

The Smart Shorelines Project

Siting & Socializing Living Shorelines in Coastal New Hampshire

The 2017-2019 New Hampshire (NH) NOAA Coastal Management Fellow project will inform the development of the NH Tidal Shoreline Management Plan by identifying sites suitable for living shorelines and developing a strategy to increase understanding of how these approaches can preserve important environmental services in the face of current and future coastal risks and hazards to tidal shorelines. The fellow will accomplish this goal in direct collaboration with NHDES Coastal Program (NHCP) Resilience Program staff and partner organizations, including The Nature Conservancy ([TNC](#)), the Great Bay National Estuarine Research Reserve ([GBNERR](#)), and the Northeast Regional Association of Coastal Ocean Observing Systems ([NERACOOS](#)). The fellow will lead two key tasks: 1) design and complete a Living Shoreline Site Suitability Assessment that builds on ongoing efforts to collect data related to current shoreline conditions, shoreline change, and current demand for shoreline treatments and 2) develop a Living Shoreline Outreach and Technical Assistance Strategy that addresses identified needs for specific audiences.

1. Background and Introduction

NH is home to a 1,000 square mile coastal watershed containing two major estuaries: Great Bay and Hampton-Seabrook (See Appendix A for a map of the NH Coastal Zone). These estuaries are recognized for their national importance as part of U.S. EPA's National Estuary Program, NOAA's Estuarine Research Reserve System, and U.S. Fish and Wildlife Service National Wildlife Refuge System. Unfortunately, water quality indicators and important habitats in Great Bay are showing declining trends, and both Great Bay and Hampton-Seabrook Estuaries could be dramatically altered by sea level rise. The state's estuaries and coasts are showing signs of stress resulting from significant population increases—the coastal region is growing at three times the rate of the State of NH—and intensifying weather events coupled with land use policies that are inadequate to manage the impacts of these stressors along the tidal shoreline, including shoreline armoring.

A recent [inventory of NH tidal shoreline protection structures](#) (Blondin 2016) showed that of the 326 miles of tidal shoreline in NH¹, 12 percent are armored with walls, rip rap, or berms and 70 percent of the Atlantic Coast shoreline is hardened. Research is increasingly demonstrating the consequences of armoring shorelines for both natural systems and socio-ecological resilience (Gittman et al. 2014, 2015, 2016; Smith et al. *in review*). As sea levels rise, salt marshes that provide important habitat and benefits to people will need to migrate upland to survive (NH Fish & Game 2014). Armored shorelines will impede marsh migration, causing the marshes to die off. Though traditionally used to curb erosion and provide flood protection, armoring can have detrimental effects on shoreline stability and nearby habitat condition, as wave and surge energy are deflected off hard surfaces. Additionally, hard armoring can be at risk of failing in major storm events if built poorly or not maintained.

These structural approaches to erosion and flood control have long been the norm for property owners in coastal New Hampshire. An analysis of NHDES Wetlands permit applications related to tidal shoreline stabilization shows that demand for permits is increasing with 157 permits issued in the 1980's compared to 564 permits issued in the 2000's (Blondin, internal NHDES analysis). With rising seas and intensifying storm surges, demand for traditional shoreline stabilization will likely accelerate. In some cases these techniques may be the best approach to achieve stabilization or flood control goals. In other cases, hardened structures may be built because they are the only known or tested option (Gittman et al. 2016). New options for 'living shorelines' stabilization approaches are starting to emerge that may provide a more balanced, long-term, habitat-friendly, and cost effective solution in certain locations (Gittman et al. 2014, 2015, 2016). A living shoreline is a shoreline stabilization technique that utilizes a variety of structural and organic materials such as wetland plants, submerged aquatic vegetation, oyster reefs, coir fiber logs, sand fill, and stone (NOAA). Appendix B shows examples of the types of living shorelines that may be suitable in along NH tidal shorelines.

¹ This study was conducted at a fine scale resolution of 1:1500.

Recognizing the need to protect and enhance the resilience and natural resource benefits of coastal community shorelines, the NH Coastal Risk and Hazards Commission (CRHC)—a state legislative Commission required to develop recommendations to assist state agencies and municipalities in preparing for storm surge, sea-level rise, and extreme precipitation impacts—recommends creation of a “comprehensive, integrated NH Tidal Shoreline Management Plan (TSMP) that presents general priorities for coastal shoreline management, as well as site specific and place-based strategies including, where appropriate, protection, adaptation, and abandonment” (Recommendation BL6).² Following a NH Shoreline Management workshop organized by GBNERR in 2014 and consistent with CRHC Recommendation BL6, NHCP has prioritized living shoreline assessment and implementation in its five-year strategy to enhance coastal management (309 Strategy, 2015) and set a longer term goal to develop a Tidal Shoreline Management Plan (TSMP) for New Hampshire. Over the past few years, NHCP and its partners have been involved in several projects to advance work on sustainable shoreline management and are now collaborating on living shoreline restoration projects that will serve as pilot projects. However, much more work is needed in NH to advance knowledge and uptake of living shoreline approaches.

