

**COMPREHENSIVE CONSERVATION  
MANAGEMENT PLAN  
for the  
BARNEGAT BAY WATERSHED  
Prepared by the  
Barnegat Bay Partnership  
Submitted to EPA**

**Draft  
July 2018**

This document is available on the Barnegat Bay National Estuary Program website:

[www.barnegatbaypartnership.org](http://www.barnegatbaypartnership.org)

Or write or call the Barnegat Bay National Estuary Program:

Barnegat Bay Partnership

Ocean County College, College Drive, PO Box 2001,

Toms River, NJ 08754

Phone (732) 255-0472 Fax (732) 255-0358

## Acknowledgements

Thank you to the many people, agencies, and organizations who have worked tirelessly to support the protection of the Barnegat Bay Estuary, and the creation of this revised CCMP document.

### **Barnegat Bay Partnership Policy Committee Members**

Hon. Paul J. Kennedy	Ocean County Mayor's Association, President
Peter D. Lopez	USEPA, Region 2, Regional Administrator (Co-Chair)
Dr. Javier E. Laureano	USEPA, Region 2, Director, Clean Water Division (Alternate)
George Murnyak	Citizen Representative
Dr. Jon H. Larson	Ocean County College, President
Catherine R. McCabe	NJDEP, Acting Commissioner (Co-Chair)
Hon. Joseph H. Vicari	Ocean County Board of Chosen Freeholders, Freeholder Liaison
Dr. L. Stanton Hales, Jr.	Co-Chair, Advisory Committee ( <i>ex officio</i> )
Karen Greene	Co-Chair, Advisory Committee ( <i>ex officio</i> )
Rob Karl	Chair, Science and Technical Advisory Committee ( <i>ex officio</i> )
Wes Dalzell	Chair, Communication and Education Committee ( <i>ex officio</i> )
Shari Kondrup	Co-Chair, Communication and Education Committee (Alternate, <i>ex officio</i> )

### **Advisory Committee Members**

Dr. L. Stanton Hales, Jr.	Barnegat Bay Partnership (Co-Chair)
Karen Greene	NOAA National Marine Fisheries Service (Co-Chair)
Dr. Matthew Poach	NOAA National Marine Fisheries Service
Keith B. Marcoon	Ocean County Utilities Authority
Scott M. Conklin	Ocean County Utilities Authority
Terry Fowler	US Army Corps of Engineers
Mary E. Brandreth	US Army Corps of Engineers
Stephen Rochette	US Army Corps of Engineers
Jeffrey Fischer	US Geological Survey
Helen Henderson	American Littoral Society
Kerry Kirk-Pflugh	NJ Department of Environmental Protection (NJDEP)
Lynette Lurig	NJ Department of Environmental Protection (NJDEP)
Carrie Mosley	Natural Resources Conservation Service
Rob Tunstead	Natural Resources Conservation Service
Dr. Peter Rowe	New Jersey Sea Grant Consortium
Michael J. Danko	New Jersey Sea Grant Consortium
John Protenensis	Ocean County Health Department
Tim Dillingham	American Littoral Society
Anthony Agliata	Ocean County Planning Department
Victoria K. Pecchioli	Ocean County Planning Department
Michael DeLuca	Rutgers University – NJEAS/JC NERR
Lisa Auermuller	Rutgers University – NJEAS/JC NERR
Greg Socha	Trust for Public Land
Virginia Rettig	US Fish & Wildlife Service, Edwin B. Forsythe National Wildlife Refuge
Mary Ann Bageac	Barnegat Bay Foundation
Nesmarie Negrón	US Environmental Protection Agency, Region II

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Barbara Spinweber	US Environmental Protection Agency, Region II
Michael Craghan	US Environmental Protection Agency, Headquarters Liaison
Dr. Steven Yergeau	STAC Vice-Chair and Rutgers Cooperative Extension of Ocean County
Thomas Fote	Jersey Coast Anglers Association
Melissa Danko	Marine Trades Association of New Jersey
Matthew Kennedy	Ocean County College
Jenn Kelemen	Ocean County College
Christine Raabe	Ocean County Soil Conservation District
Angela Andersen	Long Beach Island Foundation of the Arts & Sciences
Wes Dalzell	CEC Chair and ReClam the Bay
David Wheeler	Conserve Wildlife Foundation of NJ
Stephanie Egger	Conserve Wildlife Foundation of NJ
Tony MacDonald	Monmouth University
Carleton Montgomery	Pinelands Preservation Alliance
Charles Caruso	Pinelands Preservation Alliance
Edward Wengrowski	New Jersey Pinelands Commission
Nancy Wittenberg	New Jersey Pinelands Commission
Rick Bushnell	ReClam the Bay
Clint Lehman	ReClam the Bay
Britta Wenzel	Save Barnegat Bay
GraceAnne Taylor	Save Barnegat Bay
Louise Wootton	Georgian Court University
Will Ruocco	Brick MUA
Rob Karl	STAC Chair and Brick MUA
Shari Kondrup	CEC Co-Chair and Brick MUA
John Case	NJ Department of Transportation
Robert Parker	NJ Department of Transportation

