

Living Shorelines Strategic Needs Assessment



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Background

In many locations, shorelines that fringe coastal rivers, creeks, sounds and bays are eroding¹ and washing away due to a host of threats, resulting in declining property values, damage to the associated aquatic and terrestrial ecosystems, and degraded water quality. As development in the South Atlantic continues and accelerates, pressure on that coastal interface between land and water will increase. Alternatives to traditional shoreline management techniques (which rely primarily on engineered structures) may help strengthen coastal resilience with natural infrastructure.

The Governors' South Atlantic Alliance (GSAA) supported a process to examine the appropriate role in the South Atlantic region (NC, SC, GA, FL) for estuarine shoreline management methods other than traditional means of shoreline hardening. Particular focus was on living shorelines ("LSL"), a suite of alternative shoreline stabilization techniques that incorporate vegetation or other living, "soft" and natural elements². The assessment process³ included surveys, a summit attended by approximately 150 participants, and a workshop, which all contributed to development of this strategic needs assessment. From this process, consensus emerged that the use of the softest feasible alternative of those described on the continuum from "Green - Softer Techniques" (*e.g.*, "Vegetation Only") to "Gray - Harder Techniques" (*e.g.*, "Seawall") (SAGE, 2015, attached as Appendix C) tends to yield both the best ecological and shoreline stabilization outcomes, and GSAA partners accordingly support promoting and emphasizing the use of such techniques where compatible with site conditions.

The GSAA has therefore adopted the following Strategic Needs Assessment to advance the appropriate use of living shorelines in the South Atlantic. The Assessment's intent is to highlight and prioritize the education, research, and policies needed to establish LSLs as a desirable alternative for protecting eroding, flooding, or threatened shorelines, thereby providing better options for coastal protection that work in harmony with the land-water interface and the surrounding ecosystems.⁴

¹ Although erosion is an important part of the natural cycle of estuarine systems, where it threatens infrastructure or a property owner's use of his/her property, the owner will respond with efforts to retard or halt its progression.

² There are many definitions of "living shorelines." Definitions used by NOAA and USACE are included in Appendix A.

³ The process is described in more detail in Appendix B.

⁴ Although specific examples of action items are included for broad consideration, this Assessment is not intended to be a strategic plan, action plan, or self-tasking document for the GSAA or any other individual organization to implement.

Strategic Needs

This Assessment identifies two broad categories of strategies needed to promote living shoreline use: (1) targeted education and outreach directed to those constituencies best situated to affect shoreline management decisions; and (2) policies that could influence multiple elements of shoreline management decision-making.

Target Audience

This Assessment is intended to assist those LSL constituencies that can best address the identified education and outreach needs and can formulate and implement the recommended policies designed to promote wider use of appropriate LSLs. As such, it is not specifically addressed to private landowners, although their role in LSL decisions is critical and therefore their information needs should be addressed, as noted in the following discussion. Instead, the following groups have been identified as most likely to be able to use the recommendations of this Assessment:

- State and Federal agencies involved in shoreline management, whether that agency's focus is on regulation, research, or conservation
- Local land use planners and resource managers
- Academic institutions
- NGOs
- Funders of conservation projects and research
- Legislators, and other public officials involved with shoreline policy
- Public landowners of shoreline (including the Department of Defense)
- Land trusts with shoreline interests

Existing Resources

In each of the GSAA states, the state conservation and regulatory agencies have information (much of it accessible through their websites) concerning shoreline management of erosion and the use of LSLs. In addition, an on-line forum originally created by the Southern Environmental Law Center and now hosted by the Living Shoreline Academy⁵ (<http://livingshorelinesacademy.org/index.php/forum/index>) collects and reviews a wide variety of materials related to LSLs. Additional sites and materials are collected and described in Appendix D.

Living Shoreline Constituencies - Their Knowledge Gaps and Information Needs

Increased use of LSLs depends on: (1) the property owner/developer choosing an LSL technique instead of a hard coastal structure at appropriate sites; (2) the availability of a well-trained and experienced community of “professionals” (defined here as designers, engineers, and marine contractors); and (3) knowledgeable regulators and coastal resource managers. Property owners often lack adequate information about the range of shoreline management options, and their consequences. Choices are often influenced by the professional and regulatory community, as well as less formal networks of information, such as how their neighbors are addressing erosion on adjacent properties, and information from NGOs and realtors. These constituencies directly affect shoreline management decisions and are separately discussed below. Other important constituencies discussed below (NGOs, financial risk institutions, and community interests) also have an interest in influencing shoreline management decisions because of the cumulative impacts of those decisions along the coast. Promoting LSLs and other softer techniques, advancing their adoption, and broadening their implementation are dependent on the decision-makers, and those best situated to influence the decision-makers, having information that better informs shoreline management choices. Better information will likely lead to better decisions.

