Summaries of Publications & Resources

Many of the documents are available on the HRSSP website at: https://www.hrnerr.org/hudson-river-sustainable-shorelines/publications-resources

Project Reports:

Dalton, S. (2011). Hudson River Sustainable Shorelines Project Report: Decision Making Regarding Shoreline Design and Management. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
In 2010 and 2011, Thrive Consulting conducted 26 interviews with engineers, landscape architects, planners, consultants, developers, railroad representatives, and others involved in managing the Hudson River shoreline and designing shoreline stabilization, restoration, and development. The goals were to document how these stakeholders viewed and incorporated climate change and sea level rise into their shoreline planning and design work, to identify barriers to adopting soft shoreline engineering alternatives, and to identify training needs and information sharing mechanisms. This report documents the methods, findings, lessons learned, and recommendations from this study.

Land Use Law Center at Pace Law School. (2011). Hudson River Sustainable Shorelines Project: Legal Framework Analysis. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
The Legal Framework Analysis summarizes the various plans, laws, and policies at the federal, state, and local levels that regulate shoreline development along the Hudson River Estuary. The analysis covers a range of topics including water quality controls, wetland protection, stormwater management, coastal management, disaster mitigation, floodplain management, environmental review, local land use controls, and other laws and programs. For each of these areas, the report describes the purpose and implementation of the policies, identifies limitations and concerns, and suggests related opportunities to promote informed shoreline management and to protect Hudson River shoreline habitats. An appendix summarizes and compares these opportunities for the different subject areas and specifies how they relate to shoreline management and who can take action on each.

VanLuven, D. (2011). Economic Tradeoffs between Shoreline Treatments: Phase I – Assessing Approaches. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, http://hrnerr.org.***
This report sets forth a framework for an economic assessment of different shoreline approaches. The report focuses on nine shoreline treatment types: bulkhead, timber cribbing, live stakes/joint planting, revetment, live crib wall, vegetated geogrid, riprap, green (bio) wall, and living shoreline. VanLuven encourages incorporating the costs involved in construction and maintenance as well as the value of ecosystem services provided or supported by shorelines (focusing on recreation). He describes a variety of recreational user groups to interview or survey for more in-depth information and then identifies shoreline aspects likely to be of interest to these groups (e.g., access, aesthetic enjoyment, visibility of birds, abundance of fish). He then compares the quality of these shoreline

aspects across the nine treatments. Lastly, VanLuven identifies next steps and key questions to answer to move forward on this economic assessment.

Dalton, S. (2012). Shoreline Use and Perception Survey Report. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org***
In 2012, Thrive Consulting and the Hudson River Sustainable Shorelines Project surveyed anglers and kayakers to learn about these user groups' perceptions, values, and preferences related to shorelines. This report presents the methods and findings of the survey. There were 127 respondents to the online survey, and the results showed a variety of aesthetic preferences among shoreline users. Respondents generally had a strong sense of the ecological importance of different shorelines, but they did not necessarily connect that with their own land management practices: they liked tidy shorelines. The survey instrument, photographs of shoreline types, summary of survey results, and geographic distribution of respondents' recreational activities are included as appendices.

Hauser, E. (2012). Terminology for the Hudson River Sustainable Shorelines Project. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This document fills a need to create a common understanding and reference of important terms and concepts related to shoreline management for a multi-disciplinary team and audience. Hauser defines the terms that are often used by the professionals involved in the Hudson River Sustainable Shorelines Project. Terms covered include general definitions of the shore zone, the legal demarcation of the shoreline, natural and social science terms, and specific shoreline stabilization approaches, with examples provided wherever possible. This document introduces the term "ecologically enhanced shoreline" as an alternative to "living" or "soft" shoreline.

Rella, A. & Miller, J. (2012a). Engineered Approaches for Limiting Erosion along Sheltered Shorelines. ***In association with and published by Stevens Institute the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This literature review provides an overview of the engineered approaches used to manage erosion along shorelines. Rella and Miller describe over twenty approaches, including both traditional and ecologically enhanced techniques, providing information about the design and construction, adaptability, and the advantages and disadvantages of each. Each approach is rated in terms of approach (soft to hard), construction and maintenance costs (low to high), and adaptability to sea level rise (low to high). This document is useful for making decision-makers aware of the range of alternatives available for shoreline stabilization. It is not necessarily specific to the Hudson River Estuary.

