Guidance for Considering the Use of Living Shorelines

2015

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- National Marine Fisheries Service
  - Office of Habitat Conservation, Chair
  - Office of Protected Resources
- National Ocean Service
  - National Centers for Coastal and Ocean Science
  - Office for Coastal Management
  - Office of National Marine Sanctuaries
- Office of Oceanic & Atmospheric Research
  - National Sea Grant Program Office
  - Climate Program Office
- Office of Program Planning and Integration

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Front: NOAA Beaufort Lab Living Shoreline, Beaufort, North Carolina. Credit Carolyn Currin.
Back: NOAA Oxford Lab Living Shoreline, Oxford, Maryland. Credit Janine Harris.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Coastal communities face constant challenges from shoreline erosion. Although erosion is a natural coastal process, many valuable resources border the nation's coastline. Shorelines need protection from damage caused by intense storms, wave erosion, and sea level rise. Shoreline stabilization does not need to create a barrier between land and water, as happens with hard shoreline stabilization structures like seawalls and bulkheads. New stabilization options, like living shorelines, are gaining attention as an alternative to traditional shoreline stabilization techniques. Living shorelines can reduce damage and erosion while simultaneously providing ecosystem services to society, including food production, nutrient and sediment removal, and water quality improvement.

Living shoreline is a broad term that encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g., oyster reefs or rock sills) for added stability. Living shorelines maintain continuity of the natural land–water interface and reduce erosion while providing habitat value and enhancing coastal resilience.

NOAA encourages the use of living shorelines as a shoreline stabilization technique along sheltered coasts (i.e., coasts not exposed to open ocean wave energy) to preserve and improve habitats and their ecosystem services at the land–water interface. Toward this end, NOAA encourages early coordination across multiple scales of government and with other entities outside the government to develop shoreline management approaches that lead to the best shoreline stabilization options for a particular site. While this document focuses on sheltered coasts, NOAA has a broad interest in maintaining existing natural habitats that provide shoreline protection, like coral reefs, oyster reefs, mangroves, seagrass beds and marshes, along all coasts.

This guidance is intended to provide information on NOAA's perspective and roles regarding living shorelines implementation. It starts by describing NOAA living shorelines guiding principles, then highlights NOAA's role in providing science, tools, and training to help inform the selection of appropriate techniques. It also discusses the agency's role in reviewing living shoreline projects, depending on their location and potential effect on habitats of concern to NOAA, such as critical habitat, essential fish habitat, or protected areas. This guidance also provides a conceptual framework of 12 questions to help NOAA and our partners when planning a shoreline stabilization effort.

INTRODUCTION

As sea levels continue to rise, coastal storm intensity increases, and coastal development continues within our coastal zone, coastal communities are threatened by increasingly severe infrastructure damage and loss of habitat from extreme storms (Melillo et al. 2014, NOAA 2015, Sutton-Grier et al. 2015). If coastal populations continue to increase and shoreline hardening in the US continues at the current rate of about 200 km/year, nearly one third of the contiguous US shoreline is expected to be hardened by 2100 (Gittman et al. 2015a). There is evidence that shorelines having intact natural coastal habitats (e.g., wetlands, dunes, mangroves, and coral reefs) experience less damage from severe storms and are more resilient than hardened shorelines (Arkema et al. 2013, Gittman et al. 2014). Areas with natural coastal habitats also have higher populations of fish and other living organisms important for shorebirds and for recreation and commercial purposes (Peterson et al. 2000, Scyphers et al. 2011, Sobocinski et. al. 2008).

For these reasons, NOAA supports alternative approaches to hardened shorelines and seeks innovative ways to increase coastal resilience to erosion and storm threats while conserving habitats for living marine resources. Living shorelines provide an innovative approach to reducing damage and erosion while simultaneously enhancing coastal community resilience by providing additional social, economic, and ecological benefits. NOAA supports the use of living shorelines over hardened shorelines, where appropriate. We recognize living shorelines are not sustainable in some locations, nor are they able to achieve significant reductions to damage from flooding and storm surge unless significant intact coastal habitat is conserved.

Purpose

This guidance addresses the following three questions:

1. What to consider when selecting appropriate techniques in a given location to stabilize shorelines while conserving coastal and marine resources.
2. How NOAA is encouraging the use of living shorelines as a shoreline stabilization approach through existing programs, training, partnerships, funding, and technical assistance.
3. How to navigate NOAA's potential regulatory (consultation and permitting) and programmatic roles in living shoreline project planning.

Audience and Use

This guidance is intended for NOAA staff and partners considering the use of living shorelines across the country. The information provided should be a starting place for understanding NOAA's roles in living shoreline planning, research, and implementation and for determining whether a living shoreline is appropriate to address shoreline erosion. This may be useful background for those looking to implement a living shoreline at a particular site, but is not a guidance document with design specifications for building a living shoreline.

Scope

This guidance focuses on shorelines along estuarine coasts[1], bays, and tributaries rather than non-sheltered coasts, like shorelines facing open ocean. Maintaining natural habitats that provide shoreline erosion protection even outside of sheltered coasts (e.g, coral reefs, oyster reefs, mangroves, seagrass beds, and marshes) is favorable wherever feasible. This is not a siting or design manual and does not provide instructions for living shoreline implementation in specific locations.

Chesapeake Bay Environmental Center, MD (Credit Janine Harris)

[1] NOAA includes the Great Lakes coastline when referring to shorelines and the coast.

DEFINING LIVING SHORELINES

Living shoreline is a broad term that encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g. oyster reefs or rock sills) for added stability. Living shorelines maintain continuity of the natural land–water interface and reduce erosion while providing habitat value and enhancing coastal resilience.

Living shorelines are sometimes referred to as nature-based, green shorelines, or soft shorelines. A subset of these living shorelines may be hybrid solutions with a mix of natural (e.g. oyster shell) and nature-based (e.g. reef balls or rocks where they do not naturally occur) materials. The term living shoreline is aptly applied to a wide variety of stabilization techniques. **Figure 1** shows a continuum of project techniques along a green (natural materials only) to green/gray (hybrid) to gray (all built materials) scale. The projects on the left, green side of this continuum represent possible living shoreline design options. NOAA encourages the use of these softer techniques for shoreline stabilization. This continuum is based on the more detailed continuum in the Systems Approach to Geomorphic Engineering (SAGE) Natural and Structural Measures for Shoreline Stabilization brochure (http://sagecoast.org/docs/SAGE_LivingShorelineBrochure_Print.pdf). A number of federal agencies, including the U.S. Army Corps of Engineers, developed and agreed on the SAGE continuum.