⁵ LSA was created as a pilot project in part in response to the diverse but uncoordinated efforts of state and local entities interested in LSL issues, resulting in duplication of effort. The GSAA does not endorse any one NGO’s LSL efforts (including LSA), but does recognize and support the concept that the effective promotion of LSLs is furthered by a coordinated LSL effort that includes vehicles for: wide access to reliable information; the development of generally accepted siting, design, construction, and maintenance standards; and the development of training materials and opportunities.

Before discussing each constituency's primary information needs, one education resource was consistently identified across the board: the existence and public awareness of LSL demonstration sites, where individuals can observe different LSLs in various settings and see their effect over time. Demonstration sites inform LSL use in a myriad of ways and are of prime importance in educating all constituencies about shoreline management, protection from erosion and storm damage, flood protection, habitat preservation, ecosystem services, water quality benefits, and good stewardship of estuarine resources. Construction of and publicity about demonstration living shorelines are important parts of each of the suggested education strategies set out below.

Property Owners

In the near-term, the following were considered to be the most pressing information needs for this group:

- The need for shoreline management and the existence of LSL alternatives
- How to initiate the process (design, permit, and build)
- Comparative costs (installation and lifecycle maintenance) of hardened versus LSL alternatives
- Efficacy⁶ over time of all alternatives (hardened and LSL) in managing both gradual (erosion) and traumatic (storm) events

The ways to reach this group are varied. Most frequently mentioned were LSL professionals⁷ (discussed below) and regulators (discussed below) because of the frequency with which owners typically turn to these groups for guidance. A relatively new resource is realtors (discussed below), who are uniquely positioned at the earliest stages of a new homeowner's first exposure to shoreline management to offer advice and information about additional resources. General public education and awareness of LSL issues will rely on NGOs, public education campaigns [including Public Service Announcements ("PSAs")], and web materials, such as those being developed by non-profits and state and federal agencies.

⁶ Additional monitoring and research, as discussed below, will be necessary to demonstrate the performance characteristics over time of LSLs and other shoreline management methods.

⁷ This category includes designers, engineers, and marine installation contractors and suppliers.

Additional needs for education considered to be valuable but less critical in affecting decision-making by this constituency include:

- Ecosystem benefits of LSLs
- Indirect benefits (property value, possible insurance benefits)
- Property boundaries and regulations (ownership of the estuarine bottom)
- Perceptual barriers (aesthetics; what property owners are used to; the desire for instant solutions compared to more gradual gains)

These areas are best addressed in the types of general public education campaigns mentioned above. In addition, materials being developed by state regulatory and conservation agencies and the materials listed in Appendix D could be sources of additional content in these campaigns. Homeowners' Associations and local signage can also raise local awareness.

LSL Professionals (designers, engineers, and marine installation contractors and suppliers)

This constituency is critical to the success of LSLs. Its members must first know of the existence of LSL alternatives and understand their benefits and limitations. Equally critical, it is this constituency that must know how to properly design, install, and maintain appropriate systems. A better understanding of the challenges, over time, with hardened structures should lead professionals to look more seriously at softer alternatives.⁸ That examination of alternatives will require an understanding of design alternatives, installation best practices, costs, and potential profits. Information about new business opportunities (*e.g.*, suppliers and installers of the soft system elements) can also attract interest to these techniques. The primary information needs of this group are:

- Evaluating the need for shoreline management and potential for LSL
- Comparative costs (hardened structures and LSLs) for installation, life-cycle, and market entry capital costs
- Site suitability for LSLs

⁸ Gittman, R.K., A. Popowich, J. Bruno, C. Peterson (2014). Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category One hurricane. *Ocean & Coastal Management*, 102: 94-102. Available at: <http://www.mobilebaynep.com/images/uploads/library/Bulkheads.pdf>

- Efficacy over time of LSL versus hardened structures
- Permitting rules

The primary method for conveying information on these subjects is through trade association meetings and seminars, especially those focusing on providing continuing professional education (“CPE”) credits required by certain professions. The likely trainers are experienced LSL professionals, NGOs focused on shoreline issues, and regulators (particularly with respect to assistance with the permitting process). Research scientists carry particular weight in presenting information about LSL resilience to storm events as well as site suitability issues. Certification of levels of LSL expertise by organizations like the Living Shorelines Academy or the National Estuarine Research Reserve’s Coastal Training Programs (or the professional organization for that trade) is suggested as a way of assuring levels of competence as well as promoting public confidence and awareness.

Additional needs for information considered to be valuable but less critical in affecting decision-making by this constituency include:

- Knowledge of LSL ecosystem services and benefits, including fishing and birding enhancements
- Knowledge of plants (native and invasive)
- Business opportunities (new methods/supply needs)
- Sourcing LSL substrates (appropriate plants, oyster shell)
- Property owner interest

The first three areas are best addressed by the same CPE resources discussed above, with a more prominent role likely for the scientific community. The last category is best addressed by experienced LSL professionals and NGOs experienced in LSLs.