Rella, A. & Miller, J. (2012b). A Comparative Cost Analysis of Ten Shore Protection Approaches at Three Sites Under Two Sea Level Rise Scenarios. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This analysis compares ten shoreline protection methods at three sites along the Hudson River (Bowline Point Park, Henry Hudson Park, and Poughkeepsie) by calculating the costs (in 2012 dollars) for original construction, maintenance, and replacement as they are affected by increasing levels of sea level rise and storms. The ten approaches cover the spectrum from traditional hard structures such as bulkheads and revetments to ecologically enhanced approaches like live crib walls and vegetated geogrids, as well as the hybrid approaches in between. Two sea level rise scenarios were used: the current rate extrapolated over 70 years (a linear trend, at about 10.9" per century) and the rapid ice melt scenario (an accelerating trend, predicting 48" by 2080). Rella and

Miller found that over a 70-year period, cumulative costs for ecologically enhanced shoreline treatments can be comparable to the harder approaches.

- **Executive Summary:** This executive summary describes the cost comparison analysis work carried out by Rella and Andrew and summarizes the results of the analysis. A table presents the 70-year cost estimates for the ten shoreline protection methods at each site (where feasible), under two sea level rise scenarios (extrapolation of current rates and rapid ice melt scenario). This facilitates comparison between the different treatments, the three sites, and the two sea level rise scenarios.

Rella, A., Miller, J., LaPann-Johannessen, C., Rodriquez, E. (2015). Hudson River Wake Study. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***

An analysis of the wake climate within the Hudson River was undertaken by Stevens Institute of Technology as a part of the ongoing Hudson River Sustainable Shorelines Project, led by the NYSDEC Hudson River National Estuarine Research Reserve. The primary objective of the wake study, conducted during the summers of 2012 and 2013, was to document vessel traffic and the resulting wakes along the Hudson River; with the intent of ultimately using this information to more adequately understand the erosion potential of wakes.

Rella, A., & Miller, J. (2015). Forensic Analysis: Methodology Report. In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580

The intent of the forensic analysis was to investigate the site conditions of six engineered shorelines that were impacted by Tropical Storms Irene and Lee in 2011 and Post-Tropical Storm Sandy in 2012. The specifics of each analysis were somewhat dependent on the availability of data for each site; however a series of common tasks were performed. These included: a review of previous shoreline stabilization attempts, a characterization of the typical hydrodynamic conditions at each site, the collection of engineering/design data, site surveys, and hind-casting of the conditions during each storm. In this report, each task performed is described in detail.

Rella, A., & Miller, J. (2015). Forensic Analysis: Common Project Performance Factors. In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580

The intent of the forensic analysis was to investigate the site conditions of six engineered shorelines that were impacted by Tropical Storms Irene and Lee in 2011 and Post-Tropical Storm Sandy in 2012. The selected projects included both traditional and non-traditional shoreline stabilization, and included both projects that were significantly damaged, as well as those with only minimal damage. The objective was to identify the critical factors that determined the success or failure of the projects. This document summarizes the common themes that were identified through these analyses, and presents some recommendations for improving regulation, design, and construction of future projects.

Miller, J., and N. Georgas (2015). Hudson River Physical Forces Analysis: Data Sources and Methods. Stevens Institute of Technology, TR- 2946. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***

An analysis of the physical forces impacting the shorelines of the Hudson River Estuary was completed by Stevens Institute of Technology to provide critical but often lacking information about several of the parameters required for the proper design of ecologically enhanced shoreline stabilization projects. In particular, the physical forces analyses that were undertaken focus on wind

waves, vessel wakes, currents and ice. A brief discussion of the importance of each of these forces as well as the methods used to derive information about them is presented in this report.

