

Chapter 9 Monitoring and Habitat Plans

The Barnegat Bay Partnership and many of its partners, especially the NJDEP, routinely conduct and support monitoring throughout the watershed to help track the status of various conditions within the bay and watershed, as well as to identify emerging issues. This information is analyzed and reported on in a variety of formats; some is incorporated into the NJDEP's Integrated Water Quality Report, some into other agencies' regular reports, and much of it is incorporated into the BBP's State of the Bay Reports, which were published in 2005, 2011, and 2016. Representing the consensus of technical experts working on these issues in the bay or elsewhere, the BBP State of the Bay reports give us a big picture of the bay's condition and our collective efforts to protect and improve the bay. These reports also enable us to identify where we need more and/or other information to address existing concerns and to identify emerging issues of potential concern. Thanks to substantial commitments to monitor the watershed and bay from our partners, especially the NJDEP's Comprehensive Baywide Water Quality Monitoring program (see <http://www.nj.gov/dep/barnegatbay/plan-wqstandards.htm>), our understanding of the bay has improved considerably over the past 10 years and should continue to improve with commitments to continue most ongoing monitoring activities.

Why is monitoring important? Monitoring is an often overlooked but critical activity to support environmental assessment and ecosystem management. Single alterations, such as the invasion of bay nettle, common reed, or southern pine beetle, may produce ripple effects (*e.g.*, ecological or trophic cascades) that profoundly affect our local ecology or our use of the bay. We also recognize that the environment is changing in many ways on many scales that may be difficult to predict; nonetheless, as the physical environment changes, the impacts of any biological changes may also change. Ecosystem management cannot proceed without thoughtful attention to these changes. Monitoring and evaluation then become the essential tools for detecting, measuring and interpreting these changes over time. Assessing changes in environmental conditions, populations, and habitats over time, especially in response to management actions, may require monitoring at different levels (species, natural communities, implementation activities) and across multiple spatial (local, regional, statewide) and temporal (continuous, monthly, yearly; short-term versus long-term) scales. Through varying styles of monitoring, we can identify challenges or impacts of management activities or landscape alterations. Finally, monitoring is required to simply understand the effects, intended or otherwise, of any management approach.

In 2003 the BBNEP Science and Technical Advisory Committee released the initial Monitoring Program Plan (<https://www.barnegatbaypartnership.org/wp-content/uploads/2017/07/Barnegat-Bay-National-Estuary-Program-Monitoring-Program-Plan-2003.pdf>) for Barnegat Bay. The plan was the culmination of a series of workshops and described plans for critical activities that would track progress and achievement of the original CCMP objectives. At the heart of the 2003 Monitoring Program Plan was a series of environmental and programmatic indicators that provided an effective mechanism for evaluating progress toward the full achievement of the CCMP goals. A group of nine primary indicators (Table 8-1) that were easily communicated to the public were selected to provide a broad basis for evaluating a range of CCMP actions. A

group of twenty-one secondary indicators provided an additional basis for evaluating the programmatic output and specific environmental outcomes of CCMP implementation. For each indicator the plan identified which CCMP objectives and actions the indicator addressed, what questions the monitoring would answer, any existing partner monitoring programs that could provide data, and what information needs and data gaps were outstanding. The plan appendix also contained a description of 62 existing monitoring activities.

Table 9-1: Environmental indicators contained in the 2003 Monitoring Program Plan	
Primary Indicators	Secondary Indicators
SAV Distribution, Abundance, and Health	Temperature
Land Use/Land Cover Change	pH
Signature Species	Salinity
Watershed Integrity	Dissolved Oxygen
Shellfish Beds	Nutrients
Bathing Beaches	Turbidity
Water-supply wells/ drinking water	Fecal Coliform/Enterococcus bacteria
Harmful Algal Blooms	Phytoplankton abundance and composition and chlorophyll <i>a</i> concentrations
Freshwater Inputs	Macrophyte abundance
	Shellfish and finfish abundance
	Benthic community structure
	Toxic contaminants in aquatic biota and sediments
	Floatables
	Shoreline habitat/sensitive areas
	Boating Use
	Atmospheric and other pollutant inputs
	Rare plant and animal populations
	Stream flow
	Water allocations
	Saltwater intrusion
	Turf grass

The primary and secondary indicators contained within the 2003 Monitoring Program Plan formed the basis for the initial State of the Bay Report in 2005 (http://barnegatbaypartnership.org/wp-content/uploads/2017/08/2005-state_of_bay_tech-1.pdf). This report documented the status and trends of six of the primary indicators for which there was sufficient data (submerged aquatic vegetation, shellfish beds, bathing beaches, algal blooms, freshwater inputs, and land use/land cover). Subsequent reports in 2011 (<http://barnegatbaypartnership.org/wp-content/uploads/2017/08/BBP-2011-State-Of-The-Bay-Report.pdf>) and 2016 (https://www.barnegatbaypartnership.org/wp-content/uploads/2017/08/BBP_State-of-the-Bay-book-2016_forWeb-1.pdf) reported on additional primary and secondary indicators to provide a more holistic look at the status of the bay and watershed.

With a transition to an Ecosystem-Based Management approach in this CCMP, it is time to revisit our Monitoring Program Plan. Under a revised monitoring plan, the primary indicators do not solely reflect individual CCMP actions, but instead reflect the broader ecosystem-based targets set forth in Chapter 3. As our understanding of the bay improves and implementation actions helps improve some aspects of the bay and watershed, some indicators previously thought necessary may become less critical, whereas other indicators may increase in importance. Furthermore, the monitoring programs that are currently occurring in the bay have changed since the monitoring program survey was conducted in 2001. Several programs are no longer active, many new ones have been initiated and ongoing programs have been modified (*i.e.*, improved).

Over the next two years the BBP Program Office staff, along with the BBP Science and Technical Advisory Committee (STAC) and our partners, will work together to develop a comprehensive monitoring plan for the Barnegat Bay and Watershed, in support of CCMP implementation. The plan will take into account the new information we have learned about the bay, our shift to an ecosystem-based management approach, and the impacts of climate change and sea level rise. The Monitoring Plan will be completed in 2021, within 2 years of the publication of the revised CCMP.