2. Goals and Objectives

The goal of this project is to inform the development of the TSMP by identifying sites suitable for living shorelines and developing a strategy to increase understanding of how these approaches can preserve important environmental services in the face of current and future coastal risks and hazards to tidal shorelines. The fellow will lead two key tasks: 1) design and complete a Living Shoreline Site Suitability Assessment that builds on ongoing efforts to collect data related to current shoreline conditions, shoreline change, and current demand for shoreline treatments and 2) develop a Living Shoreline Outreach and Technical Assistance Strategy that addresses identified needs for specific audiences. This project consists of six distinct objectives, listed in the first column of the table in Section 3.

3. Objectives, Milestones and Outcomes

The following table presents the project objectives with their associated milestones/outcomes and target timeframes that will indicate completion of the objectives. The project partners expect to work with the Fellow to refine this preliminary work plan based on the Fellow’s perspectives about the project.

Objective	Milestones/outcomes	Timeframe(s)
1. Convene and consult an advisory team of experts on living shoreline siting and outreach in coastal NH in one-on-one interviews and meetings	<ul style="list-style-type: none"> • Convened project team meeting to set work plan and schedule for meetings throughout the project. • Convened meetings with expert advisors on specific topics. • Attended relevant meetings for related ongoing projects. 	Month 1-3
2. Design a Living Shoreline Site Suitability Assessment methodology and gather input data to identify appropriate conditions for different living shoreline approaches	<ul style="list-style-type: none"> • Conducted background research to become familiar with living shoreline techniques and policy approaches in the U.S., Northeast, and NH. • Selected parameters for living shoreline suitability in NH • Designed methodology for desktop Living Shoreline Site Suitability Assessment model. • Compiled data for model run. 	Months 1-12
3. Complete a geospatial Living Shoreline Site Suitability Assessment to identify appropriate conditions for different living shoreline approaches in NH’s coastal communities	<ul style="list-style-type: none"> • Completed Living Shoreline Site Suitability Assessment run. • Compiled modeling methodology, datasets, and findings in a final report. • Posted results on the NH Coastal Viewer. • Completed communications product describing modeling results for public outreach purposes (i.e., story map) 	Months 12-18

² As of October 2016, the draft CRHC report is available for download at <http://j.mp/1ROeuuE>, however the CRHC web domain is expected to change when the final report is released in November 2016.

<p>4. Develop a Living Shoreline Outreach and Technical Assistance Strategy that includes identification of at least three key audiences to reach, key partners to implement the strategy, and help to achieve goals, objectives, and desired outcomes</p>	<ul style="list-style-type: none"> Selected priorities in NH living shorelines communications and training needs assessment completed by GBNERR. Identified measurable objectives and outcomes for five-year Living Shoreline Outreach and Education Strategy. Identified audiences, strategies, tools, and materials. Identified and engaged key partners responsible for implementation. Completed and disseminated Strategy among partners. 	<p>Months 6-20</p>
<p>5. Identify a set of socio-political criteria that, together with the site suitability assessment results, are used to identify at least two potentially feasible living shoreline pilot projects and explain the pros and cons of each potential project</p>	<ul style="list-style-type: none"> Identified socio-political feasibility criteria to narrow down from physically suitable sites to potential projects. Identified subset of potential living shorelines projects based on feasibility criteria. Conducted interviews with stakeholders at potential sites. Selected two potential living shoreline projects with pros, cons, and rough budget estimate identified for each site. Identified recommendations for project team to pursue two potential living shoreline projects. 	<p>Months 18-24</p>
<p>6. Develop living shoreline outreach materials to be used in Strategy implementation, including at least two stories that fill important information gaps</p>	<ul style="list-style-type: none"> Selected two outreach materials and/or tools identified in Strategy to develop in addition to site suitability story map. Developed outreach materials. 	<p>Months 20-24</p>

4. Project Description

As part of the process to develop a TSMP, the CRHC recommends several analytical actions (Recommendation BL5) that should be completed prior to the TSMP, including: a) Identify areas where erosion and shoreline instability exist, b) Identify potential sites for nature-based approaches to shoreline stabilization, and c) Prioritize areas for beach nourishment and other shoreline stabilization techniques. Based on these actions, NHCP and its partners have identified two specific deliverables to be completed by the Smart Shorelines Project: 1) a Living Shoreline Site Suitability Assessment to determine appropriate sites for projects and 2) a five-year Living Shoreline Outreach and Technical Assistance Strategy to begin to enhance understanding of living shoreline approaches among key audiences.