Georgas, N., Miller, J. K., Wang, Y., Jiang, Y. and D. D'Agostino (2015). Tidal Hudson River Ice Cover Climatology. Stevens Institute of Technology. In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, http://hrnerr.org.
This report describes the methodology and results of climatological and statistical analyses for ice distributions along the Hudson, based on the USCG dataset. Given the scarcity of ice data in the tidal Hudson, the statistical distributions of ice thickness and ice cover area (in the form of cumulative probability density functions when ice is present) as well as ice type information, are meant to provide some guidance on engineering planning studies along the Hudson River.

Roberts, E. (2015). Outreach and Informal Conversations with Regulators & Permit Staff: a Summary for the Hudson River Sustainable Shorelines Project. In association with the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, http://hrnerr.org.
Eric J. Roberts of the Consensus Building Institute (CBI) conducted eight interviews with ten permitting or regulatory staff from the New York State Department of Environmental Conservation (NYSDEC), and Department of State (NYSDOS) and the U.S. Army Corps of Engineers (USACE) in March and April 2015. This report details the information gleamed from these conversations.

Graichen, L. (2015). Analysis of a Follow-up Survey to Determine Workshop Outcomes and Effectiveness. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This report discusses and analyzes a follow up survey for shoreline engineers, landscape architects, and state permit and habitat staff who work on shoreline protection in the Hudson River Estuary who attended the July 2014 training "Applying the Findings of the Hudson River Sustainable Shorelines Project (HRSSP)" and learned about the findings of the HRSSP and increased their capacity to design and permit ecologically enhanced shoreline protection. The goal of this follow-up survey was to learn more about the effectiveness of the July workshop and also get feedback on other aspects of the HRSSP.

Project Overview & Progress Reports:

Blair, E., Graichen, L., & Hauser, E. (2015). Project Overview. ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This overview of the Hudson River Sustainable Shorelines Project, written in January 2012 and revised in March 2015, summarizes the problem the project aims to address, the purpose and objectives, the project history and participants, and the questions the project seeks to answer. The document also outlines the various project components and products and how they line up with the project questions. The project's overarching vision is for decision-makers to have access to and apply the best available information on shoreline management practices.

Blair, E. (2013). Hudson River Sustainable Shorelines Project Phase I: Mitigating Shoreline Erosion along the Hudson River Estuary's Sheltered Coasts. Final Report. Submitted to The NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET). ***In association with and published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
The final report for the first phase of funding, which began in August 2008, was submitted to the funder, NOAA/University of New Hampshire Cooperative Institute for Coastal and Estuarine

Environmental Technology (CICEET), in 2013. It describes the Hudson River Sustainable Shorelines Project Phase 1: Mitigating Shoreline Erosion along the Hudson River Estuary's Sheltered Coasts. Key findings are summarized, and methods and results are described for each of the project's seven objectives. Project deliverables, milestones, and presentations are listed in appendices. This project included four main components: ecological research, assessments of engineering alternatives and costs, social science research, and engagement with intended users.

Peer-Reviewed Journal Articles:

Strayer, D.L., Kiviat, E., Findlay, S.E.G., and Slowik, N. (2015). Vegetation of riprapped revetments along the freshwater tidal Hudson River, New York. Aquatic Sciences, 1-10.
A comprehensive analysis of the abundance and composition of vegetation living in riprap revetments on Hudson River shorelines. Strayer, Kiviat, Findlay, and Slowik found that the vegetation was half native and half non-native and that shorelines varied from nearly barren to flush with plants. The authors postulate that the habitat value of these sites could be improved with ecologically-informed design and management.

Strayer, D.L. & Findlay, S.E.G. (2010). The ecology of freshwater shore zones. Aquatic Sciences, 72: 127-163.
Strayer and Findlay provide a comprehensive summary of what is known about the ecological functioning of the shore zone in freshwater ecosystems. They first define the shore zone and its special characteristics, then they describe a range of ecological services provided by shore zones. The authors also discuss the variety of human impacts on the shore zone (e.g., stabilization, simplification, hydrological changes, and pollution), reference principles for sustainable shore zone management, provide some information about valuing the different kinds of shore zones, and lastly identify three main gaps in existing knowledge about shore zones.