Developers

Some of the same factors important with owners are applicable to developers. In particular, the primary information needs of concern to developers are:

- Comparative costs (hardened structures versus LSLs) for installation and life-cycle
- Benefits and limitations of alternatives (hardened versus LSLs)
- Efficacy over time of alternatives (hardened versus LSLs)

- Evolving public perception of benefits of “green” development

Although less likely to be in need of CPE credits, this constituency can likely be reached at many of the same types of venues applicable to LSL professionals, such as presentations from experienced LSL professionals and NGOs at trade association meetings and shows. As discussed above, certain specific topics also lend themselves to scientists and regulators. Attention to these subjects could also be generated through recognition awards (“Stewardship Developer”) and regional publications focusing on living patterns and trends (“Coastal Living”, city/region magazines focused on living or tourism).

Additional needs for information considered to be valuable but less critical in affecting decision-making by this constituency include:

- Understanding of permitting rules
- Indirect benefits of LSLs (property value, insurance)
- Site suitability, best management practices, and adjacent effects

The same venues suggested above are also appropriate for training on these subjects. Regulators, LSL professionals, and NGOs would be the best sources for such training.

Resource Managers

The primary areas of information needs about the benefits of LSLs applicable to this constituency are:

- LSL alternatives to hardened shoreline management
- Water quality and wildlife benefits from LSLs, and how to capitalize on them
- Benefits of replacing existing hardened structures with LSLs
- Funding sources

The growing body of research demonstrating the positive differential effect of LSLs over hardening is of particular significance to this group and is best conveyed by specialized NGOs and the scientific community. Workshops and science conferences are suggested venues. Exploring ways to form partnerships among NGOs, resource managers, and the

scientific community for the sharing of ideas and innovations (*e.g.*, obtaining TMDL⁹ credits for LSL installations) should be a goal of such conferences. A central source of information, such as the Living Shorelines Academy, should collect and identify sources for LSL funding (state/federal/private grants).

Also of interest to resource managers:

- Permitting rules
- Life cycle costs
- Knowledge of ecosystem services and system biology (plants, shellfish, etc.)

The same training sources previously identified for regulators, experienced LSL professionals, NGOs, and scientists apply here.

Realtors

Someone purchasing water-front property for the first time may have no awareness of the need for shoreline management, much less the suite of options available. The realtor has a unique opportunity to inform this decision by providing very basic information and referral to more knowledgeable “experts.” The information most useful for realtors includes:

- The need for shoreline management and the potential for LSLs
- General knowledge of regulatory framework
- Benefits of LSLs and limitations of hardened and LSLs and alternatives
- Sources of “expert” advice (competent LSL professionals)

Like LSL professionals, most realtors are subject to continuing education requirements and, based on pilot projects in at least one GSAA member state, are eager to learn about LSLs. Experienced NGOs and experienced LSL professionals as well as local regulators are the best source of trainers on these subjects. Information directing realtors, and hence their clients, to web material (NGOs, state agencies) is particularly useful as a training take-away. Homeowner association meetings offer an opportunity for the realtor, in

⁹ “Total maximum daily load” set for specific contaminants (including nutrients) to address impaired waters under the Clean Water Act. TMDL credits may not be available in particular locations but are mentioned here as an example of emerging opportunities related to LSLs.

collaboration with the trainer, to introduce this subject (and the realtor) to a community. Realtors could be natural promoters of an “LSL Parade of Homes.”

Additional subjects of interest to this constituency as they become more familiar with shoreline management issues include:

- Indirect benefits of LSLs (property value, insurance)
- Efficacy over time of alternatives

The latter point is particularly significant in “re-educating” a constituency often steeped in a tradition of hardening without an understanding of its long-term effects, especially with respect to the consequences of storm related failures of hardened structures.

Regulators

Besides LSL professionals and informal information networks (friends and neighbors), this is the constituency most likely to have significant impact on property owners’ ultimate decisions. In the GSAA states, the state regulators are well aware generally of LSLs, and some are actively promoting their use in suitable environments. The LSL community needs to support these efforts while recognizing the unique non-partisan role regulators must play. Areas in which regulators generally (local, state, and federal) could benefit from additional knowledge are:

- Proof of LSL concept
- Efficacy/risk over time of LSLs versus hardened structures
- Site selection/suitability; BMPs

The scientific community is especially important in providing up-to-date research and data on these subjects, and NGOs can provide a role in channeling this information to the regulators with whom they frequently interact, especially at regional conferences (see “Promote Regional Communication and Coordination” (p. 14) below). To the extent regulators are in organizations requiring CPE, that forum would offer a particularly convenient training opportunity. Scientific research institutions are also important sources for information regarding the ecological tradeoffs inherent in each shoreline management technique (another area where on-going education is important). Finally, organizations like the Virginia Institute of Marine Science (VIMS)—combining marine research and education and providing advisory services to policy makers, industry, and the public—are extremely valuable sources of scientific knowledge applicable to specific

sites and projects and as such are models for the development of regionally focused research, education, and advisory resources.