1. A Living Shoreline Site Suitability Assessment

In order to determine sites along NH’s tidal shoreline that are suitable for living shoreline approaches, the Fellow will design and conduct a geospatial Living Shoreline Site Suitability Assessment (Assessment) using ESRI mapping applications and available spatial data. NHCP staff assessed available site suitability methodologies used in other states based on data requirements, shoreline type, and other factors, and recommended the NH Assessment should be based on a [modeling approach developed by the Virginia Institute of Marine Sciences](#) (VIMS) and used in Maryland and [Connecticut](#) (Virginia Institute of Marine Science 2008, Zylberman 2016). The model combines spatial data such as land use, LiDAR, habitat information, erosion rates, fetch (length over water that wind blows), and other datasets to delineate specific shoreline segments suitable for different shoreline treatments, including a variety of living shoreline options. NHCP has evaluated the data requirements for this modeling approach and determined that much of the data either already exists or can be compiled using existing tools. This modeling approach will make use of high resolution salt marsh data currently being collected in a project with NHCP, GBNERR, the Piscataqua Region Estuaries Partnership, and the NOAA Office for Coastal Management to be completed in July 2017. The Fellow will work with the project team to tailor the VIMS and CT approaches to fit NH, including incorporating sea-level rise data and salt marsh migration potential data. The Fellow will engage the project team and local experts to determine appropriate parameters for different living shoreline options in New Hampshire. The NH Assessment will be tailored to include a “no action suitable” result when a natural site may not require any shoreline treatment and would be most valuable left in a natural state.

Additionally, the Assessment will include creative treatment options that incorporate living elements in high energy sites that may not be appropriate for marsh- or dune-based living shorelines, such as a live crib wall (see Appendix B). The spatial Assessment results will be published on the [NH Coastal Viewer](#), a web-based, public mapping tool for spatial data related to NH coastal management. The final report will be circulated to the project team's organizations and published on the NHCP website and results will be translated into an accessible communication product for a public audience. The sites identified by the Assessment will inform a process to identify two potentially feasible living shoreline sites. The Fellow will work with the project team to identify important socio-political feasibility criteria such as land ownership, conservation status, surrounding land use, accessibility, owner interest, and estimated cost that can determine feasibility and capacity to complete a project. Depending on the availability of spatial data, some of these criteria may be integrated into the model itself, but others may be applied following the modeling process. Additionally, the project team will clarify organizational priorities for living shoreline pilot projects based on the options.

2. A Five-Year Living Shoreline Outreach and Technical Assistance Strategy

Multiple NH partners recognize a need to provide resources, education, and training opportunities to a variety of audiences in order to advance living shoreline knowledge and implementation. GBNERR is leading a technical assistance needs assessment and beginning preliminary outreach as part of the NOAA Regional Resilience Grant in partnership with the Northeast Regional Ocean Council (NROC). The Fellow will work with GBNERR and the project team to build on those efforts and develop a practical five-year Living Shoreline Outreach and Technical Assistance Strategy (Strategy) leading up to the TSMP process. The goal of the Strategy is to empower and build capacity among key stakeholders to begin adopting sustainable shoreline management approaches, so that they ultimately have the knowledge and tools to develop an effective TSMP. The Fellow and GBNERR will begin by solidifying the Strategy goal and identifying objectives, stakeholders/audiences, and outcomes for the Strategy. The Fellow will review existing outreach programs to understand what is working and to access existing resources that can be tailored to NH, including the [Living Shorelines Academy](#), the [Hudson River National Estuarine Research Reserve](#), and the [North Carolina Coastal Federation](#). The Fellow may consult with members of the target audiences to obtain input on the Strategy. The Fellow will also develop at least two new NH-specific outreach resources such as fact sheets, presentations, training modules, or stories that will be used as part of the Strategy implementation.

Project team and advisors

NHCP Coastal Resilience Specialist Kirsten Howard will lead the project together with the Fellow. A project team will meet as needed, and no less than six times over the course of the fellowship to track project progress and provide input on the project work plan, process, and deliverables. The Smart Shorelines Project team will consist of the following organizations and individuals:

- NHDES Coastal Program: Kirsten Howard, Steve Couture, Nathalie Morison, Fellow
- NERACOOS: Dr. Ru Morrison
- NH Fish & Game GBNERR: Cory Riley, Steve Miller, Lisa Graichen
- TNC: Marine Program Director (currently hiring), Dr. David Patrick

In addition to the project team, others will be available to provide expert input on the project as needed, including but not limited to:

- NHDES Wetlands Bureau: Dori Wiggin, Mary Ann Tilton, Eben Lewis
- NH Geological Survey: Neil Olson
- University of NH: Dr. Dave Burdick (Jackson Estuarine Laboratory), Dr. Tom Ballestero (Stormwater Center), Dr. Gregg Moore (Jackson Estuarine Laboratory), Alyson Eberhardt (NH Sea Grant and Cooperative Extension), Dr. Cat Ashcraft, Dr. Larry Ward (UNH Center for Coastal and Ocean Mapping), Amanda Stone (Cooperative Extension), Fay Rubin (GRANIT, Coastal Viewer)
- Rockingham Planning Commission: Julie LaBranche
- Strafford Regional Planning Commission: Kyle Pimental
- NH Coastal Adaptation Workgroup [members](#)

Proposal for a 2017-2019 NOAA Coastal Management Fellowship Project in New Hampshire

Project tasks

The Smart Shorelines Project work plan will be developed together with the Fellow upon their arrival. However a rough outline of the tasks and process is presented below to give an idea of how the project will progress:



5. Fellow Mentoring

The Fellow's mentor will be Kirsten Howard, NHCP Coastal Resilience Specialist (and a former NOAA Coastal Management Fellow for NH). Kirsten will work closely with the Fellow to solidify the work plan, execute the process, and meet project deliverables. Kirsten will also oversee the administrative details of the Fellow's integration into the NHCP, including organizing trainings. Kirsten will be available for regular mentoring sessions to strategize about the Fellow's longer-term career objectives and ensure his/her professional development goals are being met. The Fellow will be fully integrated into the NHCP staff team and will be included in staff meetings as well as other staff-related activities. Other NHCP staff will be available to mentor the Fellow as well, including Program Manager Steve Couture and Coastal Resilience Specialist Nathalie Morison. The Fellow will work closely with NHCP partner organizations on several specific initiatives including the NH Coastal Adaptation Workgroup, Setting SAIL, the Northeast Regional Ocean Council, and a living shoreline pilot project being tested at Wagon Hill Farm in Durham, NH. By participating in these initiatives, the Fellow will gain access to a broad network of professionals working in coastal management in NH and in the Northeast region. NHCP enthusiastically supports training opportunities for the fellow. Previous fellows have enrolled in trainings provided by the University of NH and the NH Bureau of Education and Training on GIS, facilitation, public speaking, as well as substantive conferences related to project topics around the United States and in Canada.

6. Project Partners

The NHCP will partner with the NH Fish & Game Department, Great Bay National Estuarine Research Reserve (GBNERR), The Nature Conservancy (TNC), and the Northeast Regional Association of Ocean and Coastal Observing Systems (NERACOOS) on the Smart Shorelines Project and representatives from these organizations will form the project team. The project will be closely linked with several ongoing projects and collaborative groups focused on living shorelines and sustainable shoreline management. These include, but are not limited to:

NHDES Shellfish Program water quality and shoreline condition monitoring

The NHDES Shellfish Program conducts regular water quality monitoring and tracks new building projects taking place along the tidal shoreline. The Fellow will occasionally (approximately 10 times per year) assist Program Manager Chris Nash with water quality monitoring in exchange for the opportunity to become familiar with NH tidal shoreline protection structures, natural shoreline areas, and shoreline condition by boat. (Timeline: throughout fellowship, more monitoring in the summer)

NOAA Project of Special Merit New Hampshire Setting SAIL: Acting on the Coastal Risk and Hazards Commission Science, Assessment, Implementation, and Legislation Recommendations

This project seeks to implement a selection of the CRHC recommendations, including conduct outreach to municipal stakeholders, provide direct technical assistance to municipalities, and coordinate state agencies. There are several ways the Smart Shorelines Project could integrate with the Setting SAIL project and continue its work into 2019. Since the fellowship project will explicitly focus on implementing several CRHC recommendations, the two projects will coordinate on outreach and other related efforts. (Timeline: October 2016-March 2018)

NOAA Regional Resilience Project: Advancing High Resolution Coastal Inundation Forecasting and Living Shoreline Approaches in the Northeast

The fellow will participate in Track 2 of this regional project, which focuses on advancing green infrastructure and living shoreline approaches in the Northeast. The deliverables from this project, including a "state of the practice" report, NH-specific white paper analysis, fact sheets, and local workshops will directly inform the fellowship project. (Timeline: May 2016-April 2018)

SOAK Up the Rain NH ([SOAK NH](#))

The fellow may coordinate with the SOAK Up the Rain program coordinators in order to understand how they have designed and executed trainings on green infrastructure stormwater management approaches and understand lessons learned. (Timeline: Ongoing)

Wagon Hill Farm Living Shoreline for Erosion Control

NHCP is collaborating with the Town of Durham to design a living shoreline erosion control project at Wagon Hill Farm. This project includes significant monitoring to evaluate pre- and post-project conditions. This project will serve as a pilot project for future living shorelines in the area. (Timeline: ongoing)

New Hampshire Coastal Adaptation Workgroup ([NHCAW](#))

The fellow will participate on the NH Coastal Adaptation Workgroup, a collaborative of 22 local organizations that provides outreach and technical assistance to coastal communities on shoreline management issues. In addition to shoreline management work on NHCAW, the fellow will have the opportunity to assist the group with other projects, events, and initiatives related to climate change adaptation in coastal NH, including the annual King Tide photo contest, annual Climate Summit, and regular public workshops. (Timeline: ongoing, meets twice per month)

Northeast Regional Ocean Council Living Shorelines Working Group

The fellow will participate in quarterly phone calls organized by NROC's Coastal Hazards Resilience Committee Living Shorelines Working Group. This is a useful way to interact with state partners and share lessons. (Timeline: ongoing, approx. quarterly)

7. Cost Share Description

The project team organizations, GBNERR, TNC, and NERACOOS will pay \$2,500; \$2,000; and \$3,000 in non-federal dollars respectively for the first year of the fellowship for a total nonfederal fellowship contribution of \$7,500 in the first year (see Appendix C). NHDES will pay the nonfederal fellowship match amount of \$7,500 for the second year of the fellowship. These funds will come from the NHDES Shellfish Program budget. NHCP will provide the fellow with cubicle space in the Portsmouth, NHCP office, a laptop computer and monitor, GIS software, a phone, access to a shared state vehicle, field survey tools, and additional resources available to state agency employees, as needed. In addition to those trainings and conferences the fellow selects through their fellowship professional development funding, NHCP may be able to support travel expenses depending on program budget.