**Science and Technical Advisory Committee (STAC) Members**

Rob Karl	Brick Municipal Utilities Authority (Chair)
Dr. Steven Yergeau	Rutgers Cooperative Extension of Ocean County (Vice-Chair)
Dr. Matthew Poach	NOAA National Marine Fisheries Service
Gregg Sakowicz	Jacques Cousteau National Estuarine Research Reserve (JC NERR)
Christine Wieben	US Geological Survey
Jeff Fischer	US Geological Survey
John Protonentis	Ocean County Health Department
Rob Tunstead	USDA Natural Resources Conservation Service
Christine Hall	USDA Natural Resources Conservation Service
Tim Dillingham	American Littoral Society
Helen Henderson	American Littoral Society
Alena Baldwin-Brown	NJDEP
Lynette Lurig	NJDEP
Will Ruocco	Brick Municipal Utilities Authority
Dr. John Manderson	NOAA National Marine Fisheries Service
Barbara Spinweber	US Environmental Protection Agency, Region 2
Darvene Adams	US Environmental Protection Agency, Region 2
Dr. Peter Rowe	New Jersey Sea Grant Consortium

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Michael J. Danko	New Jersey Sea Grant Consortium
Steve Mars	USFWS/Edwin B. Forsythe Wildlife Refuge
Eric Schradling	USFWS/Edwin B. Forsythe Wildlife Refuge
Heather Jensen	US Army Corps of Engineers
Britta Wenzel	Save Barnegat Bay
Dr. L. Stanton Hales Jr.	Barnegat Bay Partnership (ex officio)
Dr. James Vasslides	Barnegat Bay Partnership
Victoria Pecchioli	Ocean County Department of Planning
Scott Conklin	Ocean County Utilities Authority
Carol Conklin	Ocean County Utilities Authority
Dr. John Wnek	Save Barnegat Bay
Patrick Burritt	NJ Pinelands Commission
Charles Caruso	Pinelands Preservation Alliance
Dr. Ryan Rebozo	Pinelands Preservation Alliance
Rick Bushnell	ReClam the Bay
Clint Lehman	ReClam the Bay
Jim Nickels	Urban Coast Institute at Monmouth University
Dr. Jason Adolph	Urban Coast Institute at Monmouth University
Dr. Louise Wootton	Georgian Court University
Dr. Elizabeth Lacey	Stockton University
Linda Brennen	Monmouth County Department of Planning
Robert Parker	Department of Transportation
Dana Hecht	Department of Transportation

**Communication and Education Committee (CEC) Members**

Wes Dalzell (Chair)	ReClam the Bay
Shari Kondrup (Co-Chair)	Brick Township Municipal Utilities Authority
Will Ruocco	Brick Township Municipal Utilities Authority
Karen Walzer	Barnegat Bay Partnership (Staff liaison)
Angela C. Andersen	Long Beach Township & Long Beach Island Foundation of the Arts & Sciences
Kaitlin Gannon	Jacques Cousteau National Estuarine Research Reserve
Peter Brandt	US EPA, Region 2, Public Affairs Director for Estuaries & Lakes and Senior Communication Advisor
Barbara Spinweber	US EPA, Region 2
Michael Craghan	US EPA Headquarters Liaison
Lynette Lurig	New Jersey Department of Environmental Protection
Tanya Oznowich	New Jersey Department of Environmental Protection
Becky Laboy	Ocean County Soil Conservation District
Christine Raabe	Ocean County Soil Conservation District
Chris Claus	Ocean County Department of Parks & Recreation
Joel Mott	New Jersey Pinelands Commission
Scott Bruinooge	Ocean County College
GraceAnne Taylor	Save Barnegat Bay
George Murnyak	Citizen Representative to the BBP Policy Committee ( <i>ex officio</i> )
Stan Hales	Barnegat Bay Partnership ( <i>ex officio</i> )
Betsy Hyle	Barnegat Bay Partnership ( <i>ex officio</i> )
Martha Maxwell-Doyle	Barnegat Bay Partnership ( <i>ex officio</i> )

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**CCMP Steering Committee Members**

Karen Greene	NOAA National Marine Fisheries Service
Barbara Spinweber	US EPA, Region 2
Lisa Auermuller	Jacques Cousteau National Estuarine Research Reserve
Britta Wenzel	Save Barnegat Bay
Christine Raabe	Ocean County Soil Conservation District
Charles Caruso	Pinelands Preservation Alliance
Lynette Lurig	New Jersey Department of Environmental Protection
Angela Andersen	
Joseph Bilinski	New Jersey Department of Environmental Protection
Dorina Frizzera	
Linda Brennen	Monmouth County Division of Planning
Rob Karl	Brick MUA
Mark Villinger	Ocean County Department of Planning
Stan Hales	Barnegat Bay Partnership
Martha Maxwell-Doyle	Barnegat Bay Partnership
James Vasslides	Barnegat Bay Partnership
Karen Walzer	Barnegat Bay Partnership
Elizabeth Hyle	Barnegat Bay Partnership