NGOs

This constituency is particularly heterogeneous, ranging from organizations with a high degree of specialized LSL knowledge and experience to those with little or no knowledge of the subject but an interest in conservation generally. The former offer a resource for training and education, as referenced above. The latter are a potential advocacy and education vehicle with a readily available audience (their members), and their primary information needs are:

- Identifying appropriate LSL projects
- Ecological benefits of LSLs
- How to coordinate with other LSL players
- Understanding permitting procedures and options

More experienced NGOs will be the primary source of this information, along with regulators, experienced LSL professionals, and the scientific community. To reach the NGOs less experienced with LSLs, it is recommended that they be referred to the Living Shoreline Forum, and associated web materials, and encouraged to form working relationships with the more experienced LSL players and resource managers. Regional information workshops (see “Promote Regional Communication and Coordination” (p. 14) below) targeted at any of the constituencies should also specifically reach out to conservation NGOs, whether or not they have specific estuarine interests.

Additional areas of potential interest to NGOs include information about funding sources and best management practices (‘BMPs’) in shoreline management.

Financial Risk Institutions

Some of the earliest interest in the effects of sea level rise came from financial risk institutions (insurers, re-insurers, lenders), which have followed this subject closely for obvious reasons. Information about LSLs could be of significance to this constituency, especially on the following subjects:

- Efficacy/risk over time of alternatives (hardened and LSLs)

- Lifecycle costs
- Role of LSL in managing the effects of sea level rise (“SLR”)
- Effects of LSL on property values

The information sources of interest to this constituency will be primarily scientific (including engineering) and economic research, delivered either at professional conferences or through industry publications.

Other Indirect Beneficiaries

In this category we include those with an interest in shoreline health generally, but not necessarily an interest in any specific property or development decision. Examples include commercial and recreational fishing interests and other recreational beneficiaries of improved shoreline habitat (*e.g.*, boaters, birders). These groups have a vested interest in the health of the ecosystems benefited by LSLs, and the more these groups learn about the potential benefits of better shoreline management, the more advocates for LSLs there will be. In this regard, this constituency is much like the NGO community new to LSLs.

Information important to establish a better understanding of LSL issues for this constituency includes:

- Knowledge of ecosystem services
- Water quality benefits
- Evolving public perception

The primary means of reaching this audience is through targeted presentations to civic groups, public information campaigns (PSA; regional living and recreational publications (*e.g.*, “Coastal Living”) and web materials.

Additional Research Needs

Many of the information needs identified above are a matter of connecting existing sources of knowledge with target audiences. However, significant research and data gaps exist in the scientific knowledge of LSLs, including a need for both social and natural sciences research regarding LSLs. The Georgia Coastal Research Council outlined these in

detail based on a thorough literature review.¹⁰ The North Carolina Department of Environmental Quality's 2016 Coastal Habitat Protection Plan identified four areas of additional needed research specific to LSLs.¹¹

This Assessment highlights the most pressing needs, considering their overarching potential for supporting the LSL decision-making process.¹²

1. Efficacy of alternative shoreline management systems (hard and soft) over time both with respect to controlling erosion and with respect to storm/catastrophic events.
2. Better understanding of current perceptions regarding shoreline management options and keys to motivating behavior changes.
3. Comparison of LSL design elements and the appropriateness of particular elements in various sites and conditions, and the impact on adjacent sites.
4. Comparative cost data for installation, maintenance, and lifecycle for LSLs and hardened structures.

The GSAA therefore encourages the funding of research proposals related to these subjects, within the context of specific site conditions that vary from state to state.

Policies Impacting Shoreline Management Applicable to LSL Use

The GSAA also considered broader policies that promote wider use of LSLs, where appropriate, and have applicability across a number of areas and activities affecting shoreline management. Consensus was reached on four major areas meriting priority consideration, as well as other policies also supportive of LSL acceptance and use.

¹⁰ <http://southatlanticalliance.org/wp-content/uploads/2016/09/Living-Shorelines-in-the-Southeast.pdf>

¹¹ http://portal.ncdenr.org/c/document_library/get_file?uuid=68734102-5af8-462a-8562-734562dc965f&groupId=38337, p. 15

¹² See Appendix E for other specific research topics identified as also being of particular importance to promoting the use of LSLs.