8. Strategic Focus Area

The Smart Shorelines Project will primarily advance the Resilient Coastal Communities focus area, and secondarily will help advance the Healthy Coastal Ecosystems focus area. The Living Shorelines Site Suitability Assessment results will be used to enhance NHCP and its partners' understanding as well as a public understanding of approaches that could be used to adapt to coastal risks and hazards along NH's tidal shoreline. The Living Shoreline Outreach and Technical Assistance Strategy will lay out a strategic blueprint for increasing public awareness of coastal hazards associated with storms and sea-level rise and promote living shoreline options that can be taken to protect people and property from flooding. Through planning and coordination with partners, this project will build capacity for outreach and technical assistance focused on smart shoreline management approaches and set up NH's coastal managers for a detailed Tidal Shoreline Management planning process.

The Smart Shorelines Project also advances the Healthy Coastal Ecosystems focus area by exploring innovative techniques for shoreline habitat restoration and protection in the face of mounting coastal hazards. The stories, trainings, and other outreach tools that are developed through the Living Shoreline Outreach and Technical Assistance Strategy will support coastal resource managers and landowners by laying out strategies to provide data, analysis, information, tools, training, and technical assistance on living shoreline approaches. Through the selection of two potential living shoreline sites, the project will both enable restoration of coastal ecosystems at those specific sites and will also establish a process by which the Living Shoreline Site Suitability Assessment and other factors can be used to enable additional living shoreline projects that protect and enhance coastal ecosystems. By providing the analysis results on the NH Coastal Viewer, partnering with NERACOOS, and creating other media through which the project results can be accessed, the project will provide information to decision makers that helps them make shoreline management decisions that protect ecosystem values and services over the long-term.

7. References

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Program. <http://des.nh.gov/organization/commissioner/pip/publications/documents/r-wd-16-09.pdf>

Gittman R.K., Popowich A.M., Bruno J.F., and Peterson C.H. 2014. Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane. *Ocean and Coastal Management* 102: 94-102. DOI: 10.1016/j.ocecoaman.2014.09.016

Gittman, R.K., Fodrie, F.J., Popowich, A.M., Keller, D.A., Bruno, J.F., Currin, C.A. Peterson, C.H., Piehler, M.F. 2015. Engineering away our natural defenses: an analysis of shoreline hardening in the United States. *Frontiers in Ecology and the Environment* 13: 301-307. DOI: 10.1890/150065.

Gittman R.K., Scyphers S.B., Smith C.S., Neylan I.P., and Grabowski J.H. 2016. Ecological consequences of shoreline hardening: a meta-analysis. *BioScience* 66: 763-773. DOI: 10.1093/biosci/biw091

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New Hampshire Fish and Game Department (2014). Sea level affecting marshes model assessment for New Hampshire. <http://www.granit.unh.edu/data/search?sterm3=slamm&fieldname3=themekey>

Smith C.S., Gittman R.K., Neylan I.P., Scyphers S.B., Morton, J. P., Fodrie F.J., Grabowski J.H., and Peterson, C.H. In review. Hurricane damage along natural and hardened shorelines: Addressing homeowner misperceptions to promote nature-based coastal protection. *Global Environmental Change*.