**Water Quality Expert Panel Members**

**Water Supply Expert Panel Members**

**Living Resources Expert Panel Members**

Kira Dacanay – NJDEP Bureau of Shellfisheries  
Mike Celestino – NJDEP Bureau of Marine Fisheries  
Ursula Howson – NOAA/NMFS  
Eric Schradling - USFWS NJ Field Office  
Dr. Elizabeth Lacey – Stockton University  
Contractor Assistance – Tom Belton  
Staff –Dr. Jim Vasslides

**Land Use Expert Panel Members**

Nick Angarone	NJDEP Office of Coastal and Land Use Planning
Linda Brennen	Monmouth County Planning
Patricia Doerr	The Nature Conservancy
Kathy Haake	Trust for Public Lands
Tom Herrington	Monmouth University Urban Coast Institute
David Kutner	NJ Future
Brad Lanute	Pinelands Commission
Tara Paxton	Brick Township
Elizabeth Semple	NJDEP Office of Coastal and Land Use Planning
Barbara Spinweber	EPA Region 2
Mark Villinger	Ocean County Planning Department
Brita Wenzel	Save Barnegat Bay
Dorina Frizzera	Getting to Resilience LLC
Martha Maxwell-Doyle	Barnegat Bay Partnership

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**Acronyms and Abbreviations Used in the Document**

ALS	American Littoral Society
BBE	Barnegat Bay Estuary
BBP	Barnegat Bay Partnership
BMP	Best Management Practice
CCMP	Comprehensive Conservation Management Plan
CZMP	(NJ) Coastal Zone Management Program
EPA	Environmental Protection Agency
ESA	Environmentally Sensitive Areas
FEMA	Federal Emergency Management Agency
GTR	Getting to Resilience (Tool)
JC NERR	Jacques Cousteau National Estuarine Research Reserve
LID	Low Impact Development
LR	Living Resources
LU/LC	Land Use/Land Cover
MLUL	Municipal Land Use Law
MOA	Memorandum of Agreement
MUA	Municipal Utilities Authority
NEP	National Estuary Program
NJAES	New Jersey Agricultural Experiment Station
NJDEP	New Jersey Department of Environmental Protection
NJDoT	New Jersey Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NPSP	Nonpoint Sources of Pollution
OCNGS	Oyster Creek Nuclear Generating Station
OCNLT	Ocean County Natural Lands Trust
PPA	Pinelands Preservation Alliance
SAV	Submerged Aquatic Vegetation
SBB	Save Barnegat Bay
SJ	Sustainable Jersey
SLR	Sea Level Rise
SWAP	Source Water Assessment Program
TPL	Trust for Public Lands
UCI	Urban Coast Institute (Monmouth University)
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
WQ	Water Quality
WS	Water Supply

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## Executive Summary

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## Chapter 1 Introduction

The Barnegat Bay has long been called the “crown jewel of the Jersey Shore,” a critical natural resource located amidst two of the largest metropolitan areas in the United States. The Barnegat Bay system is comprised of eleven rivers and streams that empty into the Barnegat Bay-Manahawkin Bay-Little Egg Harbor estuary, and combined with the land that drains to these areas, comprises the Barnegat Bay watershed. The Barnegat Bay watershed is a diverse and beautiful natural landscape, extending from headwaters and tributary streams of the Pine Barrens, to Atlantic white-cedar swamps, cranberry bogs and lakes, to rivers flowing through riparian shorelines dense with native vegetation; through coastal intertidal wetlands, to the submerged aquatic vegetation and healthy shellfish beds of the bay. It includes some of the most ecologically productive habitats on earth, and natural features that help buffer coastal communities from storms, improve water quality, and support thriving commercial and recreational fisheries. It includes a large portion of the New Jersey Pinelands National Reserve, the nation’s first national reserve, which is the largest protected open space land area on the Mid-Atlantic seaboard between Richmond and Boston, and home to dozens of rare plant and animal species. It includes the Kirkwood-Cohansey aquifer system, which contains an estimated 17 trillion gallons of water. It includes portions of the Edwin B. Forsythe National Wildlife Refuge and adjoining marshes along the bay which were internationally recognized as one of the most important wetland complexes in North America due to its value as stopover habitats for migratory birds. And it includes beaches and shorelines which provide water access for residents and visitors alike, which has nurtured a thriving tourist-based economy and both recreational and commercial fishing.