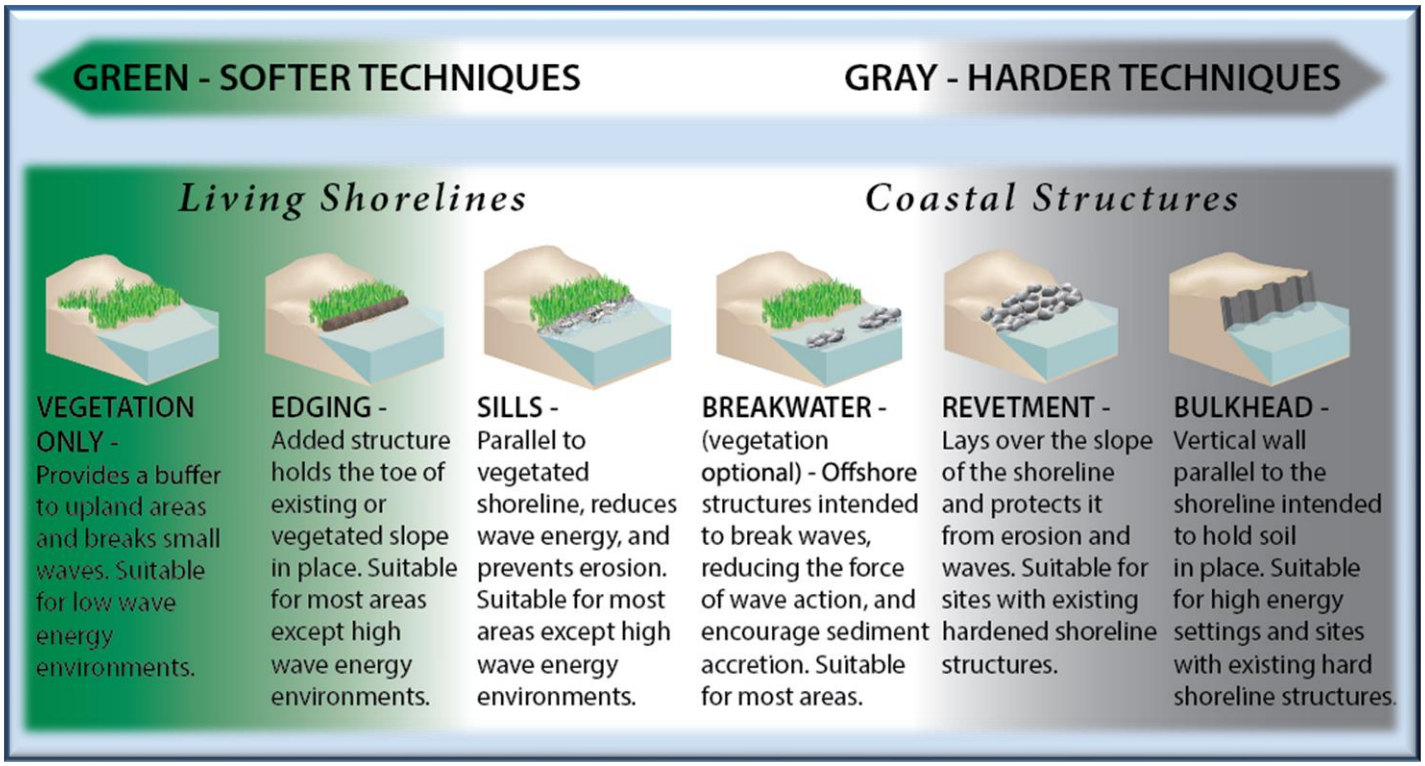

Figure 1: A continuum of green (soft) to gray (hard) shoreline stabilization techniques. Source: This continuum is based on the more detailed continuum in the Systems Approach to Geomorphic Engineering (SAGE) Natural and Structural Measures for Shoreline Stabilization brochure (SAGE 2015).

Structural elements incorporated into living shoreline designs can include a variety of materials for edging, sill, and breakwater stability. For example, oyster shells and oyster shell bags, biologs, concrete reef balls for shellfish attachment, and rock are all structural options that can be applied in the range of living shoreline designs. The shoreline treatments on the right of the continuum are not considered living shorelines. These include treatments like vertical bulkheads (wood, steel, vinyl, and concrete), and structure-dependent designs, like stone breakwaters and revetments without living components.

NOAA's LIVING SHORELINES GUIDING PRINCIPLES

NOAA encourages the use of living shorelines as a shoreline stabilization technique along sheltered coasts. Living shorelines can enhance resilience by reducing damage and erosion while simultaneously conserving and improving habitats and their ecosystem functions at the land–water interface. NOAA also acknowledges the desirability of maintaining natural habitats that provide shoreline protection on non-sheltered coasts. Specifically, NOAA's Living Shorelines Guiding Principles are shown below.

NOAA's Living Shorelines Guiding Principles

- NOAA encourages the use of living shoreline techniques to provide, maintain, or improve habitat or ecosystem function and enhance coastal resilience.
- NOAA encourages shoreline protection methodologies that avoid or minimize channel-ward encroachment into subtidal habitat; NOAA does not promote the use of living shorelines as a means for land reclamation.
- NOAA encourages shoreline stabilization using the softest approach feasible, based on site conditions.
- NOAA encourages carefully considering regional and site-specific differences in factors such as wave energy, habitat types, and geologic setting in planning the appropriate living shorelines.
- NOAA encourages early coordination across multiple government and non-governmental entities to discuss site characteristics, history of erosion at a site, and potential challenges for proposed shoreline management approaches.
- NOAA encourages incorporating the best available regional and local shoreline science and practices into the siting, design, construction, evaluation and adaptive management of projects.
- NOAA encourages the consideration of ecosystem services provided by a shoreline stabilization approach (such as erosion control and habitat for fish and other living marine resources) in living shoreline project design.

NOAA supports these living shorelines principles for a number of reasons:

- **Shoreline erosion is a natural process that supplies important sediment to coastal habitats.** If shoreline erosion is not a concern, leaving a natural shoreline is

preferred to maintain existing ecosystem services. However, taking action to stabilize a shoreline may be necessary where infrastructure is located very close to eroding shorelines.

- **Bulkheads have adverse effects on adjacent habitats.** Although gray, hardened coastal structures (like bulkheads and other examples shown in **Figure 1**) may be appropriate for shoreline stabilization at specific sites, NOAA does not consider them by themselves to be living shorelines. The vertical face of bulkheads reflects wave energy, resulting in erosion along the toe of the structure (U.S. Army Corps of Engineers 1981, Bozek and Burdick 2005, National Research Council 2007). Shoreline hardening from structures like bulkheads can cause adverse coastal habitat impacts, including the loss of shallow intertidal bottom substrate from scour, loss of fringing marshes, decline of intertidal or shallow water habitats like submerged aquatic vegetation (SAV), and a decrease in benthic abundance and diversity (Douglass and Pickel 1999, OSTP 2015, Patrick et al. 2014, Seitz et al. 2006). Treated wood bulkheads may also contain chemicals that can leach into the coastal environment (Weis and Proctor 1998). Living shorelines reduce many of these adverse effects on adjacent habitats.