Strayer, D.L., Findlay, S.E.G., Miller, D., Malcolm, H.M., Fischer, D.T., & Coote, T. (2012). Biodiversity in Hudson River shore zones: influence of shoreline type and physical structure. Aquatic Sciences, 74, 597–610.
This article reports on an effort to document the biodiversity supported by different kinds of shore zones in the Hudson River Estuary. The researchers investigated six common shore zone types (three "natural" and three engineered) and assessed their physical characteristics and biological communities. Physical characteristics measured include shore zone width, exposure, substrate roughness and grain size, and shoreline complexity. Communities sampled include terrestrial plants, fishes, and aquatic and terrestrial invertebrates. The authors found that engineered shore zones (especially cribbing and bulkheads) tended to have less desirable biodiversity characteristics than "natural" shore zones (e.g., fewer fishes, fewer native plant species, and more alien plants). No single shore type provided high values for all of the ecological functions assessed.

Georgas, N. (2012). Large Seasonal Modulation of Tides Due to Ice Cover Friction In a Mid-Latitude Estuary. Journal of Physical Oceanography, 3(42), 352-369.
Georgas investigated the impacts of ice on tidal hydrodynamics in the Hudson River Estuary. He used US Coast Guard ice reports, observations of water levels (from the National Ocean Service, the US Geological Survey, and the Hudson River Environmental Conditions Observing System), and two versions of the NYHOPS (New York Harbor Observing and Prediction System) model. This analysis showed that under-ice friction is the main cause of these observed tidal modulations. Georgas suggests that astronomical tidal predictions, tidal datums, and forecast model predictions are compromised by neglecting to include ice dynamics.

Harris, C., Strayer, D.L., & Findlay, S. (2014). The ecology of freshwater wrack along natural and engineered Hudson River shorelines. Hydrobiologia, 722(1), 233-246.
Harris, Strayer, and Findlay report on research into the ecology of wrack (organic matter that is washed onto shore) on different types of Hudson River shorelines (natural and engineered). The investigators studied standing stocks, mobility, decomposition rates, and macroinvertebrate communities of wrack. Wrack is an important component of shoreline ecosystems, and this article helps fill a gap in information about wrack in freshwater systems. The authors found that engineered shorelines tended to accumulate little wrack, have high loss rates of wrack, and have low diversity of invertebrate communities, indicating a loss of ecological functions at these types of shorelines. This article is based on Harris's work as a Polgar Fellow.

Related Polar Fellow Research:

Villamagna, A., Strayer, D., & Findlay, S. (2009). Effects of surface roughness on ecological function: Implications for engineered structures in the Hudson River shore zone. Section III: 25pp. *In* S.H. Fernald, D. Yozzo and H. Andreyko (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 2008. Hudson River Foundation.
Villamagna, a Polgar Fellow, reports on an investigation of the relationships between ecological function, surface roughness, and exposure to wave energy. The objective was to determine if manipulation of surface roughness on artificial structures alters the ecological function in the shore zone. The researchers deployed tiles with different surface roughness at four sites in the freshwater tidal Hudson River and then measured the accumulation of algae, organic matter, and macroinvertebrates. Two sites had high-energy conditions and two had low-energy conditions. They conclude that surface roughness can alter ecological function, but the effects depend at least partially on site-specific factors, including exposure to wave energy and the pre-existing food web structure.

Coote, T. & Strayer, D. (2009). Gastropods of the Hudson River Shoreline: Subtidal, Intertidal, and Upland Communities. Section IV: 32 pp. In S.H. Fernald, D. Yozzo and H. Andreyko (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 2008. Hudson River Foundation.
Coote, a Polgar Fellow, reports on a study of gastropod abundance and diversity at six types of shore zones along the Hudson River (sand, bedrock, unconsolidated rock, riprap, seawall, and timber cribbing). Surveys were conducted at three river sections (lower, mid, and upper) from Poughkeepsie to Albany, New York, and at three elevations at each site (sub-tidal, inter-tidal, and upland). The researchers found that riprap and unconsolidated rock at intertidal elevations contained significantly higher abundance and diversity of gastropods. Sand beaches and seawall structures were less supportive of gastropods communities. The survey found three aquatic species which were new records for the Hudson River.