Priority Policy Initiatives

1. **Develop Living Shoreline Incentives.** The first barrier to the wider use of LSLs as identified by Restore America's Estuaries¹³ is "institutional inertia"—"Waterfront property owners continue to use hardened shoreline protections because they are familiar with those methods..." and because "hardening was preferred due to psychological inertia. That is, when a neighboring property has a hardened approach, ... , the perception is that a similar treatment is needed." Changing engrained behaviors, rooted in part in perceived social norms, requires providing a reason for change. Since the benefits of living shorelines extend beyond the landowner installing the system, the development of private and public/regulatory incentives for the use of softer systems generally and living shorelines in particular is therefore justified and should be encouraged.

a. **Financial/Monetary Incentives.** Types of financial/monetary incentives for consideration are:

- Technical assistance grants for design or permitting
- Property tax credits
- Insurance benefits (in the flood insurance credit rating system, or wind insurance benefits for mangrove installations)
- Installation cost sharing grants
- Installation insurance (covering damage requiring re-installation in the first X years)
- Carbon trading credits (for preservation of blue carbon lost if hardened structure installed)
- TMDL credits for locality, where available
- Discounted permit fees

Funding for these incentives is obviously a challenge. In addition to traditional sources (public and private grants), potential new sources include license fees for benefited uses (recreational fishing; commercial fishing; real estate transfer tax).

b. **Non-monetary Incentives.** Types of non-monetary incentives suggested for consideration are:

¹³ RAE Living Shorelines: From Barriers to Opportunities - https://www.estuaries.org/images/stories/RAEReports/RAE_LS_Barriers_report_final.pdf, p. 26.

- Continuing Education Credits for professional groups
- Recognition/Awards (separately for owners, realtors, professionals, regulators)
- Certification of expertise (example - “Master Naturalist-Living Shorelines”)
- Permitting preferences (fast-track)
- Preferential mitigation options in permitting

2. **Expand Capacity.** The lack of qualified designers, engineers, and installers limits the ability both to install living shorelines and to educate owners, developers, regulators, and the public about their benefits. Expanded use of LSLs may strain the resources of the existing regulatory agencies. Therefore, preference should be given to research proposals, education/outreach initiatives, and installation projects that include elements that expand the institutional capacity of these constituencies (*e.g.*, include training, education, or demonstration elements targeted at these constituencies). The current efforts at expanding capacity include:

- Living Shoreline Academy, VIMS LSL design Course, and other online training modules/vehicles
- Training and educational materials developed with input from state regulatory bodies, including practical field training
- Development and dissemination (on-line) of professional directories
- Web-based GIS maps locating demonstration sites and describing the BMPs used
- Construction of demonstration projects

Additional ways to build and expand capacity could include;

- Rigorous academic course work in relevant engineering fields related specifically to shoreline management
- Permit fees for all shoreline management projects, to fund education and monitoring
- Professional certification criteria for LSL design and installation contractors
- Training for realtors

3. **Learn from Monitoring.** The lack of data about performance over time of LSLs as well as other shoreline management techniques is widely recognized as an information gap important to the decision-making and regulatory processes. The collection and analysis of performance data over time (whether as pure research or as permit-based monitoring) is critical to making better informed choices. Currently, monitoring is not consistently required of all shoreline management techniques, so comparative data is largely non-existent or anecdotal. Little or no funding is available.

As a starting point, a standard for targeted monitoring is needed. Ideally, monitoring would be a required element of all shoreline management systems, both hardened and LSLs (funded, in part, by permit fees). Since all the data potentially of interest to the scientific community would likely be prohibitively expensive for every project, a standard is needed for what minimal biophysical information should be consistently collected to monitor the performance of an installation. The TNC Oyster Habitat Restoration Monitoring Handbook (for reference, see Appendix D) discusses a variety of monitoring criteria and methods, including metrics specifically applicable to shoreline stability. A citizen-scientist approach is suggested, in which appropriately trained volunteers could aid in the collection of this data (*e.g.*, through an “adopt-a-shoreline” program). New technologies (*e.g.*, drone data collection and digital comparison of photos over time) could reduce the cost and enhance the efficiency of data collection and analysis.

Equally important is the timely use of lessons learned from monitoring data and on-going research. These lessons should impact both the understanding of appropriate BMPs for specific site conditions—thus affecting design, installation, and maintenance choices—and permitting decisions for similar sites in the future. An iterative process of refinement of methods and requirements based on these lessons learned is necessary.

4. **Promote Regional Communication and Coordination.** The GSAA has supported mechanisms for communication in the South Atlantic LSL community through its Living Shorelines Workgroup, the South Atlantic Living Shorelines Summit, and Living Shorelines Workshop. Additional efforts toward coordinating LSL efforts in the South Atlantic are also needed to reduce duplicative efforts and promote effective use of limited resources. To accomplish better regional communication and coordination, the following are needed:

- Periodic regional conferences/summits focused on coastal/estuary issues. These conferences would draw together the constituencies discussed above (including state and federal agencies) and provide opportunities for both education (as discussed above) and formulation of coordinated strategies and efforts to promote LSLs.