- **Living shorelines can protect land from erosion.** Living shorelines can be successfully used on sheltered coasts to dampen wave energy and reduce erosion (Swann 2008). Even narrow marshes—a frequent component of living shoreline designs—have been shown to slow waves and reduce shoreline erosion (Currin et al. 2015). Specifically, *Spartina spp.* salt marshes have been shown to dissipate wave energy by 50 percent within the first 2.5 meters (Knutson et al. 1982). The majority of studies have examined salt marsh wave attenuation on low- or medium-energy waves (Shephard et al. 2011). Also, Manis et al. (2014) showed that the value of a living shoreline for wave energy attenuation increases as the living shoreline matures.

- **Living shorelines can become more stable over time.** Living shorelines become more stable over time as plants, roots, and oyster reefs grow. While adjustments to hard materials within the living shoreline might be needed, the living elements of a living shoreline, like oyster reefs, are expected to maintain elevation relative to predicted sea level rise through 2100 (Rodriguez et al. 2014, Sutton-Grier et al. 2015). Living shorelines with oyster and stone sill components have also been shown to accrete sediment behind them, on the landward side of the sill (Currin et al. 2008). Also, salt marshes—a main component of many living shorelines designs—are known to trap sediment and organic matter and may also increase surface elevation through production of below-ground biomass, which is incorporated into the sediment (Morris et al. 2002, Cahoon et al. 2004,

Currin et al. 2008, Currin et al. 2010). Living shorelines also have limited costs associated with them for improvements (like rock structure augmentation or rearrangement) or additional vegetation. Bulkheads, on the other hand, have a definitive life period, perform at their best on initial installation, and need to be replaced entirely at the end of their life.

- **Living shorelines have outperformed hardened shorelines during storm events.** On sheltered coasts along the North Carolina outer banks, marshes (with and without sills) outperformed bulkheads during Category 1 Hurricane Irene in 2011. Those marsh and sill designs accreted sediment, while 75 percent of regional bulkheads surveyed were damaged (Gittman et al. 2014). During severe storms, bulkheads can fail. For example, along the South Carolina coast near Charleston, 58 percent of bulkheads were destroyed during Hurricane Hugo in 1989 (Thieler and Young 1991).

- **Living shorelines provide greater habitat function than hard shorelines.** Living shorelines provide valuable intertidal habitat for fish and marine resources. These living shoreline habitats also provide ecosystem services to society, including food production, nutrient and sediment removal, water quality improvement, carbon sequestration, wave attenuation, shoreline stabilization, and storm protection (Barbier et al. 2011). Coastal wetlands vegetation—frequently used in living shorelines on the Atlantic and Gulf of Mexico coasts—significantly reduces damages inflicted on coastal communities (Costanza et al. 2008) and also provides fish habitat and nitrogen removal. An acre of salt marsh has been calculated to have a value from $981 to $6,471 (Barbier et al. 2011). The ecosystem benefits of living shorelines are also projected to increase over time as the living components of the shoreline establish themselves, compared to a hard shoreline that will need to be replaced (Seitz et al. 2006).

- **A system-wide look at shoreline stabilization shows the true ecosystem effects from hardened shorelines.** When shoreline functions are considered at a system level, the cumulative ecosystem effects of hardened shorelines can be seen. Armoring of a few small sections of shoreline may have only local adverse impacts, but as more and larger areas of shoreline become armored, changes can occur to the coastal ecosystem and services they provide (National Research Council 2007). For example, developed shorelines negatively affect benthic infauna (organisms burrowed in the sediment, like clams and worms) in subtidal habitat adjacent to the shoreline stabilization. Where impermeable bulkheads are stabilizing a shoreline, benthic infauna in the subtidal habitat adjacent to the shoreline are negatively impacted. This could be due to a loss of nutrients from marsh materials that deposit-feeding infauna would consume. Reduced

infauna densities adjacent to bulkheads can lead to diminished predator densities and less productivity in the shoreline system (Seitz et. al. 2006).

- **A smaller living shoreline hard substrate footprint minimizes some habitat tradeoffs.** For many types of shoreline protection (including living shorelines), negative impacts can result on existing shoreline and nearshore habitats and the coastal species that depend on those habitats by replacing soft or living material with hardening materials (e.g., by replacing subtidal mudflats with rock sills). Living shoreline methodologies that avoid or minimize channel-ward encroachment into subtidal areas minimize these trade-offs. Minimizing the footprint of hard, unnatural structures reduces the effects on the infaunal community (Bilkovic and Mitchell 2013). While the vegetation and fish utilization in constructed marsh sills can mirror that of nearby natural marshes in just a few growing seasons, (Currin et al. 2008, Gittman et al. 2015b), epifauna (i.e. oysters and mussels) and infaunal species density takes longer to catch up to a natural state (Bilkovic and Mitchell 2013).

Bainbridge Island, WA (Credit WA Sea Grant)

HOW NOAA PROMOTES LIVING SHORELINES

NOAA promotes the use of living shorelines in several ways:

Building and Nurturing Innovative Partnerships

NOAA leads by providing funding and technical assistance for designs of living shorelines and through research to demonstrate the proof of concept. For example, the NOAA Restoration Center has worked with partners to contribute technical and financial assistance to more than 100 living shoreline projects, and NOAA regional offices routinely provide technical assistance on living shoreline projects. NOAA continues to build and nurture innovative partnerships to support the appropriate use of living shorelines, including through consideration of living shorelines in proactive planning. For example, NOAA is a key partner working with other federal agencies as a part of Systems Approach to Geomorphic Engineering (SAGE), to provide a forum to leverage resources for coastal projects that incorporate hybrid approaches like living shorelines.

Encouraging Living Shorelines (and Green Infrastructure) in Disaster Planning

NOAA helps communities with pre-disaster planning, encouraging the development of disaster response plans that discuss which natural and nature-based techniques, like living shorelines, can reduce future vulnerability caused by erosion or loss of habitat. NOAA also supports post-disaster response and redevelopment planning. NOAA works with planners and managers to monitor and highlight demonstration projects with post-disaster success to share with others what was learned about green infrastructure effectiveness.

Delivering Science-Based Information

NOAA provides science-based guidance to stakeholders, planning and construction professionals, coastal resource managers, and landowners. NOAA also uses this information when reviewing projects that fall under our resource management responsibilities, such as essential fish habitat, critical habitat for certain threatened or endangered species, and stewardship of designated protected areas.