Habitat Plan

As described in the ecosystem-based targets and in many of the objectives and individual actions within this document, fully functioning habitats of many different types are required to support the full range of ecosystem services that human and wildlife communities are dependent on in various ways. To help focus our efforts to protect these habitats and restore them when necessary, the BBP will develop a Habitat Restoration Plan. The Plan will build on the habitat information contained within the CCMP, providing context on their importance, describing their current status, and identifying and prioritizing potential protection and restoration projects. Under the guidance of BBP's STAC, a Habitat Restoration Work Group will be established and will work with a contractor to develop a strategic plan and potential projects. The work group will utilize existing decision support tools, *e.g.*, TNC Restoration Explore, NJ Shoreline and Marsh Restoration Decision Support Tool, the Trust for Public Land's *Barnegat Bay 2020 Report: A Vision for the Future of Conservation*. It is anticipated that the Habitat Restoration Plan will include updated habitat mapping where available, will direct managers and restoration practitioners to tools and resources, and will identify key mapping and data gaps where appropriate. The Habitat Plan will be completed in 2021, within 2 years of the publication of the revised CCMP, with contractor support.

Chapter 10 - Organizational and Financial Planning

The Barnegat Bay Partnership was established in 2002 as the Barnegat Bay National Estuary Program. Over the past 16 years, the BBP has undergone many changes: it has changed administrative hosts and relocated its offices several times while growing its staffing, activities, and organizational partners and commitments for the bay's protection. The BBP's activities include coordination with local, region, state, and national policy and management decision makers on issues related to the protection and improvement of the bay, environmental education and outreach, student education, and monitoring and scientific research. Day to day operations are led by the Program Office, which is staffed by five full-time employees, one part-time employee, and a varying number of seasonal, part-time field staff. The BBP Program Office is housed at Ocean County College (OCC), a two-year community college, and operates as a department within OCC.

Funding to support BBP's work comes in several forms. Some work related to the CCMP is completed by the BBP's partner organizations, with funding from outside sources unrelated to the BBP's operations. For the operation of the BBP Program Office, overseeing CCMP implementation, and its various science, education, and policy efforts, the BBP receives annual funding through the USEPA National Estuary Program in accordance with Section 320 of the Clean Water Act, which was most recently re-authorized in 2016 (PL. 114-162). This federal funding, which has covered a large percentage of the BBP's operations in most years, has occasionally been reduced by various legislative and administrative processes. This Section 320 CWA funding remains critical to the continuing operation of the BBP and all other NEPs.

The Ocean County Board of Chosen Freeholders, through the Ocean County Natural Lands Trust Program, provides the matching funds for land acquisition; this funding match is essential to the continued operations of the BBP. Lastly, since 2005, Ocean County College has served as the host for the program and also provided substantive support for program administration and operation of the BBP Offices.

To help supplement the funding received from USEPA, the BBP Program Office identifies and applies for other grant funding, mainly from state and local government sources, to support project implementation.

To maintain the level of work currently underway and grow various protection, restoration, and education efforts to meet the challenges of the future, the BBP and its partners recognize that they will need to continue to diversify their funding and increase the overall funding level for CCMP implementation. As part of this effort, the BBP initiated an Organizational Needs Assessment in summer 2018 to investigate the Program Office's long-term staffing and facility needs (including staff office space, laboratories, field facilities, storage, exhibit space, visitor center, outreach and educational space), assess the organizational structure of the BBP and its working relationships with OCC and the many partners that comprise its management conference. The BBP and its many partners have begun acting on the recommendations included in the Needs Assessment Report (see APPENDIX). For example, additional technical staff has been hired and collaborations with some partners have been expanded

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The Needs Assessment Report also makes clear the need to review to create a Financial Strategy for the Program Office. The Financial Strategy will document the current sources of income (NEP funding, other grant funding, *etc.*) and identify opportunities to increase revenue from each of these sources as well as potential new funding sources. The goals for income diversification in each category, along with the steps needed to work toward those goals, will be identified for future consideration. The Financial Strategy will be completed in 2020, within a year of the publication of the revised CCMP.

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Chapter 11 - Communication and Education Plan

Public participation, education, and outreach are central to the BBP's mission to restore, maintain, protect, and enhance the water quality and natural resources of the Barnegat Bay estuary and its contributing watershed. The BBP includes a number of well-established and active organizations that implement various forms of public education and outreach programs on watershed- and estuary-related topics. Historically, these organizations, individually and collaboratively, have carried out a variety of communication projects and educational programs.

The purpose of the BBP's Communication and Outreach Plan is to establish clear objectives, approaches, and methods to engage distinct target audiences important to protecting the Barnegat Bay ecosystem. The Communication Plan defines strategies for effectively leveraging and coordinating the efforts of *all* communication and outreach practitioners working in the Barnegat Bay watershed.

11.1 History and Background

In February 2009, the Barnegat Bay National Estuary Program Office convened its first "Education and Outreach Retreat." The retreat brought together education and outreach professionals working on Barnegat Bay-related topics to share information and discuss how to collaborate on Barnegat Bay education and outreach efforts. As a follow-up to the first Education and Outreach retreat, the Program Office conducted an online survey of 47 partner organizations during the summer of 2009. The purpose of the survey was to assess Barnegat Bay outreach efforts and identify opportunities for improvement. The survey collected detailed information about outreach and education topic areas, target audiences, and the tools and methods utilized. Thirty partners (64% of those asked) participated in the survey.

The first Communication and Outreach Plan, entitled "Barnegat Bay National Estuary Program: Putting All the Pieces Together," summarized the survey results and provided a blueprint for partner education and outreach efforts. In 2010, the BBP formally approved the plan and formed a Communication and Education Committee (CEC) to manage its implementation.

After the BBP partners developed and approved the 2012-2016 Strategic Plan, the CEC completed a revised Communication Plan, which the BBP approved in February of 2014. The updated Communication Plan outlines education and outreach objectives, actions, and deliverables for each of the five priorities in the Strategic Plan (water quality, water supply, land use, habitat, and fish and wildlife).

11.2 Goal and Objectives

The goal of the 2014 Communication Plan was to identify ways to enhance and improve the BBP's communication, outreach, and public involvement in support of the CCMP. To achieve this goal, the BBP CEC established the following overall objectives:

- Support the priorities of the CCMP;

- Improve coordination among partner organizations to minimize duplication, while leveraging additional education and outreach opportunities;
- Effect better two-way interaction with stakeholders and target audiences;
- Include an education and outreach component in science and research projects by BBP and its partners;
- Establish BBP recognition for all projects, programs, and events that are part of the CCMP and funded in all/or part by the BBP; and
- Provide for measurable outcomes and regular evaluation.