In his 2002 book, *Closed Sea: From the Manasquan to the Mullica, A History of Barnegat Bay*, Kent Mountford noted the “Old Barnegat” he had known for over 50 years is gone. An avid sailor and observant scientist at an early age, Kent grew up on the bay and earned his Ph. D. studying Barnegat Bay’s plankton and working as a scientist for EPA’s Chesapeake Bay Program until he retired. Over time, he witnessed many changes in his natal estuary. The “Old Barnegat” Kent grew up with actually had started changing long before he first sailed the bay solo in the 1940s. Marilyn Kralik, in her 1992 University of Pennsylvania dissertation, *Buying Barnegat Bay: A look at Ocean County shore resorts from the eyes of three women, August 1879*, shared how Barnegat Bay in the 1870s and 80s “... was a turning point in how Americans perceived their landscape, took their leisure, and worked for a new and different future.” The new and different future of the 1880s was initiated by expanding train lines, which made Barnegat Bay increasingly attractive as a summer playground for Philadelphians. Development—centered around various resorts that had sprung up in Barnegat and elsewhere on the Jersey Shore—was already profoundly affecting the futures of shore residents, from the baymen and others toiling on land and water to the entrepreneurs catering to an emerging summer tourist clientele.

The landscape was changing too. In 1926, the bay changed in new ways when the Point Pleasant Canal opened the upper bay and the Metedeconk River to tidal exchange. Fishing and duck hunting declined dramatically, and many cranberry bogs were destroyed. The canal caused erosion and shoaling problems that led to bridge, jetty, and other infrastructure changes for several decades. Nonetheless, the number of people living, working, and playing in the Barnegat Bay and its surrounding watershed continued to grow. The watershed had grown to about 60,000 inhabitants by the mid-1950s, when the completion of the Garden State Parkway laid the

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foundation for an even larger influx of people and more changes to come including changes resulting from the operation of the nuclear generating station, the reconfiguration of Barnegat Inlet, and the passage of legislation to protect the Pinelands.

What has made the Barnegat Bay watershed a magnificent place for more than a century has been the quality of its environment and its economy. With abundant open space, beautiful beaches and extensive shorelines providing access to the bay, Ocean County has experienced considerable development of the Shore for more than 50 years. Today, more than 590,000 people call Ocean County their home, and roughly twice that number enjoy the bay, its islands, beaches, rivers, and woods in summer. This population growth and tourism have brought many benefits, including educational and recreational opportunities and economic prosperity, and resulted in Ocean and Monmouth Counties being recognized as among the best places in the country to live.

This tremendous increase in the number of people living, working, and playing on the bay has had a dramatic impact on the landscape, now more than 35% developed, and the bay's ecology and living resources, especially its once vibrant fisheries. Despite the past changes in the bay, development in its coastal communities, and the number of people living throughout the watershed, the Barnegat Bay remains vital to our economy and our quality of life. According to the Economic Value of the Barnegat Bay study conducted by the Institute for Public Administration at the University of Delaware in 2012, "The water, natural resources, and ecosystems in the Barnegat Bay watershed contribute an economic value of \$2 to \$4 billion annually to the New Jersey economy." This economic value is derived from water quality, water supply, fish/wildlife, recreation, agriculture, forests and public park benefits. Commercial and recreational fishing, tourism, and other water-dependent recreation continue to generate many jobs, as do other industries based in or near the estuary. Using 2012 employment as a measure of value, natural resources within the Barnegat Bay watershed directly and indirectly support over 60,000 jobs with over \$2 billion in annual wages. In addition, a 2015 Economic Impact of Tourism Report observed that Ocean County experienced \$4.58 billion in direct sales and \$639 million in recreational activities from tourism.

However, future changes, some already evident to us, will put new pressures on the bay and all of us living along the water's edge. Sea-level rise may be unstoppable over the next century, but the slow rate of change sometimes doesn't catch our attention. The effects of Superstorm Sandy and other coastal storms should make clear the potential for change—clearly, we are no longer living along a Closed Sea as Mountford once referred to it, but a "Rising Sea." With the increased risks and costs of clean-up and recovery, we can't ignore sea-level rise, coastal storms, and other coastal changes. We should recognize that no matter where the storms hit, all of us are increasingly invested in disaster response and recovery, both locally and nationwide. BBP's focus is on ensuring a better future for the Barnegat Bay and its watershed, and rethinking the vision for our coastal communities, especially those with extensive shorelines.

This revision to our Comprehensive Conservation and Management Plan is the Partnership's blueprint for how to collectively move forward to ensure that flora and fauna can survive and flourish, that residents and visitors can continue to enjoy the benefits of coastal living, and that we will be able to share these natural resources with our children and grandchildren. To be successful, we will need to re-think the relationships between people and the landscape, our responsibilities to each other, and our responsibilities to the environment.

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Through this process it was also necessary to review the boundaries of the study area to possibly include the canal connection to the Manasquan River in the north and Jacques Cousteau National Estuarine Research Reserve to the south.