Harris, C. & Strayer, D. (2011). The Ecology of Wrack: Decomposition and Use By Invertebrates On Natural and Engineered Shorelines of the Hudson River. Section IV: 1-29 pp. *In* D.J. Yozzo, S.H. Fernald, and H. Andreyko (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 2009. Hudson River Foundation.
Harris, a Polgar Fellow, reports on research into the decomposition rates and invertebrate communities of wrack (organic matter that has washed ashore) on four different types of Hudson River shorelines (two natural – sandy and rocky – and two human-made – cribbing and riprap). The researchers found faster decomposition rates and lower invertebrate density on cribbing, compared to the other shoreline types. Riprap showed similar decomposition rates and invertebrate density to

the rocky shoreline. The authors suggest that in terms of ecological functioning, natural sandy shorelines are irreplaceable by cribbing or riprap.

Fact Sheets:

Managing Shore Zones for Ecological Benefits. (2011). ***Published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This brochure, authored by D. Strayer for the Hudson River Sustainable Shorelines Project, lays out ten steps to better shore zone management, such as preserving physical diversity, avoiding hard materials, reducing wave damage, and preventing pollution. These guidelines are useful for shore zone managers and property owners who want to protect the ecological benefits that healthy shore zones provide.

Dalton, S. (2011). Lessons Learned: Decision Making Regarding Shoreline Design and Management. ***Published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This one-pager describes key lessons learned from the Hudson River Sustainable Shorelines Project and lists recommendations for professionals involved in shoreline design and management. Key lessons include:little information sharing takes place among practitioners; there is an opportunity to share knowledge and skills through networking opportunities; sea level rise and climate change are understood to be issues of concern but are considered to be of relatively low importance compared to other concerns; and there are a variety of training needs for all audiences. Dalton identifies a variety of barriers to adopting soft shoreline management techniques. She also provides several recommendations for the Hudson River Sustainable Shorelines Project.

Ferguson, O. (2011). Lessons Learned: Five Case Studies of Recent Shoreline Development Projects. ***Published by the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
In this one-pager, Ferguson outlines lessons learned from shoreline development projects and includes recommendations gleaned from case studies. Lessons learned pertain to information needs, the influence of the permitting process, the impacts of land use on shorelines, and the importance of having a champion for hybrid or soft treatments. These case studies show that at least some soft shoreline techniques can be permitted on the Hudson. This fact-sheet is useful for making sure the lessons learned and recommendations from the past are incorporated into current and future work.

Strayer, D., Tumblety, L. (2015). Managing Shore Zones for Ecological Benefits: Handbook. ***In association with the Hudson River Sustainable Shorelines Project, Staatsburg, NY 12580, https://www.hrnerr.org.***
This handbook offers suggestions for practical ways that landowners and land managers can protect shore zones and increase the benefits that they provide. Although targeted at the Hudson River, many of these suggestions will be helpful for managing shore zones along lakes, rivers, and estuaries elsewhere.

Work Prior to the Sustainable Shorelines Project:

Allen, G., Cook, T., Taft, E., Young, J., & Mosier, D. (2006). Hudson River Shoreline Restoration Alternatives Analysis. Prepared by Alden Research Laboratory, Inc. and ASA Analysis and Communications, Inc. for the Hudson River National Estuarine Research Reserve.
Allen et al. report on a project that investigated options for restoring both ecological and sociological functions by enhancing shoreline habitats through soft engineering. The project included the

following tasks: a literature review about shoreline stabilization methods, a field survey of potential shoreline restoration sites in the Hudson River Estuary, an evaluation of preliminary designs for five example projects, and a description of the regulatory process for conducting the restoration projects. This report includes a comparison of available shoreline stabilization techniques (advantages, disadvantages, and application to the Hudson), descriptions and diagrams for the different techniques, detailed information about the five example project sites and proposed soft engineering designs, and information about the permitting process.