11.3 Implementation

The BBP's CEC made significant progress in implementing the recommended actions in the Communication Plans. Accomplishments include the following:

- Development of a new logo and brand style guide for use in all BBP communications,
- Website redesign and expansion of social media outreach,
- Inclusion of an education and outreach component in science projects funded by the BBP,
- Outreach to new audiences (*e.g.*, Spanish speaking residents, tourists, and urban communities),
- Production of new outreach materials, including publications (*e.g.*, "Going Native") and videos,
- Development of a new website, "Jersey-Friendly Yards," to educate property owners about best landscaping practices,
- New citizen science opportunities, including the "Paddle for the Edge" shoreline assessment project,
- New volunteer opportunities, including the Barnegat Bay Volunteer Master Naturalist Program, and
- Annual Education and Outreach Retreat to promote collaboration between watershed educators.

11.4 Next Step – Revision

The BBP has reviewed and begun revising the Communication Plan with the goal of supporting the objectives and actions in the new CCMP. Social media outreach and marketing strategies will be incorporated into this revised Communication Plan, scheduled for completion in 2020, within a year of the publication of the revised CCMP.

Chapter 12 CCMP Revision Process

12.1 Identification of NEP Changes

Nearly 16 years have passed since the completion of the original CCMP for the Barnegat Bay. In that time, much has been accomplished in the way of working together, conducting research, and developing a better understanding of how the bay works and how best to manage these resources. There are several key changes in the approach to developing the revised 2018 Barnegat Bay CCMP, which are reflective of our growing knowledge of the interconnectedness of the issues impacting our estuary and the best ways to effectively address these issues.

The first change is the incorporation of climate change vulnerability into our development of the CCMP Objectives and Actions. Estuaries and coastal areas are particularly vulnerable to sea-level rise and other aspects of climate change (*e.g.*, higher temperatures, more precipitation, invasive species, and more frequent and intense storms, such as Superstorm Sandy). New Jersey coastal areas, including the Barnegat Bay estuary, are experiencing one of the highest rates of sea-level rise in the continental United States. Current observations have shown recent rates of approximately 4 mm per year (about 16 inches per century) of sea level rise (Kopp R. A., 2016). Though this may seem inconsequential to some, these rates are recognized by national and regional experts to be of sufficient magnitude to transform the character of the mid-Atlantic coast, with a large-scale loss of tidal wetlands and potentially significant changes to the topography of barrier islands and low-lying, “back-bay” areas.

Adapting to climate change and sea level rise impacts nearly every aspect of the work done by BBP and its partners and is a challenge that requires site-specific remedies. This CCMP has been developed with consideration of the impacts of climate change, and those objectives and actions which are most vulnerable to climate change and sea level rise have been noted as such in the Objectives and Actions tables. Identification of Objectives and Actions which are most susceptible to climate change will allow BBP and its partners to prioritize actions and ensure that the proper strategies are in place to protect and manage our natural resources. Additional information about the climate change vulnerability assessment is provided in Chapter 8.

The second area of change involves the combining of the Habitat and Fish & Wildlife priorities from the original CCMP into a combined Living Resources priority area. In reviewing the original CCMP Goals, Objectives and Actions, as well as the priorities included in the most recent BBP Strategic Plan, it was evident that considerable overlaps between these two priorities has resulted in unnecessary duplication. Upon further examination, it was concluded that combining the two categories into one priority area would streamline the document and would

allow the CCMP Goals, Objectives and Actions to be more focused, without sacrificing detail or impacting intended ecological outcomes.

12.2 NEP Contributions

Working Together: Memorandum of Understanding, Charters and Supporting Policies

Shortly after moving to Ocean County College, the BBP began developing a Memorandum of Understanding (MOU) to clarify how the Program Office and the organizational partners of the Management Conference would work together. This document formalized the commitments and responsibilities of the BBP Office, OCC as the administrative host, and other organizations as members of the Policy Committee, Advisory Committee, Science and Technical Advisory Committee, and Communication and Education Committee. It was vetted and signed by representatives from all committees and the Program Office in 2011.

In addition to the MOU, the STAC (2011) and CEC (2011) developed Charters which formalized membership and operational procedures, which were critical for identifying priorities and processes for providing federal funding to other organizations. In addition, the BBP developed Advocacy (2012) and Donation (2012) policies. Presently, the BBP has begun reviewing and revising its foundational, operational and policy agreements, including additional policies (e.g., data sharing) that may be needed.

Technical Memoranda on Fertilizer, Soil Health, and Other Issues

One hallmark of the National Estuary Program is its commitment to making decisions on the best available science. In 2009, NJDEP developed the Healthy Lawns-Healthy Waters Initiative as part of its effort to address nonpoint-source pollution. There was considerable interest in developing and establishing a fertilizer law: several different laws were developed by different groups across the state. Other efforts focused on codifying other practices, such as soil permeability. During 2009, the BBP STAC developed and reached consensus on 2 separate memoranda, one on soil health and one on fertilizer; each document represented agreement among the many different interests and perspectives among BBP partners. To address data gaps and further build on these documents, Rutgers University's Institute for Turf Science and Water Resources Research Institute, NJDEP, and the BBP co-sponsored the Nutrient Management Summit in 2010. These three documents identified and gave an overview of the critical technical issues and thus were important to advancing fertilizer and soil health legislation, which were signed into New Jersey law in 20xx.

Climate Ready Estuaries

In recognition of Barnegat Bay's vulnerability to climate change impacts, the BBP received funding through the United States Environmental Protection Agency's "Climate Ready Estuary

Program” to support research, planning, and outreach activities to address future impacts of climate change.

Adapting to climate change and sea level rise is a local challenge that requires site-specific remedies. As Superstorm Sandy and other recent storm events have demonstrated, local planners and managers need access to detailed information on critical infrastructure that is potentially at risk, and the tools to plan and prepare for the future. To address these needs, two new online tools have been developed for use in New Jersey – NJ Flood Mapper and Getting to Resilience.

The US Army Corps of Engineers is also engaged in an ongoing New Jersey Back Bays Coastal Storm Risk Management Study to investigate Coastal Storm Risk Management (CSRМ) strategies and solutions to reduce damages from coastal flooding affecting population, critical infrastructure, critical facilities, property, and ecosystems (USACE, 2019).