- Federal agencies involved in LSLs (USACE (both regulatory offices and SAGE), USFWS, NOAA) should be involved with such conferences and can provide communication and training that addresses regional issues common to LSL activities across states.
- As noted above (Learning from Monitoring), a consensus standard is needed concerning how to monitor shoreline management installations and measure their “success,” both with respect to controlling erosion and storm damage as well as habitat and ecosystem services protection. These “success” standards could be both general, on a large scale, and specific as to particular site types/conditions. Such standards would create a common baseline from which to discuss LSL issues (*e.g.*, BMPs, site suitability, long-term impacts) and learn from regional experiences.
- A better understanding of the permitting process by many constituencies is needed, and it is recommended that an up-to-date state-by-state table summarizing the permit requirements for both hard and soft structures is needed¹⁴.
- All LSL resource websites, particularly state and federal agency (whether regulatory or informational) websites, need to be linked more centrally to provide a “one-stop-shop” for LSL information. Sites like the Living Shoreline Academy may be well positioned to fill such a role. Any central LSL website should be supported by plans for regular (at least annual) updates and maintenance and either a long-term support plan or an exit plan.

Other Policy Initiatives Important to LSLs

- **Public agencies as role models.** Many public bodies own property including shoreline, and could serve as role models in using LSLs which could also serve as demonstration projects. In addition, many public agencies are directly or indirectly involved in policy formation that affects development of shorelines. These agencies are well situated to

¹⁴ In 2012, TNC prepared “Shellfish Restoration and Alternative Shoreline Protection Policies of the Southeastern United States: Florida, Georgia, North Carolina and South Carolina”, which provides an explanation of the regulatory framework in place at that time in each of the GSAA states related to shellfish restoration and LSL projects.

http://masgip.olemiss.edu/Advisory/TNC_Policy.pdf

be leaders in education and advocacy of LSLs as tools in conserving our aquatic resources.

- **SLR planning.** Wise management now of our shorelines can, in some sites, ameliorate the effects of SLR. The role of shoreline management generally and LSLs in particular are therefore important aspects of long term SLR planning and policy.
- **Protection of existing natural shorelines.** Important to this policy is obtaining a comprehensive inventory of the state of the shoreline in each area, a prioritization of those shoreline areas most in need of protection, and a vehicle (*e.g.*, regulatory, monetary incentives, conservation partnerships) for conserving areas before they are degraded.
- **Broader understanding of the economic impacts of shoreline management decisions.** LSLs are too often seen only through the lens of conservation and ecology. LSLs also have economic impacts, albeit not well documented or publicized. Construction and maintenance of LSLs provide employment opportunities, often in economically depressed areas. The resulting habitat (often marsh) provides ecosystem services that can have wide-ranging impacts on a variety of other economically valuable activities (*e.g.*, recreational and commercial fishing, tourism). They can have important economic benefit in property protection from erosion and storm damage, as well as positive impacts on property value. The benefits to water quality from LSLs can, in some cases, result in direct economic benefit to a community in the form of TMDL credits. The economics of LSLs is an important but too often overlooked benefit of good stewardship.

Conclusion

The GSAA states are endowed with estuarine resources of extraordinary value and importance. The experience of others whose resources have been seriously degraded through the gradual hardening of sensitive shorelines cannot be ignored. While not a cure-all, living shorelines offer improvement in many instances, both for the landowner trying to protect property from erosion, storms, and SLR, and for all of those dependent on the services provided by that estuarine system. The GSAA supports educating those affected by and having the power to affect shoreline management decisions about the challenges and benefits of LSLs, and encourages entities involved in shoreline management to consider the policies described above to promote the wider adoption of LSL techniques.

Appendix A: Living Shoreline Definitions

“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.”

Guidance for Considering the Use of Living Shorelines, NOAA (2015), p.7.

The same definition is used by USACE in its Proposed Living Shoreline Nationwide Permit, with only the last sentence slightly modified and one additional sentence added, as follows: “Living shorelines should maintain the natural continuity of the land-water interface, and retain or enhance shoreline ecological processes. Living shorelines must have a substantial biological component, either tidal or lacustrine fringe wetlands or reef structures.”

Fed. Reg. p. 35230-31 (June 1, 2016).

“Living Shoreline: Shoreline stabilization approaches that integrate living components, such as plantings, with strategically placed structural elements, such as sills, revetments, and breakwaters.”