**Vision**

Our vision for the Barnegat Bay ecosystem is of lands and waters that are clean and healthy, defined by the capacity for sustainability in the soils, waters, plants, and animals.

It is a vision of publicly accessible and trash-free lands and waterways that are safe for educational and societal activities, or recreational pursuits, such as sailing, fishing, canoeing, hunting, kayaking, swimming, or just enjoying a sunny day on the water's edge.

It is a vision that recognizes the dependence of the Shore's economy and quality of life on healthy lands and waters, and celebrates communities and citizens working together to develop a shared vision for a changing bay.

It is a vision developed by knowledgeable and engaged citizens and communities, sustained by public and private stewardship.

Our vision recognizes that the bay and its watershed are changing in uncertain ways and that our commitment to its protection and restoration must remain guided by the best available science and with participation by the public.

## Chapter 2 Comprehensive Conservation Management Plan for the Barnegat Bay

### 2.1 Mission

The Barnegat Bay Partnership is a partnership of federal, state, county, municipal, academic, business, and private organizations that work together with the communities of the Barnegat Bay watershed to help restore, protect, and enhance the natural resources of the Barnegat Bay ecosystem.

A thriving Barnegat Bay ecosystem is important to the environmental, cultural, and economic well-being of all people who live near, work in, and enjoy the bay. The Barnegat Bay Partnership (BBP) is committed to protecting, restoring, and enhancing the Barnegat Bay ecosystem and to advancing the sustainable use of its natural resources. The BBP recognizes the need to increase focus on emerging issues and to promote understanding of the value of functioning natural systems to our economy and quality of life.

### 2.2 History and Background

Around 1609 Henry Hudson sailed along the coast of New Jersey coming to an inlet which he named Barendegat, a Dutch word meaning an inlet with breakers. The arrival of European settlers in Ocean County first affected the environment through changes in land use and the creation of colonial industries. As natural resources were extracted and depleted for colonial industries such as lumbering and sawmills, bog iron manufacture, and charcoal manufacturing, some settlers moved on from the area in search of new places to settle. However, those who remained in the colonial settlements survived by becoming skilled in farming, hunting, fishing, and berry harvesting, and these ways of life endured for generations. Not until the mid-19th century did the recreational tourist industry truly begin to expand. Construction of the Interstate Highway System, which started in the 1950's, along with the completion of the Garden State Parkway and an increase in car ownership, helped create an increased interest in vacationing. Combined with the construction of the lagoon system in the 1960's and the subsequent expansion of housing in many coastal communities, Ocean County experienced tremendous growth during the last half of the 20th century into the beginning of the 21<sup>st</sup> century, making it one of the fastest growing counties in the state.

#### 2.2.1 Barnegat Bay Estuary and Watershed

The Barnegat Bay's watershed (the land that drains to the Barnegat Bay estuarine system) covers over 600 square miles (1,554 km<sup>2</sup>), and includes coastal dunes and marshes, developed areas which were historically coastal dunes and marshes, other developed lands, protected Pine Barrens habitats, and other forested areas. The Barnegat Bay watershed encompasses most of the 33 municipalities in Ocean County, as well as four municipalities in Monmouth County and one municipality in Burlington County.

The Barnegat Bay-Little Egg Harbor estuary ("Barnegat Bay") stretches over 42 miles in length (67 km) from the Point Pleasant Canal on the northern end to Little Egg Harbor Inlet at the southern end and

is protected from the open ocean by a system of barrier beaches, wetlands and dunes. An estuary is a partially enclosed body of water formed where fresh water from rivers, streams, and groundwater flows to the ocean, mixing with the salty seawater. Estuaries come in all shapes and sizes and are often known as bays, lagoons, harbors, inlets, or sounds. They are among the most productive habitats on earth and are vital spawning, nursery, and feeding grounds for fish and shellfish. They are also critical to the survival of tens of thousands of birds, fish, and other wildlife.

The Barnegat Bay estuarine system is composed of three shallow, micro-tidal bays: Barnegat Bay, Manahawkin Bay, and Little Egg Harbor. The 75-square mile (194 km<sup>2</sup>) Barnegat Bay estuary is rich in biological resources, including migratory birds, threatened and endangered species, and commercially and recreationally important species of fish and shellfish. An array of environmentally-sensitive habitats exists here, such as sand beaches, bay islands, submerged aquatic vegetation, finfish nursery areas, shellfish beds, and waterfowl nesting grounds.