NJ Flood Mapper

The NJ Flood Mapper is an interactive mapping tool that provides ready access to sea level rise simulations and FEMA flood/storm surge maps, along with location of key facilities, coastal evacuation routes, and social and environmental vulnerabilities. Utilizing a user-friendly Google Maps platform, the website helps users to visualize different flooding scenarios and the potential impacts. Users can see how sea level rise from one to six feet and coastal flooding events will affect key facilities – hospitals, schools, police and fire stations – and emergency evacuation routes. Users can also print their maps and share them electronically with others and see on-the-ground photo visualizations of sea level rise and flooding impacts at iconic Jersey Shore locations.

Getting to Resilience

Developed to be used in association with NJ Flood Mapper, “Getting to Resilience” is the next step in community planning for the risks associated with climate change and sea level rise. “Getting to Resilience” is an online self-assessment tool developed to assist communities in reducing vulnerability and increase preparedness by linking planning, hazard mitigation, and adaptation. The “Getting to Resilience” questionnaire was developed to be completed by a set of individuals from a community and to be completed over a period of time. Creating an account allows key municipal officials and staff to work together on one set of answers. Participants in the online assessment will include land use planners, hazard mitigation planners, floodplain managers, emergency managers, stormwater managers, natural resource planners, municipal engineers, municipal leaders, zoning and permitting officials, and public works officials. Through the “Getting to Resilience” interactive process, communities will learn how their preparedness can yield valuable points with voluntary programs like FEMA’s Community Rating System and Sustainable Jersey. The assessment process will also increase the

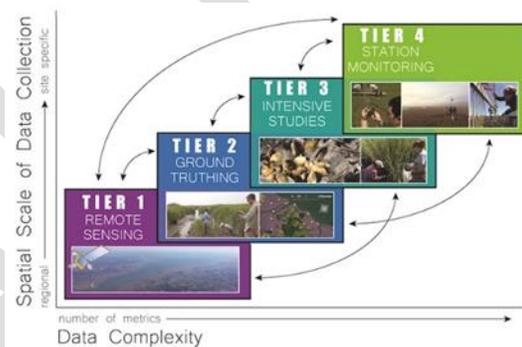
community's understanding of where future vulnerabilities should be addressed through hazard mitigation planning.

Ocean County's All-Hazards Mitigation Plan

In 2011, Ocean County Office of Emergency Management began the process of compiling the county's Multi-Jurisdictional All-Hazards Mitigation Plan. BBP was asked to participate on the Steering Committee and to provide technical support and input to the plan concerning future climate risks that might affect Ocean County. The Plan was approved by FEMA in 2013 and it was the first approved county-wide plan in New Jersey to include climate risks. In 2018, BBP continued to provide technical support to the County on the five-year update to Ocean County's Multi-jurisdictional All-Hazards Mitigation Plan which will be released in June 2019.

Wetlands Research

In 2009, BBP collaborating with the Partnership for the Delaware Estuary (PDE) established an integrated wetland monitoring and assessment in New Jersey that would cover Barnegat Bay and the Delaware Bay. This monitoring initiative utilized the USEPA's three-tier wetlands guidance and expanded on it to include an Intensive Studies component. Our monitoring consists of remote sensing analysis, rapid assessments, and long-term fixed station monitoring and special studies of wetlands in the Delaware Estuary and Barnegat Bay, spanning three states: New Jersey, Pennsylvania, and Delaware. This collective work led to the formation of the Mid-Atlantic Coastal Wetlands Assessment (MACWA).



Through MACWA, BBP continues to work closely with PDE, NJ Department of Environmental Protection, Delaware Department of Natural Resources and Environmental Control, USEPA Region 2, 3 and Headquarters Offices of Wetlands, Oceans and Watersheds, The Academy of Natural Sciences of Drexel University, US Fish & Wildlife Service and other partners to increase our knowledge base on tidal wetlands. Together we are working to collect data in an integrated manner that will allow us to supply coastal managers with the best information for wetland management. MACWA is the first regional tidal wetland program to study tidal wetland health in our region and has also led to the newly established NJ Tidal Wetlands Monitoring Network which is linking together long-term tidal wetlands monitoring locations into a statewide network.



To date, the New Jersey BBP/PDE wetlands initiative has received funding support from the USEPA (Headquarters and Region 2 Wetlands Program Development Grant Program) and pass-

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through funding from the NJ Department of Environmental Protection’s 319 (h) Program and NJ Coastal Management Office.

CEC-Funded Public Outreach and Education Grants

Since its inception, the BBP has provided small grants (*i.e.*, “minigrants”) to NGOs, faith-based groups, community organizations, schools, and other organizations to support education, increase environmental awareness, and promote stewardship. The BBP has funded more than 70 projects since 2002.

Recipient	Project Title	Fiscal Year
Forked Mountain River Coalition	Documentation of Rare, Threatened & Endangered Species in the Headwaters of the Middle Branch of the Forked River	02
Ocean County Vocational Technical School	Lesson Plans for Guardians of Barnegat Bay video	02
NJ Audubon Society	Seniors on the Bayshore	02
Alliance for a Living Ocean	Barnegat Bay Watch Monitoring Program 2	02
DM Group Inc.	Advanced Water Recycling System	02
NJ Society of American Foresters	Watershed-Friendly Demonstration Garden	04
Barnegat Bay Decoy & Baymen's Museum, Inc.	Tuckerton Seaport Horseshoe Crab Project	04
Save Barnegat Bay	Restoration & Conservation Programs at Island Beach State Park	04
Jersey Shore Council of Boy Scouts of America	Scouting Out the Bay	04
Anastasia Nast Roda	LBI - Not Just Another Vacation Spot	04
Seaside Park Recreation Department	“S.P.E.N.D.” the Day in the Park	04
Literacy Volunteers of Ocean County (LVA)	LVA for Barnegat Bay	04
Ocean County Soil Conservation District	Environmental Educator's Roundtable	04