Miller, D., Bowser, C., & Eckerlin, J. (2006). Shoreline Classification in the Hudson River Estuary, unpublished, NYSDEC Hudson River National Estuarine Research Reserve.
Miller and Bowser completed an inventory of shoreline types along the Hudson River from the Tappan Zee Bridge to Troy. This inventory is a tool to calculate shoreline extent and distribution at three levels of classification. It also provides a baseline of summer/fall 2005 shoreline conditions. Available attributes include shoreline segment length, the character of the shoreline segment (hard engineered, soft engineered, or natural), type of 'structure' (revetment, gabion, cribbing, bulkhead, broadleaf vegetation, woody vegetation, unvegetated, woody debris, other), primary structure material or substrate (timber, sheet pile, concrete, mixed mud/sand, unconsolidated rock, solid bedrock, sand with brick, other), GPS date, and feature geometry.

Hudson River Estuary Shorelines Workshop: Soft Engineering Solutions to Shoreline Stabilization. March 23, 2006. NYSDEC Hudson River National Estuarine Research Reserve.
Slides are available from presentations at the Hudson River Estuary Shorelines Workshop: Soft Engineering Solutions to Shoreline Stabilization, held March 23, 2006, by the Hudson River NERR. Presentations include: Understanding and Managing Hudson River Shorelines (Dan Miller, Hudson River Estuary Program/NYSDEC HRNERR), Training Objectives (John Young, ASA Analysis and Communications, Inc.), The Hudson River Estuary (John Young), Soft Shoreline Stabilization Options (Tom Cook, Alden Research Laboratories, Inc.), Shoreline Alternatives (Tom Cook and Greg Allen, Alden Research Laboratories, Inc.), Project Design Considerations, Project Cost Estimates, and Example Projects.

Presentations from this workshop include:

- Understanding and Managing Hudson River Shorelines (Dan Miller, Hudson River Estuary Program/NYSDEC HRNERR)
- Training Objectives (John Young, ASA Analysis and Communications, Inc.)
- The Hudson River Estuary (John Young)
- Soft Shoreline Stabilization Options (Tom Cook, Alden Research Laboratories, Inc.)
- Shoreline Alternatives (Tom Cook and Greg Allen, Alden Research Laboratories, Inc.)
- Project Design Considerations, Project Cost Estimates, and Example Projects

Demonstration Site Network Case Studies:

Case study reports have been compiled about ecologically enhanced shoreline projects owned and designed by a variety of organizations. Information in the case studies includes: designer, partners, project cost, background information about the site, planning and design considerations, and implementation. Photos, design plans, and lessons learned complete the reports, which can be used to learn about real-world projects that have applied sustainable shoreline guidelines to manage erosion and balance other objectives. They can also be used to find organizations or people to contact for more information. Case studies are available for the following projects:

- **Coxsackie Boat Launch**
- **Harlem River Park (New York, NY)**

- Hunts Point Landing (New York, NY)
- Habirshaw Park and Tidal Marsh (Yonkers, NY)
- Esopus Meadows Preserve
- Foundry Dock Park (Cold Spring, NY)
- Athens Fourth Street Kayak and Canoe Launch

Demonstration site assessments
If you are a designer of shoreline projects in the Hudson River Estuary, we would like to know about any of your finished or planned projects that use the principles of sustainable shorelines. Use this form if you would like your project to be considered for the demonstration site network. This form asks for information about the site and the project. If possible, attach photos, plans, and any additional supporting documents. This form also includes a glossary of terminology used in the assessment form. Return this form to Sarah Lipuma at sarah.lipuma@dec.ny.gov; PO Box 315, Staatsburg, NY 12580; 845-889-4749 (fax).

- Finished Project: Demonstration Site Assessment for the HRSSP Site Network
- Planned Project: Demonstration Site Assessment for the HRSSP Site Network

Geospatial Data and Tools:

Hudson River Estuary Shoreline Type
D. Miller and C. Bowser completed an inventory of shoreline types along the Hudson River from the Tappan Zee Bridge to Troy. This inventory is a tool to calculate shoreline extent and distribution at three levels of classification. It also provides a baseline of summer/fall 2005 shoreline conditions. Available attributes include shoreline segment length, the character of the shoreline segment (hard engineered, soft engineered, or natural), type of 'structure' (revetment, gabion, cribbing, bulkhead, broadleaf vegetation, woody vegetation, unvegetated, woody debris, other), primary structure material or substrate (timber, sheet pile, concrete, mixed mud/sand, unconsolidated rock, solid bedrock, sand with brick, other), GPS date, and feature geometry. Data available at the

