads/library/Bulkheads.pdf.

[49] Comments on Draft RAE Report submitted by Coasts, Oceans, Ports, and Rivers Institute, Dec. 12, 2014.

[50] U.S. Army Corps of Engineers, *Coastal Engineering Manual.* Available at http://chl.erdc.usace.army.mil/cem.

[51] American Society of Civil Engineers Std. 7, Minimum Design Loads for Buildings and Other Structures.

[52] And even when innovative living shoreline elements are incorporated, extant design and construction guidance may fail to achieve the maximum natural benefits a living shoreline could provide.

[53] Lisa Schiavanato and J. Kalo, eds., *Management Strategies for North Carolina Estuarine Shoreline,* North Carolina Sea Grant, and NC Coastal Resources Law, Policy, and Planning Center, Final Recommendations (2014), p.40. Available at http://ncseagrant.ncsu.edu/ncseagrant_docs/products/2010s/estuarine_shoreline_report.pdf.

[54] NRC 2007 Report, Finding, p.7.

[55] NRC 2007 Report, Finding, p.8.

[56] The CWA states that the Secretary cannot issue a 404 (wetland) permit unless it "will have only minimal cumulative adverse effect on the environment." at CWA sec. 404 (e)(1) specifically referencing issuance of NWPs. See also EPA's 404b1 guidelines - conditions for issuance of a general permit - 40 CFR 230.7(a)(3) and 230.11(g) and (h).

[57] 40 CFR 230.3(c) ["aquatic environment…include[s] interacting communities and populations of plants and animals"].

[58] V.R. Burkett and M.A. Davidson, eds. *Coastal Impacts, Adaptation, and Vulnerabilities,* (2012), National Climate Assessment Technical Input Report, p.101. Available at http://downloads.usgcrp.gov/NCA/technicalinputreports/Burkett_Davidson_Coasts_Final_.pdf.

[59] http://ccrm.vims.edu/ccrmp/index.html.

[60] Newton, I., Philosophiæ Naturalis Principia Mathematica (1687), translation by I.B. Cohen and A. Whitman, University of California press, Berkeley 1999.

[61] NRC 2007 report.

[62] See https://www.estuaries.org/2013-mid-atlantic-living-shorelines-summit for proceedings, agenda, and related materials.

[63] Virginia Institute of Marine Science. www.vims.org.

[64] Gulf of Mexico Alliance. http://www.gulfofmexicoalliance.org/.

[65] Governors' South Atlantic Alliance. http://southatlanticalliance.org/.

[66] Southern Environmental Law Center. https://www.southernenvironment.org/.

[67] National Sea Grant College Program. www.seagrant.noaa.gov.

[68] National Estuary Programs. http://water.epa.gov/type/oceb/nep/index.cfm#tabs-2.

[69] National Estuarine Research Reserve System. http://www.nerrs.noaa.gov/.

[70] Lisa Schiavanato and J. Kalo, eds., *Management Strategies for North Carolina Estuarine Shoreline,* NC Sea Grant, and NC Coastal Resources Law, Policy, and Planning Center, Final Recommendations (2014), p.40. Available at http://ncseagrant.ncsu.edu/ncseagrant_docs/products/2010s/estuarine_shoreline_report.pdf.

[71] 40 C.F.R. 230.

[72] "The impact of shoreline hardening is cumulative. One bulkhead or riprap may have only a small effect on the overall estuarine system. But multiple projects can exceed a "tipping point" that could be catastrophic." NCCOS explanation of long term study of shoreline changes in Chesapeake and Delmarva Bay ecosystems. http://www.coastalscience.noaa.gov/projects/detail?key=60.

[73] A decision in favor of the plaintiffs could significantly curtail the installation of hardened structures and thus necessarily advance wider use of living shorelines. Conversely, a loss by the plaintiffs would enable continued use of NWP 13 as an easy alternative to living shorelines.

[74] U.S. Army Corps of Engineers, *Regulatory Program of the Corps of Engineers,* Federal Register, 42(138): 37121 – 37164, (1977). Available at http://media.swf.usace.army.mil/pubdata/environ/Regulatory/permitting/nwp/1977/1977nwp.pdf.

[75] U.S. Army Corps of Engineers, *Decision Document: Nationwide Permit 13,* (2012). Available at http://www.usace.army.mil/Portals/2/docs/civilworks/nwp/2012/NWP_13_2012.pdf.

[76] White House, *Executive Order 13508 – Chesapeake Bay Protection and Restoration,* (2009). Available at http://www.gpo.gov/fdsys/pkg/FR-2009-05-15/pdf/E9-11547.pdf.

[77] White House, *Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance,* (2009) Available at https://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf.

[78] White House, *Executive Order 13547: Stewardship of the Ocean, Our Coasts, and the Great Lakes,* (2010). Available at https://www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes.

[79] White House, *Executive Order 13554: Gulf Coast Ecosystem Restoration Task Force,* (2010). Available at https://www.whitehouse.gov/the-press-office/2010/10/05/executive-order-13554-gulf-coast-ecosystem-restoration-task-force.

[80] See endnote 23.

[81] White House, *Executive Order 13653: Preparing the United States for the Impacts of Climate Change,* (2013). Available at https://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change.

[82] U.S. EPA, *Report of the Interagency Task Force on Carbon Capture and Storage,* (2010). Available at http://www.epa.gov/climatechange/Downloads/ccs/CCS-Task-Force-Report-2010.pdf.

[83] The White House Council on Environmental Quality, *Final Recommendations of the Interagency Ocean Policy Task Force,* (2010). Available at https://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf.

[84] National Ocean Council, *National Ocean Policy Implementation Plan,* (2013). Available at https://www.whitehouse.gov/sites/default/files/national_ocean_policy_implementation_plan.pdf.

[85] National Research Council, *Urban Stormwater Management in the United States,* (2008), p. 387 et seq.

[86] http://ccrm.vims.edu/ccrmp/index.html.

[87] States surveyed included Maryland, Virginia, Delaware, South Carolina, North Carolina, Rhode Island, Georgia, Florida, Mississippi, Alabama, Texas, Massachusetts, and Washington.

[88] http://portal.ncdenr.org/web/wm/sf/ihs/recprogram.

[89] Department of Defense. 2004. *Design: Low Impact Development Manual.* UFC 3-210-10. Available at http://www.lowimpactdevelopment.org/lid%20articles/ufc_3_210_10.pdf.

[90] National Research Council, *Urban Stormwater Management in the United States,* (2008), p. 102 et seq.

[91] The Southeast Regional Partnership for Planning and Sustainability. http://serppas.org/.

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