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Alliance for a Living Ocean	Eco Tour of a Barrier Island	04
Ocean County Vocational Technical School	Incorporating Barnegat Bay Research Directly into the Classroom at all Levels	04
Rutgers Cooperative Extension of Ocean County	What the Bay HINGES On	04
Ocean Nature and Conservation Society	Nature Discovery Backpacks	05
Barnegat Bay Decoy & Baymen's Museum, Inc.	Family Summer Science Project	05
Pinelands Preservation Alliance	Up Close & Personal: Pinelands Curriculum	05
Crawford Rodriguez Elementary School	Metedeconk Watershed Map Deck	05
Ocean County Soil Conservation District	Blue Card Training Program	05
Natural Resource Education Center of NJ	Experience Barnegat Bay	05
Master Gardeners of Ocean County	2008 Master Gardeners Calendar	06
Long Beach Island Foundation of the Arts & Sciences	Marine Science Program	06
Save Barnegat Bay	Student Scholarship Program	06
Jersey Shore Council of Boy Scouts of America	Nature Activity Trail	06
Georgian Court University	Increasing Water Conservation Awareness	06
Toms River Regional Schools	Environmental Service Learning Projec	06
Ocean County Vocational Technical School	Citizens and Educators Stewardship Program	06
New Jersey Audubon Society	Ecosystem Education	06
The Crab Chix, LLC	Horseshoe Crabs: Pretty as a Picture?	06
Borough of Point Pleasant Beach	Pet Waste Stations	06
Parkday Organization	Multimedia Barnegat Bay Watershed Map	07

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Long Beach Island Foundation of the Arts & Sciences	LBI Blue Pages	07
Stockton University	Sedge Island Natural Resource Education Center Marine and Estuarine Habitat Course-Volunteer Master Naturalist Certificate Program	07
Berkeley Township Elementary School	Potter Creek Crusaders	07
Borough of Point Pleasant	Earth Day Education Program	07
South Toms River Municipal Alliance	South Toms River Rain Garden	07
American Littoral Society	Speaking for the Bay	07
Ocean County Soil Conservation District	Rain Gardens as Outdoor Classrooms	07
Alliance for a Living Ocean	Shellfish, Fish and a Healthy Bay	07
Bay Head Environmental Commission	Rain Garden	08
Nellie F. Bennett Elementary	Learning Today for a Cleaner Barnegat Bay	08
Borough of Lavallette	Island Bay Front Gardens	08
Master Gardeners of Ocean County	2010 Master Gardeners Calendar	08
NJ Audubon Society	Teaching Inquiry Through Environmental Investigations In the Barnegat Bay Watershed	08
Ocean County Board of Agriculture	Sustainable Landscapes Education Project	08
Long Beach Island Foundation of the Arts & Sciences	Coastal Rain Garden	08
Borough of Seaside Park	Native Vegetation Garden Walking Tou	08
The Berkeley Shores Homeowners' Civic Association	Allen Road Beach: A Living Shoreline	09
Girl Scouts of the Jersey Shore	Water, Water Everywhere... But not a Drop to Drink	09
Borough of Seaside Park	Multi-objective Stormwater Management Demonstration Projects for Coastal Communities (Phase II	09
Tuckerton Seaport & Baymen's Museum	Just Enough: Working the Cycle Past, Present and Future	09

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St. Stephen's Episcopal Church	A Garden of Native Plants	09
Long Beach Island Foundation of the Arts & Sciences	Got Milkweed	09
Conserve Wildlife Foundation of NJ	Barnegat Bay Birder-in-Residence Program	09
Lake Riviera Middle School	Kettle Creek Crusaders	09
Island Beach State Park	Harvest the Bay	13
ReClam the Bay	Shellfish in the Classroom	13
Meadows of Lake Ridge Homeowners Association	A Pathway to Possibilities	13
Long Beach Island Foundation of the Arts & Sciences	Discovery Fridays in Spanish	13
Conserve Wildlife Foundation of NJ	Businesses for a Healthier Bay	13
Conserve Wildlife Foundation of NJ	Barnegat Bay Turtle Gardens: Supporting Living Shorelines to Safeguard Terrapins for Sea-Level Rise	15
Ocean County Soil Conservation District	From Lawn to Garden – Going Green, Saving Green!	15
Boating Education and Rescue	Everything Eventually Ends Up in the Water	15
Cedar Hollow Consulting and Bob Birdsall Photography	Streaming the Rivers and Creek in the Barnegat Bay Watershed	15
Church of the Visitation, Visitation Relief Center	The Beneficial Indigenous Plants Project	15
Ocean County Soil Conservation District	Experience Jersey-Friendly Yards!	17
Brick Township Municipal Utilities Authority	Greening Your Landscape While Protecting the Watershed	17
Borough of Beach Haven	Conserve Water and Reduce Pollution at the Native Garden	17

STAC-Funded Research Grants

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Since its inception, the BBP has provided funding for research projects that advance our understanding of the bay and watershed. The BBP has funded over 38 research projects since 2003, in topics across all of the priority areas.

Organization	Project Title	Fiscal Year
Rutgers University	Barnegat Bay Build-out Analysis	2001
Rutgers University	Establishment of a Biodiversity Index for the Barnegat Bay-Little Egg Harbor Estuary	2002
USGS	An Analytical Framework For Evaluating Present And Future Watershed Inputs To The Barnegat Bay-Little Egg Harbor Estuary	2003
Rutgers University	Submerged Aquatic Vegetation and Benthic Habitat Mapping for the Barnegat Bay-Little Egg Harbor Estuary	2003
Rider University	The Effect of Artificial Shoreline on Habitat Quality and Mortality of Blue Crabs, <i>Callinectes sapidus</i>)	2004
OCSCD	Sub-aqueous Vegetation Sediment Classification System and Mapping Study for the Barnegat Bay	2005
Montclair University	Assessing Harmful Macroalgal Blooms on Submerged Aquatic Vegetation	2005
Rutgers University	GIS Based Tool for Riparian Zone Health Assessment	2005
Rutgers University	Demographic Investigation of Submerged Aquatic Vegetation in Barnegat Bay	2005
Birdsall Inc.	Silver Bay Bacterial Source Tracking	2006
Birdsall Inc.	FC/FS Sampling in Long Swamp Creek Watershed	2006
USGS	Assessment of Shallow Groundwater Quality Indicator	2006
Rider University	The impacts of artificial shoreline on species diversity	2007
Rider University	Assessing Population Structure, Reproductive Potential and Fishing Efforts for Blue Crab in Barnegat Bay	2008
USGS	Determining Sources of Nitrogen Inputs to Barnegat Bay-LEH Estuary	2008
Rutgers University	Development of Nutrient Pollution Indicators for the BB-LEH Estuary using Eelgrass	2008
Rutgers University	SAV Remote Sensing and in situ survey of SAV in BB	2009
USGS	Evaluating Present and Future Watershed Inputs to the BB-LEH, Nitrogen inputs to Groundwater	2009
ALS	An analysis of pollution reduction capability of existing BMPs located in the TR sub-watershed of BB	2009
Rider University	Assessing Population Structure, Reproductive Potential and Movement of adult Blue Crab in BB	2009
Montclair University	Assessment of Sea Nettle Polyps in Barnegat Bay	2009
USGS	Quantifying Sources of Nutrient Inputs to BB-LEH: Monitoring and Discrete sampling of streams and shallow groundwater	2009