Hudson River Ice Climatology
Nickitas Georgas, Jon Miller, and David D'Agostino from the Stevens Institute of Technology compiled observed ice data statistics from US Coast Guard daily ice reports along the tidal Hudson River during the ice season (December to March) from 2005-2012. Attributes include observed ice occurrence (percentage of reported ice season days with ice), estimated ice cover thickness, estimated ice cover area, most prevalent ice type by region (fast and drift ice), and all observed ice types and percentage of time each was observed per region (drift, brash, plate, floe, slush, pancake, grease, frazil, rafted, hummocked, skim, and fast ice). There are also graphical overviews of the data and photographs of regions taken during US Coast Guard-commissioned ice flights.

Hudson River Estuary Flow Model
Nickitas Georgas and Jon Miller from the Stevens Institute of Technology compiled simulated riverside water circulation statistics from a high-resolution numerical model of circulation in the tidal Hudson River, using data from 2010. Parameters that characterize physical forces include: water levels, currents, vertical current stresses and mixing, and surface wind waves. These data can be used to understand the energy regimes impacting shorelines and to help identify suitable shoreline stabilization alternatives for sites along the Hudson River.

New York Harbor Observing and Prediction System:
The NYHOPS (New York Harbor Observing and Prediction System) model provides meteorological and oceanographic conditions both in real-time and forecasted out to 72 hours in the Hudson River,

the East River, NY/NJ Estuary, Raritan Bay, Long Island Sound and the coastal waters of New Jersey. Parameters available include: surface currents and salinity, bottom salinity, surface water and air temperatures, water level, waves, wind, and CDOM (chromophoric dissolved organic matter).

Rapid Assessment Tool: Shore Zone Condition and Ecological Function
This tool, developed by Stuart Findlay of Cary Institute of Ecosystem Studies for the HRSSP, can be used to provide a rough quantification of site attributes known to affect biota and ecological processes in the shore zone. It is designed for use in the tidal freshwater Hudson River. The assessment covers a description of the problem (e.g., erosion, vulnerable infrastructure, and invasive species), the physical characteristics (e.g., slope, sinuosity, length, substrate, and wrack), and vegetation cover and composition. An equipment checklist, instructions, and a datasheet for collection are included.

Training Resources:

Conference: Regional (NY-NJ-DE) Dialogue to Advance Sustainable Shorelines along Sheltered Coasts (October 4, 2013, Rutgers University, New Brunswick, NJ).
This was a one-day invitation-only workshop designed to examine opportunities for regional collaboration and advance the sharing of sustainable shorelines information and projects in New York, New Jersey, and Delaware. Resources available include: agenda, proceedings, findings of a pre-conference assessment of stakeholders, workshop materials, presentations, event summaries, and a follow-up webinar (February 10, 2014). This workshop was funded by a NERRS Science Collaborative transfer project.

NOAA NERRS Living Shorelines Webinar Series (2013 to 2014).
This series of online presentations was designed to introduce the concept of living shorelines, increase awareness about the types of living shorelines, and look at regional differences in perceptions of living shorelines. The series was produced by the National Estuarine Research Reserve System and NOAA's Office of Ocean and Coastal Resource Management.

- Living shorelines: Perspectives from around the country (September 2013)
- Applications of living shorelines and lessons learned (November 2013)
- Regulatory challenges and solutions for using living shorelines (December 2013)
- Science of living shorelines (January 15, 2014)
- Living shorelines: Case studies from the NERRS (February 19, 2014)

Workshop: Applying the Findings of the Hudson River Sustainable Shoreline Project (July 23, 2014, Norrie Point Environmental Center, Staatsburg, NY).
This one-day workshop was designed to introduce the audience of shoreline engineers, landscape architects, and state permit and habitat staff to the findings of the Hudson River Sustainable Shoreline Project. The presentations covered a range of topics, including ecological principles, planning considerations, lessons from implementation, sea level rise, physical forces, shoreline treatment performance during storms, climate adaptability, and cost information.