Leading by Example

NOAA has installed living shorelines as a management strategy on our own properties, such as at the National Centers for Coastal Ocean Science laboratories in Beaufort, North Carolina, and Oxford, Maryland. NOAA also issued a NOAA National Habitat Policy in which we confirm NOAA's responsibility, driven by the agency's stewardship mandates, to ensure the nation has a strong foundation and network of healthy habitats that are important for achieving NOAA's goal to increase resilience to coastal communities. NOAA-funded partners, such as the National Estuarine Research Reserves, Coastal Zone Management programs and State Sea Grant Programs are doing innovative work with NOAA funding to lead by example as well. For example, the Hudson River National Estuarine Research Reserve (NERR) is a leader in assessing shoreline suitability along the Hudson River for shoreline projects, developing guidance on implementation, and training on how to incorporate living shorelines into planning.

NOAA's engagement in living shoreline approaches to shoreline stabilization is influenced by several of our coastal habitat and natural marine resource mandates and authorities, which are described in the Appendix.

NOAA Lab, Beaufort, NC (Credit Carolyn Currin)

NOAA CONCEPTUAL FRAMEWORK FOR CONSIDERING LIVING SHORELINES

This framework consists of 12 guiding questions and answers to consider when determining the shoreline stabilization approach for a site that will best stabilize the shoreline and sustain coastal connections between land and water.

A number of factors should be considered when planning and designing a living shorelines project. Physical and ecological considerations include site conditions, presence of ecologically important or sensitive resources, and the potential effects of climate change and sea level rise over time. Policy considerations include evaluating trade-offs between coastal development and habitat conservation at a given site, and applying specific federal and/or state authorities to the project site, which may require a formal project review, consultation, or issuance of a permit.

Physical and Ecological Considerations

1. What are the physical site conditions?

It is important to understand the conditions at the site being considered for shoreline stabilization, including the local ecosystem context. Natural stabilization systems, like marshes and reefs, should be considered before a hybrid living shoreline design. Living shorelines should be designed based on specific site conditions and the design should be developed in consultation with regulatory staff, a coastal contractor (designer), stakeholders, and other coastal specialists (e.g., engineer or biologist) if possible.

Important site factors to consider when designing living shorelines include:

- What types of natural habitat are present at the site and along adjacent shorelines?
- What is the extent, rate, and cause of the current erosion problem?
- What are the site's slope, orientation, bathymetry, prevailing currents, waves, and fetch?
- Are other hard shoreline stabilization structures adjacent or nearby?
- Does land loss occur mostly during large storms, or year-round?
- What are the current land and water uses in the area and who owns or manages them?
- How much boat traffic occurs along the shoreline?
- Is the site suitable for planting vegetation as part of a living shoreline project?
- What would be the result if nothing was done to the site?

2. Are ecologically valuable aquatic habitats or animals living along the shoreline at the site?

Minimizing impacts to NOAA trust resources[2] through protection of ecologically valuable aquatic habitats is of primary importance to NOAA when evaluating any shoreline protection or enhancement project where NOAA has natural resource management authorities. When a project may impact NOAA trust resources, NOAA, through its statutory authority, may require or recommend measures for avoiding or minimizing impacts, including reduction of channel-ward encroachment or use of an alternative to hardened shorelines for shoreline protection. Ecologically valuable aquatic habitats include:

- Submerged aquatic vegetation beds.
- Coral reefs, shellfish beds, and oyster reefs.
- Tidal wetland dominated by native species.
- Habitat used by federally threatened or endangered species
- Cobble, gravel, riffle and pool, sand, and mud substrate used as spawning and nursery grounds for NOAA trust resources.

3. How should the effects of sea level rise, and water level changes in the Great Lakes, be considered in living shoreline projects?

To ensure long-term effectiveness, living shoreline projects should include consideration of predicted sea level rise and Great Lake water level changes. Projects will have greater resilience to projected ranges of potential sea-level rise when constructed adjacent to areas where existing fringe marsh or restored marsh is capable of landward migration or sediment accretion. When there is capacity for migration, living shorelines can play a role in adapting to sea level rise. Living shorelines allow for more natural shoreline migration or increasing elevation through sediment trapping and accretion, whereas traditional structures create a break in the land–water interface that does not allow for accretion.

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[2] NOAA trust resources are living marine resources that include: Commercial and recreational fishery resources (marine fish and shellfish and their habitats);Anadromous species (fish, such as salmon and striped bass, that spawn in freshwater and then migrate to the sea); Endangered and threatened marine species and their habitats; Marine mammals, turtles, and their habitats; Marshes, mangroves, seagrass beds, coral reefs, and other coastal habitats; and Resources associated with National Marine Sanctuaries and National Estuarine Research Reserves.

Several NOAA tools are available to assist with planning for the effects of sea level rise on a shoreline or fluctuating Great Lakes water levels. These tools may be helpful for assessing the potential application and benefits of living shorelines in an area.

NOAA Sea Level Rise and Great Lake Water Level Tools Include

- **Digital Coast Sea Level Rise Viewer**: http://coast.noaa.gov/digitalcoast/tools/slr
- **MAPTITE:** Marsh Analysis and Planning Tool Incorporating Tides and Elevations http://tidesandcurrents.noaa.gov/maptite.html
- **National Environmental Sensitivity Index (ESI) Shoreline Viewer:** http://egisws02.nos.noaa.gov/esi/esi.html
- **Sea Level Rise Tool for Sandy Recovery:** http://oceanservice.noaa.gov/news/features/aug13/sandy-slr-tool.html
- **Great Lakes Water Level Dashboard:** http://www.glerl.noaa.gov/data/dashboard/GLWLD.html
- **Great Lakes Water Level Viewer:** http://coast.noaa.gov/llv/

4. What balance between green (softer) and gray (harder) stabilization is appropriate given particular site conditions?

It is important to evaluate the level of risk for continued erosion with the level of protection that is acceptable at a particular site. Decision-makers should keep in mind that no shoreline stabilization technique (hardened or a living shoreline) is guaranteed to prevent the loss of infrastructure during the most severe storms. In theory, a living shoreline can be more resilient than a bulkhead in storms with high storm surge, because storms can roll over the living shoreline inundating the land and then leave the shoreline minimally impacted. In contrast, the wave energy from the channel-ward side and retreating water can undermine bulkhead and seawall structures that are not high enough to prevent inundation and provide storm surge protection. NOAA regional staff and partners (like state Sea Grant programs, state coastal management programs, and the regional U.S. Army Corps of Engineers districts) can provide assistance in evaluating decisions that balance the use of green (softer) and gray (harder), natural and unnatural materials for shoreline stabilization at a local level.