A significant source of freshwater for the Barnegat Bay estuarine system is derived from tributaries that drain the New Jersey Pine Barrens and other forested land. From the headwaters of these streams, pristine freshwater flows eastward through predominantly forested areas along the coastal plain to the bayshore area. A nearly continuous barrier island complex runs along the eastern edge of Barnegat Bay system, separating it from the Atlantic Ocean. Seawater enters the Barnegat Bay system through the Point Pleasant Canal via the Manasquan Inlet in the north and the Barnegat Inlet and Little Egg Inlet in the south. The flow of fresh water from rivers, creeks, and groundwater into the bay produces the variety of salinity zones that are needed for the survival of crabs, fish, birds, and other wildlife, as well as for human uses. Additionally, activities impacting the Manasquan Bay to the north and Great Bay to the south are of significance to the Barnegat Bay watershed as well.

### **2.3 National Estuary Program and the Comprehensive Conservation Management Plan**

In response to growing concerns about the health of the Barnegat Bay, the New Jersey Legislature passed an act in 1987 requiring a study of the nature and extent of the impacts that development was causing on the bay. The Act, P.L. 1987, Chapter 397, created the Barnegat Bay Study Group and mandated a study of the bay and its watershed. The planning process that resulted from the Barnegat Bay Study Act involved significant coordination and public participation with citizens who live, work, and recreate in the bay area. A citizens advisory group was formed to identify the issues and objectives of most concern to the citizens of the Barnegat Bay watershed and define the focus of the plan.

The work of the Study Group resulted in a three-part study of Barnegat Bay, including the following:

- Profile of the Barnegat Bay - characterization of conditions and trends in bay water quality, ecosystem vitality, and human activities that rely on or affect the bay
- Management Recommendations for the Barnegat Bay - assessment of alternatives for managing the bay based on the above publication as well as issues of importance to the public

- Watershed Management Plan for the Bay - defined a multi-objective management approach directed at achieving meaningful and measurable improvements to the quality of life and resources in the bay area

After release of the third and final report, members of a citizens advisory committee formed the Barnegat Bay Watershed Association (BBWA). This led the Governor of New Jersey to petition the U.S. Environmental Protection Agency (USEPA) to nominate Barnegat Bay into the National Estuary Program (NEP), which was also created in 1987 in recognition of the need to protect the natural resources of our nation's estuaries from the increasing threats of pollution, habitat loss, development, and resource conflicts. Established under Section 320 of the federal Clean Water Act and managed by the USEPA, the purpose of the NEPs is to address the many complex issues that can contribute to the deterioration of the major estuaries in the United States.

The USEPA accepted the nomination of the Barnegat Bay Estuary into the NEP on July 6, 1995, officially making it one of the 28 National Estuary Programs in the United States. A Management Conference, comprised of a variety of stakeholders from the local, regional and national level, was created for the Barnegat Bay to provide a forum for consensus building and problem solving among interested agencies and user groups. This Management Conference worked together to establish the first Comprehensive Conservation and Management Plan (CCMP) for the Barnegat Bay, which was approved by EPA in 2002, and has guided the organization's work since that time. The purpose of a CCMP is to address all uses affecting the restoration and maintenance of the chemical, physical, and biological integrity of the estuary through the establishment of Goals, Objectives and Actions. It is meant to serve as a "road map" for improving the bay's water quality and enhancing its natural resources.

Along with the establishment of the CCMP for the Barnegat Bay, the Barnegat Bay Partnership, which was known as the Barnegat Bay Estuary Program at the time, was formed as a partnership of federal, state, county, municipal, academic, business, non-profit, and private organizations working together to protect Barnegat Bay.

The Barnegat Bay Partnership is still comprised of a collection of organizations and agencies that are committed to protecting and improving the Barnegat Bay, with the BBP program office staff serving as the lead in overseeing the implementation of the CCMP for the Barnegat Bay.

The Barnegat Bay Partnership has continued to assess progress toward completion of the Goals, Objectives, and Actions established in the original 2002 CCMP and has updated its priorities periodically through the completion of two Strategic Plans. This revised CCMP document takes into account both the original CCMP as well as the most recent Strategic Plan to ensure that all relevant issues and concerns have been assessed and addressed. While ecological targets in this document



have been set for a 20-year timeline for planning purposes, the CCMP is intended to be a 10-year plan and a reassessment will be conducted every 3 to 5 years to evaluate progress, challenges to implementation, and any updates or revisions that may be required, including a review of the study area boundaries.

### *2.3.1 Climate Change and Other Threats to the Bay and Watershed*

The Barnegat Bay and its watershed are affected by an array of impacts that threaten its ecological integrity, including impacts of human activity. With the tremendous amount of growth and development occurring in this region, negative consequences have emerged that are directly affecting the health of the Barnegat Bay and its watershed. These impacts include: significant declines in water quality, increasing demands on water supply, habitat loss and fragmentation, and declines in our fisheries.