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Rider University	Fecundity of BB Blue Crab: the influence of size, seasons and relative fishing efforts	2010
Rutgers University	Status and Trends of Shellfish Populations in BB with a focus on hard clam	2010
Rutgers University	Implementing American eel passage on existing dams	2011
USDA-NRCS	Subaqueous soil survey of Barnegat Bay	2012
Stockton University	Derelict crab trap identification and removal in Barnegat Bay	2013
Rutgers University	<i>In situ</i> surveys of seagrass in northern Barnegat Bay	2011
OCSCD	Soil Health Improvement Project	2011
Rutgers University	Characterization of phytoplankton functional taxonomic groups	2012
Stockton University	Modeling <i>Zostera marina</i> restoration potential in Barnegat Bay	2012
Montclair University	Plant and Soil Community Structure in Riparian Soil Nutrient Retention	2013
Stockton University	Assessing the Status of Barnegat Bay Submerged Aquatic Vegetation	2015
Stockton University	Barnegat Bay-Little Egg Harbor Oyster Spat Settlement Evaluation	2016
Rutgers University	Restoration Planning for hard clams in Barnegat Bay	2016
Stockton University	Barnegat Bay oyster reefs: biological and coast benefit analyses	2016
Stockton University	Barnegat Bay Seagrass Monitoring	2017
USGS, UNCW	Seagrass Vulnerability to Climate Change in Barnegat Bay	2018

12.2.1 Water Quality Success Stories:

Statewide Fertilizer Law

The New Jersey Fertilizer Law (New Jersey Act, P.L. 2010, c. 112; C.58:10A-64, signed January 5, 2011) established statewide fertilizer standards in an effort to reduce nutrient pollution from fertilizers. Implemented in three phases over several years, the law:

- sets standards for fertilizer content, requiring at least 20% slow release nitrogen content and eliminating all phosphorus, except for application on new lawns and certain fertilizers made from recycled biosolids;
- restricts the amount of nitrogen used in a single application and the total amount applied in a year;
- sets limits for when and where lawn fertilizer can be applied by homeowners and landscape professionals; and
- requires professional applicators to be trained and/or certified in proper fertilizer use.

Presently, the law is being fully implemented; however, the efficacy of the law in reducing nutrient loadings to the bay has not yet been assessed. See NJDEP's Healthy Lawns-Healthy Waters web page (<http://www.nj.gov/dep/healthylawnshealthywater/>) for the latest information regarding implementation of the state's fertilizer law.

Soil Compaction and NPS Pollution Reduction

The New Jersey Soil Restoration Act (P.L. 2010, CHAPTER 113, signed January 5, 2011) required that the N.J. Secretary of Agriculture and the Commissioner of the NJDEP, through the State Soil Conservation Committee, propose modifications to the existing statewide soil erosion and sediment control standards to set limits to soil compaction in the Barnegat Bay watershed and across the state, and thus improve infiltration and reduce NPS pollution throughout New Jersey. In 2017, the New Jersey Department of Agriculture proposed and adopted compaction standards for new development that are included in the Technical Standards for Soil Erosion and Sediment Control in New Jersey. The NJDEP is also developing a model ordinance to apply the soil restoration standards for both new construction and redevelopment projects and support additional soil restoration.

Many BBP partners worked together to reduce nutrient and sediment runoff from the developed landscape. Building on the NJDEP Healthy Lands-Healthy Waters Initiative, with outreach and advocacy from the NGO community, and technical coordination from governmental and other organizations, the State of New Jersey passed two ground-breaking pieces of legislation to: (1) reduce the fertilizer being applied to turf and (2) increase infiltration of fertilizer nutrients through establishment of a soil restoration standard on all new development.

At present, soil restoration is required when critical compaction, *i.e.*, root-limiting compaction, occurs when a subsoil resistance of 300 pounds per square inch (psi) occurs at 6 inches or less (NJ Department of Agriculture, 2017). This standard has been criticized for not adequately reducing bulk density of soils to a sufficient depth on new development and thus not ensuring adequate infiltration of water. In addition, the procedure for testing compliance with the law is inadequate. The NJDEP proposed that Barnegat Bay communities and counties consider developing and adopting a more effective standard as part of its Phase 2 Plan for the Barnegat Bay.

Improvements in Stormwater Management

New statewide stormwater management rules were established by the NJDEP in 2004. These rules establish the design and performance standards for new development including groundwater recharge, runoff quantity controls, runoff quality controls, and buffers around Category One (C1) waters. In the Pinelands, the rules are even more strict for major development--the resulting increase in runoff from a large storm event (equivalent to the 24-hour storm event occurring on average once every 10 years) must be retained and infiltrated onsite

Stormwater Basin Retrofits & Rain Garden/Rain Barrel Installations

Much progress has been made to improve or retrofit antiquated stormwater infrastructure to better meet current water quality and groundwater recharge design standards and/or reduce the amount of runoff directly entering waterways. Examples include retrofits of detention basins, storm inlets and outfall pipes, installations of rain gardens, rain barrels and pervious pavement, and restoration of riparian corridors and compacted soils. This work has been undertaken by various organizations, including NJDEP, Ocean County, Ocean County Soil Conservation District, Brick Twp. MUA, municipalities, non-profit organizations and others, and the success of these “Green Infrastructure” programs will support additional stormwater management improvements throughout the watershed in the coming years.

Ocean County Pump-out Boat Program

The Barnegat Bay-Little Egg Harbor estuary complex was recognized as a no-discharge zone in June 2003. In support of this designation, Ocean County established a pump-out boat program to supplement land-based sewage pump-out facilities in service at marinas in Ocean County waters. The boats have been highly successful in addressing the needs of non-marina-based boats, such as those moored in open waters or in lagoon developments. The boats provide services for free, and typically operate from Memorial Day through the end of September. Since 1997, with the first pump-out boat, the “Circle of Life”, over 1.6 million gallons of concentrated effluent waste have been removed from the holding tanks and portable toilets of boats that may have otherwise been directly discharged into the Bay. Because of high demand, the fleet now includes six full time pumpout vessels, with the Circle of Life operating as a backup boat for busy weekends (See <http://www.planning.co.ocean.nj.us/coastal.htm> for additional information).