5. How can functional habitats be added to a necessary hard structure?

If a shoreline designer has determined a stabilization approach needs to include hard structure, the project implementer should consider ways to associate that hard structure with functional habitat. Methods might include:

- Incorporating oyster or clam shell bags or marine-safe concrete that encourages shellfish to attach or settle.
- Establishing living structure, like corals and oysters, and designing systems to function as closely to natural systems as possible.
- Incorporating native low and high marsh vegetation augmented by regionally specific coastal plants (such as mangrove seedlings).
- Incorporating native seagrass.
- Incorporating sandy or cobble beach, mudflats, or other natural shoreline features.
- Maintaining wetlands and/or upland riparian buffers adjacent to a structure.
- Adding fish habitat enhancement structures to bulkheads
- Incorporating breaks or openings in any hard structural elements (excluding bulkheads and seawalls) to facilitate natural water flushing and allow aquatic organisms to access nearshore and shoreline habitat (e.g., fish and turtles for upland nesting).

6. Where is more information available about designing and siting living shoreline projects?

State coastal zone management programs and local non-profit organizations are increasingly available to provide technical assistance with the design of living shorelines, considering the important role of local shoreline development regulations. NOAA partners with state coastal management programs, National Estuarine Research Reserves training programs, and local organizations to provide technical assistance with the design of living shorelines and to offer training in living shorelines implementation. Trainees may be good local resources. Landowners with existing living shorelines may also provide referrals and recommendations for the work done on their property and for marine contractors that do living shorelines work. Links to state contacts for the coastal management programs is available online at: http://coast.noaa.gov/czm/mystate/.

SAGE (Systems Approach to Geomorphic Engineering), co-led by NOAA, is a Community of Practice working together to use and promote green–gray approaches to ensure coastal community and shoreline resilience. The SAGE website (http://sagecoast.org/info/sci-eng.html) provides links to state- and region-specific guidance about designing and siting living shoreline projects. Also, in 2014, through the SAGE initiative, NOAA and the U.S. Army Corps of Engineers developed a brochure presenting a continuum of green to gray shoreline stabilization techniques, highlighting living shorelines. The brochure provides a detailed overview of different types of natural and

structural measures for shoreline stabilization, along with basic information on the environments for which they are suitable, benefits, disadvantages, options for materials, and relative costs for initial construction and maintenance. The brochure is available online at: http://coast.noaa.gov/digitalcoast/publications/living-shorelines.

State Sea Grant programs may offer regionally specific design and siting guidance for living shorelines on a site-by-site basis. The National Sea Grant Network also offers an online Resilience Toolkit that has a section devoted to Natural Infrastructure and Living Shorelines. The Toolkit is an evolving website where local Sea Grant programs upload toolkits, guidance documents, and handbooks for shoreline projects. Contacts for the state Sea Grant programs are available online at: http://seagrant.noaa.gov/wherewework/seagrantprograms.aspx and the toolkit is available at: http://seagrant.noaa.gov/WhatWeDo/ResilienceToolkit/BrowseToolkit/TabId/618/PID/5569/el/0/CategoryID/76/CategoryName/Natural-Infrastructure-/Default.aspx .

7. What kind of maintenance is associated with a living shorelines project?

Maintenance is critical for the success of a living shorelines project, including replanting vegetation as needed, trimming tree branches (depending on the native vegetation's sunlight requirements), removing debris, and removing any interfering invasive species. Traditional hard stabilization also requires maintenance, such as bulkhead repairs, replacement, and rock movement and replacement.

Monitoring the effectiveness and habitat function of existing living shorelines is important for the adaptive management of these structures. Learning more about how living shorelines protect shorelines from erosion and sustain fish habitats is important to evaluate whether the use of more living shorelines is appropriate. Living shoreline designers should consider adding monitoring to their sites wherever possible (even if monitoring is not a permit requirement), and should consider how to encourage monitoring of all projects without adding burden to the landowner.

Policy Considerations

8. What NOAA authorities need to be considered when identifying objectives for a living shoreline project site?

NOAA recognizes that there may be differences of opinion as to the best approach for shoreline management at a particular site, as managers simultaneously consider habitat protection for specific species and erosion and storm protection for human infrastructure. There will always be trade-offs between the existing habitat and ecosystem functions and the change in ecosystem functions considered for any site. NOAA encourages coordination among government,

stakeholders, and other entities involved in the design and review of living shoreline projects early in the project planning process to consider these trade-offs.

Some considerations for NOAA related to using living shorelines for shoreline protection include:

- **Coastal Development and Habitat Conservation**
  NOAA has mandates both for protecting habitat and marine species and for considering multiple uses of the coastal zone, National Marine Sanctuaries (NMS), and other areas See the Appendix for more information about NOAA's mandates, authorities, and programs. For example, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) defines a process for NOAA to protect and conserve fish habitats from fishing and non-fishing impacts (such as coastal development) through essential fish habitat (EFH) consultation with federal and state agencies (16 U.S.C. § 1855(b). The EFH consultation process requires action agencies and project proponents to consider impacts and steps to reduce, avoid, minimize, or mitigate impacts to fish habitat. NOAA is also charged with administering the Coastal Zone Management Act (CZMA), which seeks to preserve, protect, develop, and restore the resources of the nation's coastal areas through comprehensive planning. Through the CZMA, full consideration is given to ecological, cultural, historic, and aesthetic values as well as the needs for compatible economic development.

  NOAA has mandates through the CZMA to support state plans that give priority consideration to such coastal-dependent uses as facilities related to national defense, energy, fisheries development, recreation, ports, and transportation. NOAA accomplishes the CZMA's objectives by funding participating states to develop and adopt coastal plans for sustainable use of the coastal zone and coastal-dependent activities. In addition, participating states may require federal agencies and federal permittees to ensure that their activities are consistent with the state plan to the maximum extent practicable. These priority considerations need to be reconciled with NOAA's other living marine resource conservation mandates. Avoiding or minimizing development impacts to ecologically valuable coastal habitats to the extent practicable is a priority for NOAA. Encouraging living shorelines as a shoreline stabilization technique, where appropriate, helps meet NOAA's broad mandates and goals of assisting states in their decision-making while preserving a more natural shoreline habitat.