**Eutrophication** - As has been well documented over the past 15 years, the present-day Barnegat Bay-Little Egg Harbor estuary continues to face the decades-old problem of eutrophication. Eutrophication is an increase in the rate of supply of organic matter to the bay, which is manifested as blooms of drift algae, attached microalgae, or phytoplankton (including harmful algal species), and low or no dissolved oxygen. These conditions ultimately lead to other changes in the bay such as increased turbidity, and changes in key biotic components such as loss of shellfish and submerged aquatic vegetation, and blooms of jellyfishes. Eutrophication is overwhelmingly driven by increases in nitrogen from nonpoint source pollution, the pollution caused by rainfall or snowmelt moving over and/or through the ground, where it picks up and carries various pollutants, and deposits them into lakes, rivers, wetlands, coastal waters and ground waters. However, eutrophication is also affected by other nutrients, such as phosphorus, as well as other processes and conditions including temperature changes, coastal currents, and seasonal climate patterns.

**Climate Change and Sea Level Rise (SLR)** - Sea level has been rising by approximately 0.16 inches (4 mm) per year and is likely to rise even faster over the next 50-75 years. According to one report published by Rutgers University scientists, sea level along the Jersey Shore will likely rise approximately 0.8 feet by 2030 and 1.4 feet by 2050<sup>1</sup>. Some areas may experience more frequent flooding from normal tidal events and from episodic storm events. Other low-lying “back-bay” communities along the Barnegat Bay (e.g., Beach Haven West) which are built on filled wetlands of

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<sup>1</sup> Kopp, R.E., A. Broccoli, B. Horton, D. Kreeger, R. Leichenko, J.A. Miller, J.K. Miller, P. Orton, A. Parris, D. Robinson, C.P. Weaver, M. Campo, M. Kaplan, M. Buchanan, J. Herb, L. Auermuller and C. Andrews. 2016. Assessing New Jersey’s Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel. Prepared for the New Jersey Climate Adaptation Alliance. New Brunswick, New Jersey.

soft sediments and have considerable exposure to long fetches of wind and waves, may be more vulnerable to SLR and coastal storms.

Considerable changes in regional weather patterns such as more frequent and larger storms, and increased amounts and overall variability in temperature and precipitation, are also projected in the northeastern United States. This changing weather has the potential to affect the ecology and physiography of the entire region in a number of ways, such as by increasing bay temperatures or increasing runoff amounts and timing due to increased rain and less snowfall. Areas already in or adjacent to coastal flood plains are vulnerable to inundation by rising waters, but some areas may be at greater risk to other processes such as erosion due to surge and wave action.

Changes in sea level and coastal climate have considerable potential impacts to: 1) the water quality and natural resources of the bay, 2) the terrestrial landscape and land uses throughout the watershed, and 3) the human population and economy of coastal communities. In addition, sea level rise and changing climatic conditions will increase some costs and risks to living in vulnerable, low-lying areas along the coast.

The continued ecological and economic health of the Barnegat Bay watershed is dependent on the protection of its waters and other natural resources. Addressing these issues presents both a challenge and an opportunity and requires the involvement and commitment of a wealth of government agencies, academic institutions, businesses, non-profit organizations, and individuals who are committed to dedicating the time and resources necessary to make progress toward these goals. As our collective understanding of climate change increases, BBP and its partners must keep pace with the latest research findings and support efforts at the federal, state and local levels to address these emerging issues.

## Chapter 3. Ecosystem-Based Approach and Targets

Much has changed in the years since the approval of the original CCMP. While significant progress has been made on several issues such as land protection, reducing certain types of nutrient loading to the bay, and protecting fisheries, the original CCMP did not address issues such as the impacts of climate change and sea level rise. As such, the 2018 revised CCMP uses an ecosystem-based management approach. Ecosystem-based management is a means of protecting and managing natural resources in a way that considers the various interrelated parts of the ecosystem and how they interact with each other, instead of addressing each issue separately. By using this approach, resource managers, researcher, policy makers, elected officials, and residents identify ways to assess and address the often-complex issues facing a natural system such as the Barnegat Bay. In addition, by looking at the many interrelated causes of an identified problem, those involved can better understand the impacts of natural systems and human activity on the environment, leading to a much more holistic solution.

### 3.1 Priority Areas

Beginning in 2017, the BBP and its partners initiated a process of updating the CCMP to reflect changes in the Barnegat Bay's condition and in consideration of emerging threats. This revised plan focuses on four priority areas: Water Quality, Water Supply, Living Resources, and Land Use. Each priority includes a specific Goal, several key Objectives, and multiple Actions which will be undertaken to achieve the stated Objectives. Many partners and stakeholders have been instrumental in the creation of these updated Goals, Objectives and Actions, which will guide the work of the BBP moving forward.