Source-Tracking: Beachwood Beach

Using a “find it and fix it” approach, the NJDEP’s Pollution Source Tracking program’s goal is to have a targeted improvement in water quality that has been degraded by NPS pollution and sewage infrastructure failures. NJDEP has a five-step process in which they work with local partners to perform intensive monitoring to narrow down and identify sources and solutions to problems. As an example, NJDEP and partners performed a Source Tracking project at a recreational bathing beach in Beachwood Borough in 2015-17. Located on the Toms River, Beachwood Beach West has had frequent closures. As little as 0.1 inch of rain was found to result in exceeded beach standards. Samples were collected upstream and downstream of the bathing area during various weather and tidal conditions. The results identified two nearby stormwater outfalls as the main sources of pollution at the beach. The pollution remained near the beach area in eddies, resulting in longer closures. Dye test results showed that extending the outfall location would reduce beach impacts. Beachwood Borough, with Ocean County, developed a plan to connect the two outfalls and relocate the discharge away from the beach. The borough also inspected nearby sewer lines, identified some cracks, and made repairs in July 2017. These actions reduced the number of beach closures during rain events that total less than

0.5 inches. Closures still occur with rain events larger than 0.5 inches due to other sources. The investigation continues to track down pollution sources along the Toms River that impact this beach.

Understanding the Barnegat Bay

One hallmark of all National Estuary Programs is their commitment to utilizing sound science to provide a good foundation for decision making. Embracing this commitment, the BBP's Science and Technical Advisory Committee, comprised of the BBP office and expert technical partners, developed in 2009-2010 a research prospectus which identified outstanding science information gaps and research needs to advance our understanding of the bay's condition and its challenges. This document provided the foundation for the monitoring, research studies, and other activities undertaken as part of the NJDEP's 2010 Barnegat Bay Initiative (<http://www.jcronline.org/toc/coas/78>; <http://www.bioone.org/toc/coas/78>). Much of this monitoring and research was later published (NJDEP, Barnegat Bay Phase Two: Moving Science into Action). In turn, this science helped generate considerable public support and guided additional efforts and investment in bay protection and restoration².

Pinelands Comprehensive Management Plan (CMP)

The Pinelands CMP, established in 1981, has been very successful in preserving the unique Pine Barrens ecosystem particularly in pristine headwater areas of the bay's watershed. The Pinelands CMP incorporates landmark regional land use and environmental controls and is responsible for the permanent protection of large tracts of forest and extensive wetland systems. In addition to protecting large tracts from development, the CMP incorporates a nitrogen dilution model to ensure that development does not exceed the assimilative capacity of the environment. The water quality of the lower tributaries of Barnegat Bay stand as a testament in part to the success of the Pinelands CMP.

12.2.2 Water Supply Success Stories:

Water Supply Plan Update

As described previously, in 2017 the NJDEP released the New Jersey Water Supply Plan 2017-2022, representing the second comprehensive revision to the NJWSP.

Hydrologic Monitoring

Streamflow and groundwater levels at many sites in the Barnegat Bay watershed are monitored on a continuous or recurring basis by the USGS, in cooperation with and primarily funded by the NJDEP and others. The USGS/NJDEP cooperative program also monitored tidal flow continuously at the Point Pleasant Canal, Barnegat Inlet, and Little Egg Inlet in support of the development of the hydrodynamic model of the bay.

Water-Supply Studies

Several scientific, watershed-scale studies have been conducted by the USGS in cooperation with and funded primarily by the NJDEP to assess water-levels in confined and unconfined aquifers, the effects of groundwater withdrawals on streamflow, and the extent to which the groundwater system is susceptible to potential saltwater intrusion into near-shore supply wells. Results of these studies informed the 2017 Statewide Water Supply Plan. A USGS study in cooperation with NJDEP developed a hydrodynamic flow model of the bay which describes circulation patterns and residence times and provides the framework for modeling water quality in the bay.

Expansion of Public Outreach

Numerous agencies and organizations have developed and implemented outreach programs (*e.g.*, USEPA WaterSense (<https://www.epa.gov/watersense>), Pinelands Preservation Alliance Save the Source (www.savethesource.org) to educate the public about water resources and their conservation and protection. These programs have been very effective and are being continually expanded.

12.2.3 Living Resources Success Stories:

Ecologically Sensitive Areas Designation

In addition, to help address the adverse effects associated with motorized boating activities in Barnegat Bay, a network of ecologically sensitive areas (ESAs) were identified to receive special consideration and management¹. The boundaries for these ESAs were based on a GIS interpretation of both habitat natural features (*e.g.*, shellfish beds, submerged aquatic vegetation), and living resources (*e.g.*, presence of endangered species, hard clam densities, and proximity to shorebird nesting areas). The mapping clearly showed extensive prop scarring in these ESAs confirming that some form of spatial zoning, with slow speed regulations or outright closures, are warranted to protect SAV. Additional management actions to reduce boating impacts were clearly warranted and to reach a spectrum of the recreational boating community, a three-pronged approach was enacted in 2012 that included public education in responsible boating practices.

Osprey Rebound

The return of ospreys to the Barnegat Bay watershed is an encouraging wildlife management success story. Ospreys (*Pandion haliaetus*) are well-loved birds of our coastal bays and marshes. Formerly known as the fish hawk, ospreys rely almost exclusively on fish for their diet. They (like eagles and falcons) succumbed to the effects of DDT, habitat loss, and persecution and their population dropped to about 60 pairs statewide by the early 1970s. Since inclusion on New Jersey's Endangered Species List in 1973, the osprey population has shown a steady increase, with 668 pairs of ospreys observed nesting throughout New Jersey in 2017, exceeding historic

numbers of approximately 500 nesting pairs (pre-DDT exposure). In the Barnegat Bay watershed there were 112 active nests in 2017¹, the most in any watershed in New Jersey. The Barnegat Bay watershed nests averaged 1.34 young per nest in 2017, more than twice the number needed for a stable population.

Establishment of MACWA

Though critically imperiled by overdevelopment and sea-level rise, marshes are among the habitat types most responsive to environmental change. However, coastal marshes throughout New Jersey remain poorly monitored and assessed with regard to sea-level rise or other potential threats. Historically, no single entity has been able to assess and track both the extent and condition of tidal wetlands across New Jersey. Consequently, only patchy, obsolete, or inconsistent data were available on current wetland status and trends, despite the importance of such data to decision makers. This lack of information hampered our collective abilities to provide watershed-scale guidance to managers about how to protect and enhance wetlands long-term. To address this critical need BBP and its partners established the Mid-Atlantic Coastal Wetlands Assessment in 2009.