- **Effects on Existing Habitat**
  There are habitat trade-offs associated with shoreline stabilization techniques, as a project can reduce habitat important for one living marine resource while supporting habitat important to another. Installing a hard shoreline structure may result in degradation and/or loss of aquatic habitat. However, living shoreline projects can sometimes convert

existing aquatic habitat to another habitat type. For example, planting a marsh where there had been open, shallow water changes the habitat there. Consistent with, and in addition to, relevant NOAA statutes and authorities (*see Appendix),* some considerations when evaluating habitat trade-offs include:

- Projects should be accomplished with the minimum channel-ward encroachment needed to effectively accomplish the project purpose and should minimize displacement of other aquatic habitats of importance to NOAA trust resources. Exceptions to this may be appropriate if the newly established living shoreline habitat type would yield a net environmental benefit.
- Loss of EFH and ESA critical habitat should be minimized.
- Once avoidance and minimization has been demonstrated, equivalent restoration or preservation for similar ecosystem services may be needed to offset the unavoidable habitat losses (see question 11 about compensatory mitigation).

9. How should living shorelines project planning consider public access and other social contexts?

A state may enhance or secure public access to coastal areas using funds provided under the CZMA. Depending on state laws and policy, land below either the high or low tide line is a public trust resource—i.e., the public may have a right to walk and fish along that portion of the shoreline. Living shoreline projects should not impede access to the public trust shoreline. Thus, an important consideration is whether a living shoreline project would interfere with an existing public access site (e.g., shoreline access point, walkway, or boat launch) or enhance a site (e.g., provide public access or serve as an outreach and education component). Because living shorelines can allow the shoreline to migrate inland with sea level rise and coastal erosion, they may be a better alternative for preserving shoreline access compared to hard stabilization structures, like bulkheads, which can erode land shore-ward of the structure. For these hard structures, any intertidal area that may have been in the public trust erodes away over time, and that public access opportunity is lost.

It is important to consider the complete societal context where a living shoreline is being considered as well, including how effectively the surrounding community is engaged in the project plans to address particular concerns, and if the shoreline could be designed to enhance recreational opportunities. The Ecosystem Service Assessment: Research Needs for Coastal Green Infrastructure (OSTP 2015) report provides helpful approaches for how to evaluate tradeoffs between ecosystem services and the values stakeholders place on them, for a living shorelines project.

10. When does NOAA review, consult on, or permit living shoreline projects?

NOAA may have roles and responsibilities related to living shoreline projects depending on the location and potential effect of the project. As explained above, NOAA might, for example, engage in consultation pursuant to the MSA's EFH requirements. See the Appendix for an overview of relevant NOAA mandates, authorities, and programs. Below are four key steps to help determine when NOAA's authorities may apply.

Key steps:

1. Identify whether the project will affect resources under NOAA's jurisdiction, such as EFH identified under the MSA, species listed as threatened or endangered under the Endangered Species Act (ESA) or critical habitat for those species[3]; marine mammals; National Marine Sanctuary or National Estuarine Research Reserve land–water interfaces; and/or areas subject to a state's coastal management shoreline policies.
2. If so, find out which programmatic or regulatory requirements apply to the project.
3. Discuss project goals and design with government and other entities involved in the design and review of living shoreline projects early in the planning process to find the appropriate solution for the site environment.
4. Once project planning and design are complete, submit the project formally for the appropriate regulatory review and/or permitting processes.

[3] The National Marine Fisheries Services (NMFS) and the U.S. Fish and Wildlife Service (FWS), U.S. Department of the Interior, have joint responsibility for administering the ESA. NMFS generally manages marine species, and FWS manages land and freshwater species.

NOAA Consultation and Permit Contacts and Helpful Links

- **Coastal Zone Management state program managers:** http://coast.noaa.gov/czm/consistency/
- **Essential Fish Habitat regional contacts:** http://www.habitat.noaa.gov/protection/efh/regionalcontacts.html
- **Endangered Species Act species:** http://www.nmfs.noaa.gov/pr/species/esa/ and critical habitat: http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm
- **Marine Mammal Protection Act Incidental Take Authorizations:** http://www.nmfs.noaa.gov/pr/permits/incidental/#when.
- **National Estuarine Research Reserve locations:** http://www.nerrs.noaa.gov/
- **National Marine Sanctuaries locations:** http://sanctuaries.noaa.gov/about/welcome.html

11. Can a living shorelines project be used as compensatory mitigation?

Maybe. Compensatory mitigation refers to the restoration, establishment, enhancement, and/or preservation of wetlands, streams, or other aquatic resources conducted specifically for the purpose of offsetting authorized impacts to these resources. NOAA evaluates each compensatory mitigation project on its own merits and considers the ecological functions lost or degraded, as well as the existing and proposed functions of the compensatory mitigation site. Because NOAA is required under its mandates (see Appendix) to protect, conserve, restore, and promote the stewardship of coastal and marine habitats such as EFH, submerged aquatic vegetation, corals, shellfish beds, and complex bottom habitats, we seek to ensure that compensatory mitigation fully offsets the functions lost, or provides habitat of equal or greater ecological value.

There may be instances where filling of intertidal and subtidal habitats for the construction of a living shoreline project may be acceptable as compensatory mitigation, if the living shoreline project results in an overall ecological benefit to aquatic resources and if impacts to ecologically valuable habitats such as submerged aquatic vegetation, shellfish, and complex bottoms have been avoided or minimized. The effects of an individual project on ESA-listed species and their critical habitat also needs to be determined though a ESA Section 7 consultation to determine if compensatory mitigation is appropriate. Any living shoreline project used as compensatory mitigation must also comply with the federal mitigation regulations put into law in April 2008 by

the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers. These regulations[4]) outline a number of requirements for all compensatory mitigation projects, including long-term site protection mechanisms, development of ecological performance standards, requirement to monitor the mitigation site for a minimum of 5 years, submission of monitoring reports, and long-term monitoring and maintenance of the mitigation site.

12. What types of support does NOAA provide for living shorelines?

NOAA offers support for three aspects of living shorelines work: design and construction; research; and training, technical assistance, and policy development. The existence of ecologically valuable habitat associated with shoreline stabilization enhances the likelihood of funding from NOAA's habitat-focused programs. A few examples of NOAA programs that provide funding and training support for living shorelines include:

- **Funding for On-the-Ground Projects:** The NOAA Community-based Restoration Program and state Sea Grant programs provide funding that may be used for living shorelines projects. NOAA also periodically receives one-time supplemental storm or disaster recovery funding that may be used for living shorelines on-the-ground projects. Disaster recovery funding has included the RESTORE Act after the Deepwater Horizon oil spill in the Gulf of Mexico and the Hurricane Sandy Recovery and Rebuilding Supplemental Appropriations.

- **Research Projects:** The National Estuarine Research Reserve System (NERRS) Science Collaborative and the National Centers for Coastal Ocean Science (NCCOS) support living shorelines research. The Coast and Ocean Climate Application (COCA) program in NOAA's Climate Program Office supports interdisciplinary applications research aimed at addressing climate-related challenges in coastal communities and coastal and marine ecosystems, which includes research on living shorelines.