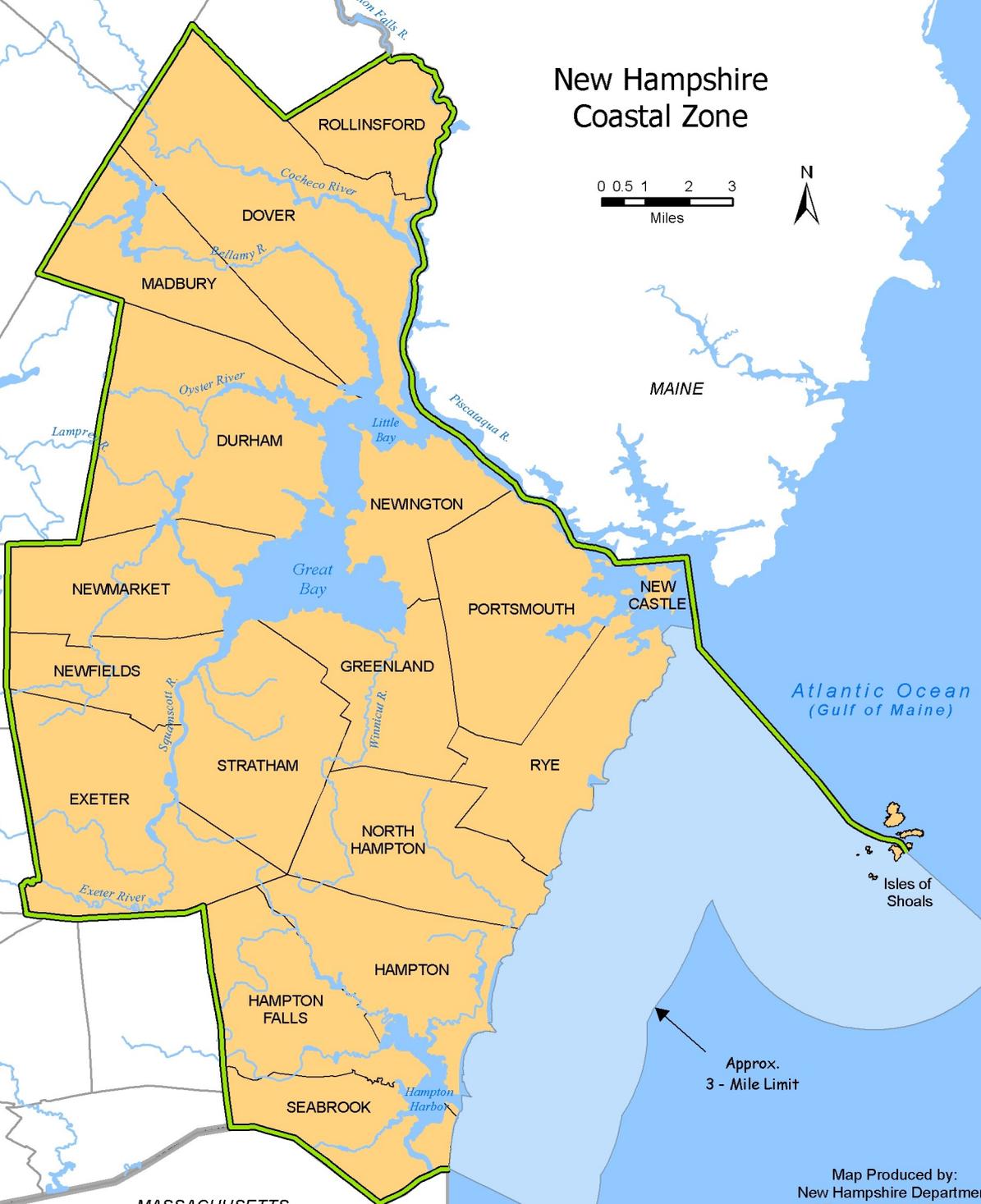
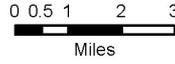
Virginia Institute of Marine Science , College of William and Mary (2008). Living Shorelines Suitability Model: Worcester County, Maryland. Coastal Zone Management Program, Maryland Department of Natural Resources. http://ccrm.vims.edu/publications/projreps/worcester_living%20shoreline_v2.pdf

Zylberman, J. (2016.) Modeling Site Suitability of Living Shorelines in Connecticut. University of Connecticut Department of Natural Resources and Environment. <http://www.arcgis.com/apps/MapSeries/index.html?appid=150edfcff35d4103afe8a20856067c05>

APPENDIX A

Map of the New Hampshire Coastal Zone

New Hampshire Coastal Zone



Atlantic Ocean
(Gulf of Maine)

Isles of Shoals

Approx.
3 - Mile Limit

MASSACHUSETTS

Map Produced by:
New Hampshire Department
of Environmental Services

APPENDIX B

Examples of living shoreline options for New Hampshire

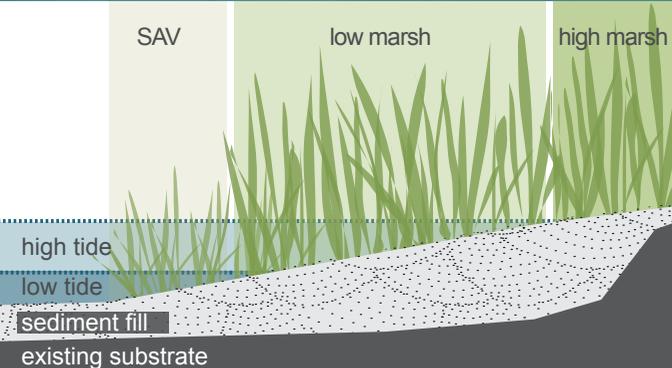
Illustration by Liz Podowski King. Original content developed by Carolyn LaBarbiera and Liz Podowski King with support from the New York Department of State. Adapted for use by the NH Department of Environmental Services Coastal Program.

LIVING SHORELINE EXAMPLES FOR COASTAL COMMUNITIES



NOTE: low tide conditions displayed

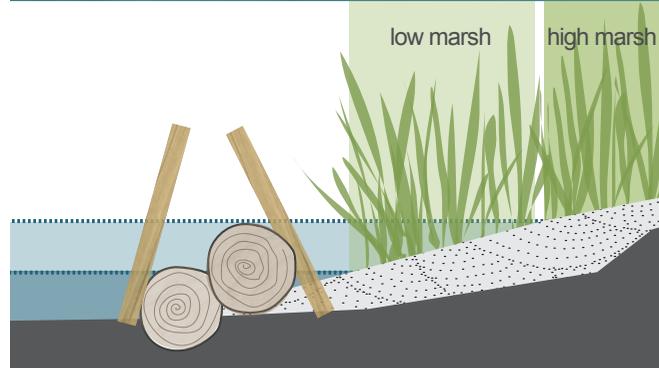
MARSH PLANTING



- MATERIALS:** native submerged or terrestrial plants; coir fiber logs; sediment fill
- SUITABLE LOCATIONS:** sheltered coasts; low wind and low wave energy environments
- PROS:** most natural approach; least impact to adjacent properties; provides habitat
- CONS:** unsuitable in high energy environments