USACE SAGE: Systems Approach to Geomorphic Engineering

<http://sagecoast.org/info/glossary.html>

Appendix B: GSAA Strategy Assessment Process

The process began with GSAA contractors¹⁵ conducting surveys of the southeast Atlantic LSL community to assess the areas of interest for the planned South Atlantic Living Shorelines Summit. A steering committee then planned the specific agenda for the day and a half Summit, held in Jacksonville Florida on April 12-13, 2016. The Summit, attended by approximately 150 individuals from all of the GSAA states and beyond, offered a forum for scientists, regulators, policymakers, planners, contractors, conservation organizations, and LSL practitioners to share their LSL knowledge and experience and discuss needs (technical, informational, financial, and regulatory) for wider understanding and acceptance of LSLs. The Summit was summarized in a report available at <http://files.ctctcdn.com/e7868fa3401/c3b78c44-d63e-4fca-b36d-a0617dce05f4.pdf>.

GSAA then invited a smaller working group to a workshop in Charleston on October 12-13, 2016 to prepare this Strategic Needs Assessment. Facilitated by Chrissa Waite from the NOAA Office for Coastal Management, the group:

- Identified and discussed each constituency potentially important to shoreline management decisions
- Identified and prioritized the information needed to be conveyed to each constituency to make it more effective in the near term in expanding the use of LSLs
- Discussed best methods to convey the needed information to each constituency
- Discussed information gaps—where additional research is needed to promote LSL use—and prioritized those needs
- Identified policy initiatives that impact a number of areas of shoreline management decision-making and prioritized those based on the ones most likely to be achievable and having a near-term impact on the wider use of LSLs

This Assessment was then prepared and circulated to that working group to ensure it accurately and adequately captures the consensus reached in the Charleston workshop. Finally, the Assessment was reviewed and, with revisions to reflect the GSAA leadership consensus, adopted by the GSAA partners.

¹⁵ GSAA was assisted by Moffatt & Nichol and the North Carolina Coastal Federation in conducting the surveys, planning and conducting the Summit and Workshop, and completing this Assessment.

Appendix C: Green to Gray Continuum

(excerpt from SAGE “Natural and Structural Measures for Shoreline Stabilization”)

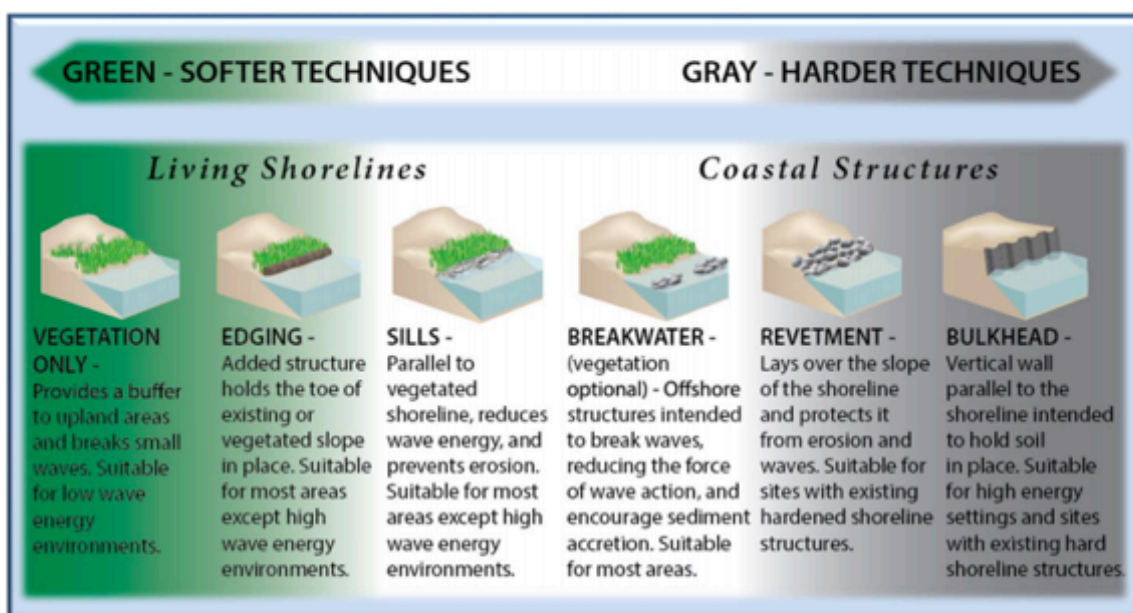


Figure 1: A continuum of green (soft) to gray (hard) shoreline stabilization techniques. Source: This continuum is based on the more detailed continuum in the Systems Approach to Geomorphic Engineering (SAGE) Natural and Structural Measures for Shoreline Stabilization brochure (SAGE 2015).