Over the last few years, BBP has partnered with the Partnership for the Delaware Estuary (PDE) to work cooperatively to establish an integrated wetland monitoring and assessment network in New Jersey. The monitoring project employed USEPA's three-tier wetlands guidance for wetland monitoring and assessment program. This project is a major step forward as part of a larger initiative, the Mid-Atlantic Coastal Wetlands Assessment (MACWA). MACWA is envisioned as a regular, ongoing program that spans the area from coastal New Jersey to coastal Delaware. Of the existing nine continuously monitored sites, four are in the Barnegat Bay Watershed. The BBP and the PDE are working closely with the NJDEP, USEPA Region 2, US Fish and Wildlife Service and other partners.

12.2.4 Land Use Success Stories:

Pinelands National Reserve and Management Plan

The New Jersey Pinelands Commission protects the Pinelands through its implementation of the Pinelands Comprehensive Management Plan (CMP). The CMP contains the rules that guide land-use, development and natural resource protection programs in the state Pinelands Area. The Commission was granted the authority to preserve this special part of New Jersey through the passage of the National Parks and Recreation Act of 1978 and the New Jersey Pinelands Protection Act in 1979. Fifty-three municipalities within seven counties in the Pinelands Area have incorporated the Pinelands Comprehensive Management Plan into their municipal plans to help enforce protection of the Pinelands within their communities. Similarly, BBP aims to have all municipalities in the watershed reference the BBP's revised CCMP in their municipal plans.

Metedeconk Watershed Restoration and Management Plan (MWRMP)

The Brick Twp. MUA completed a comprehensive watershed protection and restoration plan for the Metedeconk Watershed. The main goals of the plan were to preserve the Metedeconk River as a viable water supply source for the region and to protect the health of the Barnegat Bay watershed by reducing NPS pollution, eliminating water quality impairments, addressing TMDL's, and attaining compliance with the surface water quality standards throughout the watershed. The plan includes a prioritized listing of projects/management actions that will help protect the Metedeconk Watershed. Subsequent to the state's approval of the plan, funding has been acquired from a number of agencies and organizations to implement a number of projects to enhance water quality.

Municipal Public Access Plans and Ordinances

Several municipalities within the Barnegat Bay Watershed are nearing completion of Municipal Public Access Plans to ensure equitable access to open space and natural resources, such as the beach, rivers and bay. Municipalities which are completing Municipal Access Plans include Barnegat Light Borough, Bay Head Borough, Beach Haven Borough, Berkeley Township, Harvey Cedars Borough, Little Egg Harbor Township, Long Beach Township, Mantoloking Borough, Ocean Gate Borough, Seaside Heights Borough, Seaside Park Borough, Ship Bottom Borough, South Toms River Borough, Surf City Borough, Toms River Township.

Numerous municipalities have adopted local ordinances aimed at protecting water supplies (*e.g.*, mandatory riparian buffers, wellhead protection areas, and outdoor irrigation restrictions) which serve as a model for towns that have yet to embrace these effective strategies. The Pinelands Commission developed an especially protective Model Stormwater Control Ordinance¹ to ensure that sites and maintenance plans for proposed stormwater BMP's are appropriate.

New Jersey Department of Environmental Protection's Coastal Zone Management Plan

The BBP's CCMP is recognized as part of the federally approved NJ Coastal Zone Management Plan which is closely tied to land use management. The NJDEP has also sponsored over \$3.8 million of research studies in the Barnegat Bay under the Barnegat Bay Action Plan (2012-2015). These research projects are intended to inform science-based decision making. Ten research projects were funded, the results of which will create one of the most comprehensive compilations of research on a single estuary¹. Tens of millions of dollars for stormwater infrastructure and upgrades were also made available to municipalities and counties in the Barnegat Bay watershed.

Metedeconk River Greenway and Turkey Swamp County Park Expansion

The Monmouth County Parks System (MCPS) established the 457-acre Metedeconk River Greenway to protect water quality and wildlife habitat along the Metedeconk River. MCPS also

expanded the 2,266-acre Turkey Swamp County Park within the Metedeconk River subwatershed; this wooded park features lots of camping and other outdoor venues, including miles of trails, an archery range, playgrounds, and a 17-acre lake for fishing, boating, and ice-skating.

Ocean County Natural Lands Trust Program

Established in 1997, the Ocean County Natural Lands Trust Program (OCNLT) has established a system of protected lands which, in combination with the Farmlands Preservation Program, enhances the quality of life in Ocean County by helping to maintain the County's rural characteristics, protecting critical environmental resources and water supply; maintaining and enhancing active agriculture, and buffering areas which are not compatible with development. The program generates over \$10 million annually for natural lands acquisitions and farmland preservation. Between 2010 and 2015, approximately 11,114 acres in the Barnegat Bay watershed were acquired by federal, state, county, local, and non-governmental agencies for conservation purposes. The OCNLT also coordinates and leverages funding with federal, state, municipal and private programs including NJDEP Green Acres and Blue Acres Programs, Pinelands Commission, Department of Defense, U.S. Fish and Wildlife Service's Edwin B. Forsythe National Wildlife Refuge (EBFNWR), and private land trust organizations. Examples of such acquisition efforts include the Brick Township portion of the EBFNWR at Reedy Creek, the Barnegat Township portion of the EBFNWR at Good Luck Point, and more than 5,000 acres of buffer around Joint Base Fort Dix Maguire Lakehurst.

Getting to Resilience (<http://www.prepareyourcommunitynj.org/>)

This online self-assessment tool was built off a questionnaire developed by the NJ Coastal Management Program to assist communities to reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. New Jersey communities use the tool to assess, plan and implement strategies to improve resilience. An online mapping tools helps visualize the community's exposure to current and future hazards. Completing the online assessment helps municipalities evaluate their preparedness, planning and public outreach activities around flood hazards. Utilizing the resilience recommendations, communities can prioritize next steps and improve the resilience of their community to sea level rise and other climate change stressors, such as fire and coastal storms. Support for this effort was provided by the BBP, JCNERR, USEPA's Climate Ready Estuaries Program, NOAA , NJ Sea Grant , Rutgers Bloustein School of Planning and Public Policy and Sustainable New Jersey