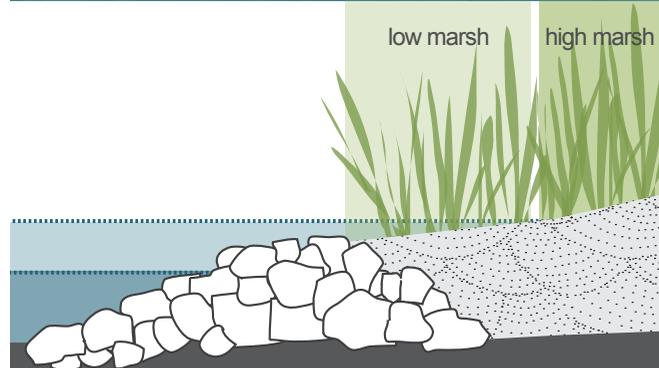
FIBROUS SILL



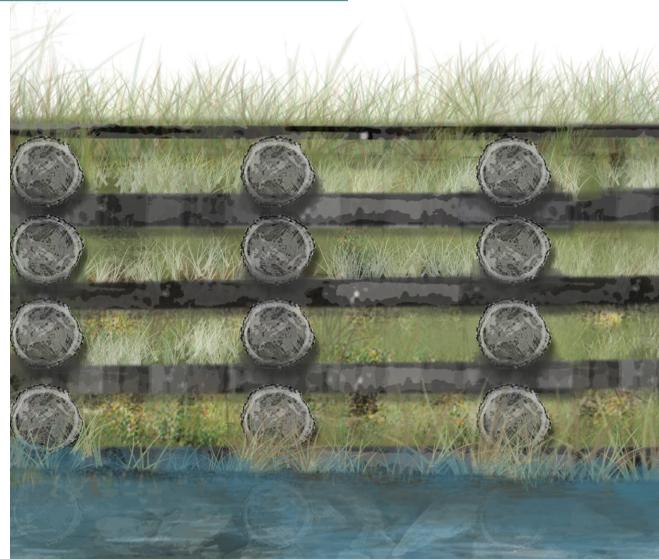
- MATERIALS:** native plants; coir fiber logs; sediment fill
- SUITABLE LOCATIONS:** low to moderate wave energy environments
- PROS:** protects marsh; biodegradable; can reduce slopes; provides habitat
- CONS:** does not last as long as a rock sill; possible habitat conversion



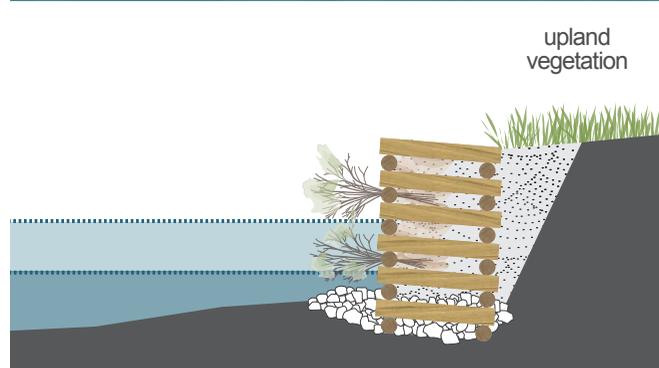
ROCK SILL



- MATERIALS:** native plants; stone, rubble, or fibrous toe protection; sediment fill
- SUITABLE LOCATIONS:** shallow depths; low boat wake; low to moderate wave energy environments
- PROS:** protects marsh; maintains tidal flushing; provides habitat
- CONS:** not biodegradable; can restrict navigation; possible adjacent erosion; possible habitat conversion



LIVE CRIB WALL



- MATERIALS:** timber, box-like structure filled with soil or rock and live tree branches
- SUITABLE LOCATIONS:** urbanized shorelines; higher wind and wave energy; mostly freshwater
- PROS:** highest level of erosion management
- CONS:** may cause more adjacent erosion; less marsh habitat value

APPENDIX C
Letters of Support



New Hampshire Fish and Game Department

HEADQUARTERS: 11 Hazen Drive, Concord, NH 03301-6500
(603) 271-3421
FAX (603) 271-1438

www.WildNH.com
e-mail: info@wildlife.nh.gov
TDD Access: Relay NH 1-800-735-2964

11 October 2016

To Whom it May Concern,

On behalf of the Great Bay National Estuarine Research Reserve (GBNERR) we are pleased to express our support for the Coastal Management Fellow proposal entitled "*The Smart Shorelines Project: Siting and Socializing Living Shorelines in Coastal New Hampshire*". This letter not only endorses the anticipated outcomes and plan for the fellowship project, but also reflects our financial and staff commitment to be an active part of this effort as members of the fellowship project team, and to leverage this opportunity to build upon current and past efforts to work with the NH Coastal Program to advance Living Shoreline concepts in New Hampshire.