Appendix D: Additional Resources

The following are important existing major resources for information about shoreline management issues generally and LSL issues in particular:

- NOAA Guidance for Considering the Use of Living Shorelines Report - http://www.habitat.noaa.gov/pdf/noaa_guidance_for_considering_the_use_of_living_shorelines_2015.pdf

Focused on estuarine coasts, bays and tributaries, this guidance addresses: selecting LSL techniques appropriate to the site conditions; NOAA training, partnership, funding, and technical assistance programs; and understanding NOAA's potential regulatory roles.

- SAGE Natural and Structural Measures for Shoreline Stabilization ACOE Report - http://www.sagecoast.org/docs/SAGE_LivingShorelineBrochure_Print.pdf

Developed by NOAA and the USACE SAGE (Systems Approach to Geomorphic Engineering), this brochure presents a continuum of shoreline management techniques from "green to gray" (natural/soft to hardened) appropriate for addressing coastal risks in a variety of settings and explains the benefits and challenges of LSLs in each.

- Florida Living Shorelines website - <http://floridalivingshorelines.com/>

This website explains "how to use plants and other natural materials to help protect eroding shorelines from wave and storm damage in the bays and estuaries of coastal Florida."

- Georgia Living Shorelines website - <http://coastalgadnr.org/LivingShorelines>

This website hosts a report that describes in detail the planning, design and engineering, construction, and monitoring of Georgia's first three living shoreline projects. It also hosts a storyboard of projects that is updated when new information becomes available.

- North Carolina Living Shorelines website - <https://deq.nc.gov/about/divisions/coastal-management/coastal-management-estuarine-shorelines/stabilization>

This website explains alternatives, including LSLs, for shoreline stabilization with links to several reports, including the State's Living Shorelines Strategy Report, research reports, and a "Resource for Homeowners and Professionals" detailing available resources for planning and implementing a living shoreline.

- “Living Shorelines in the Southeast: Research and Data Gaps Report”, Georgia Coastal Research Council (August 2016) -

<http://southatlanticalliance.org/wp-content/uploads/2016/09/Living-Shorelines-in-the-Southeast.pdf>

This report collects and describes the existing research relevant to LSLs in the GSAA states and identifies areas (gaps) where additional research is needed.

- RAE Living Shorelines: From Barriers to Opportunities - https://www.estuaries.org/images/stories/RAEReports/RAE_LS_Barriers_report_final.pdf

This report identifies institutional barriers to the wider acceptance and use of LSLs and suggests strategies for overcoming those barriers.

- Living Shorelines Academy (“LSA”) - www.livingshorelinesacademy.org

A product of collaboration between Restore America’s Estuaries and the North Carolina Coastal Federation (and their many partners), LSA hosts a website that collects up-to-date information, including peer reviewed research, on all areas affecting LSLs. It also provides on-line training materials and is developing additional on-line and in-person training programs for all LSL constituencies.

- TNC Oyster Habitat Restoration Monitoring Handbook - <http://www.oyster-restoration.org/wp-content/uploads/2014/01/Oyster-Habitat-Restoration-Monitoring-and-Assessment-Handbook.pdf>

This report recommends monitoring techniques and performance criteria that would allow for more extensive and consistent post-restoration assessment between oyster restoration projects on varying geographic scales.

- TNC South Atlantic Policy Assessment - <http://masglp.olemiss.edu/publications/index.html> (Living Shorelines)

This page links to a number of LSL resources.

- VIMS training materials - <http://ccrm.vims.edu/livingshorelines/index.html>

This site includes information about LSLs ranging from a description of their benefits to specific design and build criteria.

- Rachel Gittman – “Ecological Consequences of Shoreline Hardening - A Meta-Analysis”, <http://bioscience.oxfordjournals.org/content/66/9/763.full>

Appendix E: Additional Scientific Research Needed

- Optimum biophysical energy conditions for various design options, and technical engineering specs for various sites and conditions/substrates
- Regional-scale mapping of shoreline erosion and LSL suitability modeling
- Effects of SLR on project success relative to other techniques
- Effects of projects on managing the effects of SLR
- Effect on property values
- How shoreline protection alternatives interact with sediment dynamics
- Effects of living shorelines and hardened structures on coastal processes (near field and ecosystem)
- Comparison of living shoreline designs in various sites and conditions
- Quantification of the ecosystem benefits and tradeoffs
- Data about comparative costs
- Efficacy of various shoreline management techniques (including hardened structures) in protecting shorelines
- Priority/protected species impacts/habitat impacts
- Damage from introduction of invasive species (often via construction materials)
- Performance at ecosystem scale
- How to change behavior/current perceptions
- Where are eroding shorelines and suitability modeling
- LSLs' ability to trap contaminants and resulting effect on aquatic species
- Common definition of success at all scales
- Long term performance monitoring of various technologies
- Blue carbon storage potential
- Preservation of genetic diversity