[4] 33 CFR Parts 325 and 332 and 40 CFR Part 230 of the Compensatory Mitigation for Losses of Aquatic Resources Final Rule. The purpose of this part of the Final Rule is to establish standards and criteria for the use of all types of compensatory mitigation to offset unavoidable impacts to waters of the United States authorized through the issuance of Department of the Army (DA) permits pursuant to section 404 of the Clean Water Act (33 U.S.C. 1344) and/or sections 9 or 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401, 403).

- **Training, Technical Assistance, and Policy:** NERRS, the National Coastal Zone Management Program, and the Sea Grant College Program can provide direct technical assistance and develop guidance and manuals to support the implementation of living shorelines at a regional level. These programs also provide trainings and public webinars to educate others about living shoreline implementation and monitoring. Through the National Coastal Zone Management Program, NOAA works with state coastal management programs to support the revision of state policies and regulatory processes to encourage and facilitate the use of living shorelines. On a project-specific basis, staff from NMFS and the Restoration Center provide technical advice and guidance on project design and permitting.

Magnolia Springs, AL (Credit National Estuarine Research Reserve)

CONCLUSION

Living shorelines are an important tool for managing coastal erosion, enhancing intertidal habitat for fish and marine resources, and enhancing the resilience of coastal communities and ecosystems against sea level rise, climate changes, and extreme climate events. When used at appropriate sites, living shorelines allow for continued coastal processes and ecosystem connections while also providing shoreline stabilization. As such, NOAA encourages the use of living shorelines as a shoreline stabilization technique along sheltered coasts to preserve and improve habitats and their ecosystem services at the land–water interface. NOAA recognizes that there are a variety of green and living shoreline options that can be implemented to preserve coastal habitats and build coastal resilience and participates in partnerships to identify and clarify those options. Through our many roles—from building and nurturing partners, to delivering science-based information and leading by example—NOAA continues to promote living shorelines for shoreline stabilization, habitat connectivity, and community resilience.

Londontowne, MD (Credit Mary Andrews)

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APPENDIX- NOAA's MANDATES, AUTHORITIES, AND PROGRAMS

This appendix provides a non-exhaustive, list of NOAA mandates, authorities, and programs that may be relevant to the use of living shorelines for erosion control and habitat connectivity.

Coastal Zone Management Act:

The Coastal Zone Management Act (CZMA) establishes two important partnership programs with states that are involved in living shorelines work: The National Coastal Zone Management (CZM) Program and the National Estuarine Research Reserve System (NERRS).

Living shorelines are a growing interest for state **Coastal Zone Management (CZM) Programs**. Through the voluntary CZM Program partnership, many states are promoting softer shoreline stabilization methods, such as living shorelines, as alternatives to hard structures. With support from NOAA, states are promoting living shorelines is several ways. Some state programs have worked (or are working) to revise their coastal policies and regulatory processes to encourage and facilitate the use of living shorelines**.** State CZM programs have also developed technical assistance guides, training, and other capacity building efforts to educate people about living shorelines, often in partnership with the NERRS and Sea Grant Programs. Some states may have shoreline rules, such as specific riparian buffer requirements, that are part of their NOAA-approved coastal management program. Federal actions—such as the issuance of shoreline stabilization permits, funding for living shorelines, and direct agency activities that have reasonably foreseeable coastal effects—need to be consistent with the state's NOAA-approved coastal management policies. Most state CZM programs recommend pre-consultation to ensure the living shoreline proposed is consistent with the state's coastal policies and regulatory requirements.

While NOAA provides financial and technical assistance to state programs and can encourage states to promote living shorelines, as the federal partner in the National Coastal Zone Management Program, NOAA does not get involved in day-to-day state permit decisions. State decision-making rests entirely with the state. In cases where there is a disagreement between a federal agency and a state coastal management program as to whether a federal action is or is not consistent with the state's coastal policies, NOAA may play a role in mediating a solution. More information about this "federal consistency" provision of the CZMA is available online at: http://coast.noaa.gov/czm/consistency/, including a link to state points of contact.

The **National Estuarine Research Reserve System (NERRS)** conducts research, offers training, and provides reference data for understanding habitat function and quality and local water levels and inundation patterns that can be used to support design of living shorelines. The NERRS Science Collaborative puts reserve-based science to work for coastal communities. By incorporating the intended users of living shorelines science into the research process to identify living shorelines science

needs, this collaborative effort results in practical applications of the living shorelines research occurring in NERRS sites and NOAA properties, including long-term protection on NOAA property. Working in partnership with Restore America's Estuaries, from 2013 to 2014 NERRS hosted a series of living shorelines webinars that explored the rationale, science, application, tools, and case studies of how living shoreline projects are applied to address a wide array of shoreline management challenges. The webinars targeted a national audience of NERRS and state CZM coastal program staff. The recorded webinars are available online at: https://www.hrnerr.org/estuarytraining/trainingtopic.

Endangered Species Act

All federal agencies are directed, under Section 7(a)(2) of the Endangered Species Act (ESA), to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Federal agencies are further required by Section 7(a)(2) of the ESA to consult with National Marine Fisheries Service (NMFS) regional Protected Resources Division staff when actions they fund, authorize, or carry out may affect species under the agency's jurisdiction and/or designated critical habitat for those species. NMFS also reviews non-federal activities that may affect species listed under the ESA and issues permits under Section 10 of the Act for the incidental take of those species and for scientific research and enhancement purposes. A list of the federally threatened and endangered marine species that NOAA has jurisdiction over and maps representing their habitat are available on the NMFS Protected Resources website: http://www.nmfs.noaa.gov/pr/species/esa/. Land-based species under state or U.S. Fish and Wildlife Service (FWS) jurisdiction should also be considered for a living shorelines project. Note that, in additional to having jurisdiction over all land-based species, FWS has authority over some marine species, including Pacific walrus, sea otters, polar bears, and manatees, as well as certain other freshwater aquatic species.