The Great Bay Stewards, the friends group for the Great Bay National Estuarine Research Reserve (GBNERR), will commit \$2,500.00 in cash to help cover year one matching costs for the fellow. In addition, the GBNERR manager, CTP Coordinator and current climate outreach contractor will all be engaged as a part of the project team. This proposal presents a unique opportunity for a fellow: the project described is building off of solid work that has happened over the past three years to work on living shoreline issues; it has clearly articulated products that serve a demonstrated need for our coastal management community; and has a committed group of advisors that can help shape the project, provide professional guidance and serve as an excellent network in the coastal management community.

As described in the proposal, the project flows directly from needs identified first in a Shoreline Conference held in the winter of 2014 by the GBNERR CTP program and the NH Coastal Program, then refined over the coming years by the Coastal Adaptation Workgroup and the NH Coastal Program, and finally incorporated into the draft recommendations of the state legislatively directed Coastal Risk and Hazards Commission. It also relates directly to a NOAA Coastal Resiliency Grant that is being led by the Northeast Regional Ocean Council; of which NERACOOS, the NH Coastal Program and the GBNERR are involved in understanding local user information needs to inform regional approaches to promoting living shorelines. This fellowship project will allow these complimentary efforts to be used by NH and leveraged into useful products for our state. In order to advance the use of living shoreline treatments, people in New Hampshire have to trust that it will work here; the site suitability assessment, the education and outreach plan, and the selection of pilot projects will advance our efforts to use sustainable options to protect our shoreline in Great Bay and on the Atlantic coast and assist in the creation of a Tidal Shoreline Management Plan. This group of partners has a proven track record of successfully partnering to mentor Coastal Management Fellows and partnering to advance the resiliency of New Hampshire natural and built communities.

Sincerely,

Cory A. Riley, Reserve Manager
Great Bay National Estuarine Research Reserve
Region 3, NH Fish & Game Dept.

REGION 1

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Lancaster, NH 03584-3612
(603) 788-3164
FAX (603) 788-4823
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REGION 2

PO Box 417
New Hampton, NH 03256
(603) 744-5470
FAX (603) 744-6302
email: reg2@wildlife.nh.gov

REGION 3

225 Main Street
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(603) 868-1095
FAX (603) 868-3305
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REGION 4

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(603) 352-9669
FAX (603) 352-8798
email: reg4@wildlife.nh.gov



Northeastern Regional Association
of Coastal Ocean Observing Systems

Delivering ocean information to the people who need it

October 12, 2016

To Whom it May Concern,

On behalf of the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS), I am pleased to support the NOAA Coastal Management Fellow proposal, "The Smart Shorelines Project: Siting and Socializing Living Shorelines in Coastal New Hampshire." This letter serves as both a commitment to provide staff support on the project team and a financial commitment to cover \$3,000.00 of the non-federal cash match requirement in the first year of the fellowship.

NERACOOS is currently working with the Northeast Coastal Zone Management Programs and other partners on the NOAA Regional Resilience Grant Project focused on flood forecasting and living shorelines. The Smart Shorelines Project will be a direct extension of our work on the NOAA resilience grant project, allowing for additional progress advancing living shorelines in New Hampshire. The site suitability assessment and the outreach plan will be extremely important to building trust in living shoreline approaches for tidal waters in New Hampshire, and will ultimately provide critical information for the NH Tidal Shoreline Management Plan. Additionally, this project boasts an extremely strong team of partners, proven to work together successfully on many past and ongoing projects, who are committed to advancing sustainable shoreline management and treatment in coastal New Hampshire.

I look forward to working on this project, if it is selected. Please contact me if you have any further questions.

Sincerely,

A handwritten signature in blue ink, appearing to read "Ru Morrison". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Ru Morrison, Ph.D.
Executive Director
NERACOOS

October 12th 2016

To whom it may concern,

On behalf of the New Hampshire Chapter of The Nature Conservancy, I am writing this letter in support of the application by the New Hampshire Department of Environmental Services Coastal Program for a 2017-2019 NOAA Coastal Management Fellowship project focused on living shorelines in NH.

The Great Bay Estuary represents one of our most valuable and threatened resources for nature and people here in New Hampshire, and a critical part of The Nature Conservancy's overall efforts to restore nearshore habitat in the Gulf of Maine. Living shorelines represent an exciting option for addressing several pressing threats to the estuary including sea-level rise and coastal erosion using green-infrastructure. However, we currently lack sufficient understanding of where living shorelines may best be employed in the bay and the type of approaches that will be best suited to different geophysical settings. Furthermore, the use of living shorelines is not well socialized among critical stakeholders living around and working in the estuary. The proposed coastal fellow will address these informational needs, laying a strong foundation for a wide range of stakeholders including The Nature Conservancy to begin implementation of this strategy. We also expect that the outputs from this work will inform the adoption of living shorelines more broadly in the Gulf of Maine, with information being disseminated by a strong network of regional partners including The Nature Conservancy's Gulf of Maine Whole System Project.

We have been incredibly impressed by the caliber and quality of output from the previous NOAA Coastal Fellows working in the coastal watershed, and are committed to supporting this project through our participation in the fellowship Project Team. The Nature Conservancy is also committed to providing \$2,000 in non-federal funding match for the first year of the fellowship. Please let me know if there is any additional information I can provide and thank you for your consideration.

Sincerely,



David Patrick, Ph.D.
Director of Conservation Programs