Fish and Wildlife Coordination Act

In many circumstances federal action may affect habitat of a fish species that does not have Essential Fish Habitat (EFH) described and identified for it and, therefore, an EFH consultation is not warranted (e.g., forage species). However, recommendations on ways to avoid, minimize, or mitigate impacts on these habitats under the Fish and Wildlife Coordination Act (FWCA) may be appropriate. The FWCA, 16 U.S.C. 661 *et seq,* requires that all federal agencies consult with NMFS, FWS, and state wildlife agencies on the impacts of proposed living shorelines projects and other water-resources development projects that are undertaken or authorized by a federal agency. Because FWCA consultation applies generally to wildlife including fish and fish habitat, it has broader applicability than consultation regarding EFH under the Magnuson-Stevens Fishery Conservation and Management Act, discussed below. Based on environmental impacts analysis performed under FWCA consultation, NOAA may prepare a report that includes recommendations to mitigate project impacts to NOAA trust resources and their habitats and steps that the project proponent can take to protect and enhance such resources as part of the water-resource development project.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal agencies to consult with NMFS on any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH) identified under the MSA. A Clean Water Act Section 404 Permit issued by the U.S. Army Corps of Engineers is an example of a federal action applicable to a living shorelines project that may require consultation with NMFS under the MSA EFH authority. EFH can be identified via fishery management plan text descriptions, almost all of which are accessible from the EFH Mapper (http://www.habitat.noaa.gov/protection/efh/efhmapper/). (Note that EFH data in the EFH mapper may be of low resolution or missing in estuaries and along the shoreline.) When a federal agency determines that a shoreline project may adversely affect EFH identified under the MSA, that agency conducts an EFH Assessment and initiates a consultation with NMFS to consider the biological effects of the activity on coastal fish habitat. NOAA responds to the assessment with conservation recommendations for reducing habitat loss and degradation. NMFS' Habitat Conservation Divisions conduct these consultations and also can provide technical assistance to federal, state, and local agencies before the consultation on EFH for federally managed species. This assistance includes recommendations for ways to reduce habitat loss and degradation. NOAA encourages early coordination among agencies involved in permit review to identify design requirements and potential issues early in order to streamline the consultation process. Contacts for the regional Habitat Conservation Division EFH Coordinators are available online at: http://www.habitat.noaa.gov/protection/efh/regionalcontacts.html.

Marine Mammal Protection Act

NOAA issues permits under the Marine Mammal Protection Act (MMPA) for activities that result in a "take" of marine mammals. The MMPA was enacted in response to increasing concerns among scientists and the public that significant declines in some species of marine mammals were caused by human activities. The act prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas. The nation's coastline provides important marine mammal habitat, including haul-outs for seals and sea lions and nearshore areas that provide important foraging opportunities. The quality of acoustic habitat is extremely important for marine mammals. Some shoreline work, especially activities that produce underwater sound or that disturb seals or sea lions on shore, has the potential to incidentally affect marine mammals and may require an Incidental Take Authorization (ITA). Some precautions can be taken during the design and implementation of living shorelines projects to account for marine mammals, such as ensuring that construction is conducted in a manner that does not create an entanglement risk to marine mammals, incorporating marine mammal escape routes at construction sites, monitoring construction sites for marine mammal presence, and adapting underwater work to dampen sound as required. While NOAA recommends best practices to prevent takes of marine mammals by entrapment and entanglement, use of these measures cannot guarantee a take will not occur. Additional information about when ITAs are required and appropriate NOAA contacts are available online at: http://www.nmfs.noaa.gov/pr/permits/incidental/#when.

National Marine Sanctuaries Act

The Office of National Marine Sanctuaries (ONMS) has a broad range of activities that fall under the living shorelines continuum, including marine debris removal from coastal, intertidal, and subtidal areas and restoration activities associated with groundings or other sanctuary injuries. If a shoreline project is located within a National Marine Sanctuary, landowners should contact the National Marine Sanctuary to discuss the project in the context of its regulations and management. The list of National Marine Sanctuaries is available online at: http://sanctuaries.noaa.gov/about/welcome.html. The National Marine Monument Program is different than the National Marine Sanctuaries Program. The four Pacific Ocean National Monuments co-managed by NOAA were created by Executive Order and are co-managed with the U.S. Fish and Wildlife Service via the Antiquities Act and the Fish and Wildlife Coordination Act. National Marine Sanctuaries are also different than the National Marine Protected Areas Center (MPA Center). The MPA Center builds partnerships and tools to protect special places rather than providing direct management for specific sites.

Digital Coast

Digital Coast is a resources developed by NOAA in partnership with key users to help coastal managers and communities address coastal issues. It provides data, tools, trainings, and examples that can be used to help plan and implement living shorelines projects. The Digital Coast is accessible online at http://coast.noaa.gov/digitalcoast/. The Digital Coast features a few specific resources related to living shorelines on the following page: http://coast.noaa.gov/digitalcoast/topic/green-infrastructure .

National Sea Grant Office and State Sea Grant Programs

Sea Grant's mission is to enhance the practical use and conservation of coastal, marine, and Great Lakes resources in order to create a sustainable economy and environment. Living shorelines are a coastal application that falls under this mission, and individual state sea grant programs provide a variety of resources for their states. Local Sea Grant programs may offer regionally specific design and siting guidance for living shorelines on a site-by-site basis. For example, the Hawaii Sea Grant published "A Landowners Guide to Coastal Protection," which reviews recognized methods for shoreline protection and distinguishes between hard and soft applications. It also gives general guidance on decisions on which method to use depending on whether the environment is low, moderate, or high energy. State Sea Grant program contacts are available online at: http://seagrant.noaa.gov/wherewework/seagrantprograms.aspx

National Centers for Coastal Ocean Science

The National Centers for Coastal Ocean Science (NCCOS) work directly with managers, regulators, and scientists to deliver relevant, timely, and accurate scientific information and tools. Current living shorelines research projects include measuring marsh vegetation, surface elevation, and sediment accretion rates in stabilized (stone sill) and natural fringing marshes, and assessing the carbon sequestration potential of fringing marshes and living shorelines. Working in partnership with the Department of Defense, NCCOS is measuring estuarine shoreline erosion rates, examining the role of marshes in reducing erosion, and developing adaptive management approaches, like living shorelines,

for the conservation of marsh habitats. At the NCCOS lab in Beaufort, North Carolina, scientists with expertise in living shorelines work closely with North Carolina on many living shorelines research efforts. For example, with North Carolina, NERRS, and NOAA funding, NCCOS has implemented two living shorelines demonstration projects that incorporate oyster reefs and marsh. NCCOS has also published a handbook, "Weighing Your Options," which is being distributed by the North Carolina Division of Coastal Management permitting staff.

NOAA Restoration Center, Regional Habitat Conservation Divisions, and the habitat-related components of the West Coast Region Area Offices

The NOAA Restoration Center (RC), Regional Habitat Conservation Divisions (HCDs) and the habitat-related components of the West Coast Region Area Offices have been involved with living shoreline design, consultation, and implementation for decades. RC project partners have completed close to 150 projects funded through annual appropriations, the American Recovery and Reinvestment Act of 2009, and Damage Assessment Remediation and Restoration Program settlements since 2000. Projects range from small-scale projects on private property to those spanning several miles of shoreline.

HCDs and the habitat-related components of the West Coast Regional Area Offices work with partners to discuss and consult on project impacts to EFH and endangered species and their critical habitat. The regional divisions provide conservation recommendations, as applicable, for conserving these natural resources while in the scope of a living shoreline project.