In adopting an ecosystem-based management approach to the development of the CCMP, factors including our changing climate, sea level rise and other dynamic processes in the bay can be factored into decisions and management strategies in the four priority areas. The goals for the four priority areas are as follows:

- *Water Quality - To protect and improve water quality throughout Barnegat Bay and its watershed by reducing the causes of water quality degradation to achieve swimmable, fishable and drinkable water, and to support aquatic life.*
- *Water Supply - To ensure adequate water supplies and flow in the Barnegat Bay Watershed for ecological and human communities now and in the future.*
- *Living Resources - To protect, restore, and enhance habitats in the Barnegat Bay and its watershed as well as ensure healthy and sustainable natural communities of plants and animals both now and in the future.*

- *Land Use - To improve and sustain collaborative regional approaches to responsible land use planning and open space protection in the watershed that protect and improve water quality, water supply, living resources, soil function and hydrology.*

Chapters 4 through 7 provide a more detailed look at the important issues and considerations for each priority area, along with the current status and trends relevant to each, to provide a framework for understanding how focusing on these priority areas will lead toward a higher level of protection for the Barnegat Bay.

### 3.2 Ecosystem-Based Targets

While the focus of the Action Items in this CCMP are broken into four priority areas, many of these issues will require actions in more than one priority area. The following are broad, aspirational Ecosystem-Based Targets that span across multiple priority areas. While these targets are identified with 2040 as the target completion date, taking steps toward meeting these targets will start immediately. A detailed list of actions can be found under each priority area in Chapters 4 through 8. In addition, it should be recognized that making measurable progress toward ecological improvement is a long and arduous process. The targets identified below have been developed taking into account the challenges of not only guarding against future loss/degradation in each respective area, but also working toward measurable improvement/restoration of these natural resources.

- **Public Beach Openings/Closures:** Increase the number of bay, river and lake beaches open for swimming from the 2018 baseline. Reduce the average number of annual beach closure days below that of 2016-2018. **Increase number of beaches monitored from 2018 baseline.**
- **Approved Shellfish Areas:** Upgrade 5% of the potentially harvestable shellfish acreage that is currently restricted or closed for shellfishing in 2018.
- **SAV Extent:** Maintain the overall extent of submerged aquatic vegetation present in 2009 and restore an additional 10 acres of eelgrass.
- **Wetland and Riparian Buffer Preservation:** Maintain or increase the current acreage of upland buffers adjacent to all wetland and riparian corridors.
- **Wetland Protection:** Maintain overall extent of coastal wetland acreage as identified on the 2015 aerial imagery<sup>2</sup>. Restore or enhance 10 acres of coastal wetlands impacted by sea level rise and erosion through nature/natural based strategies to limit further loss.

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<sup>2</sup> It is recognized that some erosion is likely to have occurred since 2015, which is why periodic assessment of shorelines is crucial. This is one reason that programs like Paddle for the Edge are so valuable. However, net-zero erosion remains the best target, as it represents "equilibrium" where gains equal losses baywide.

- **Clam restoration:** Return the hard clam abundance in Little Egg Harbor to 1985/87 levels. (1985/87 baseline assessment was 201,475,066.)
- **Ecological Flows:** Maintain flow levels at least 30% over minimum ecological flows for gauged waterways within the watershed.
- **Water Conservation and Reuse:** Reduce five-year rolling average water withdrawals 10% below the 2010 estimate of 85.56MGD. Explore appropriate water-reuse technologies used elsewhere in NJ and possibly other states.

*Preface to Chapters 4-7:*

In the following 4 chapters, the Goals, Objectives, and Actions for each of the four priority areas of the CCMP are established. These Chapters were generated through a collaborative process by all BBP partners including review of previous guidance documents including the original CCMP, BBP Strategic Plan, and other BBP publications, state and local reports, etc. In addition, outreach to residents and stakeholders was conducted throughout the watershed to obtain input and feedback throughout this process.

This document presents a comprehensive and current set of Goals, Objectives and Actions, which take into consideration the many issues, challenges and opportunities that exist for the protection and management of the Barnegat Bay Estuary. For each set of Goals, Objectives and Actions, appropriate performance measures and milestones have been identified as a means to accurately track progress toward the established goals. The following chapters are a representation of what BBP believes to be feasible through the year 2040, and reflects the conditions that are targeted for improvement through the actions of BBP and its partners.

Status and trends infographics will appear in each of the Priority Area chapters below. Taken from the 2016 State of the Bay Report, these infographics serves as a quick reference to indicate the overall status of each area discussed in greater details in the chapters that follow. Moving forward, this provides a useful frame of reference to track progress toward achieving the stated goals.

## Chapter 4 WATER QUALITY GOALS, OBJECTIVES, and ACTIONS

### Highlights

- The bay's water quality is critical to the bay's overall condition, as well as coastal communities within this region and their tourism-based economies.
- Eutrophication of the bay caused by high nutrient loading is the major problem affecting the northern portions of the bay, while sedimentation is the largest issue affecting the southern portion of the bay.
- Improvements in the bay require aggressive efforts to reduce nonpoint source and other pollutant loadings to the bay.
- Our understanding of the bay has improved substantially in recent years; however, continued monitoring and science are essential to improving the bay as our world changes.

### 4.1 Goal

To protect and improve water quality throughout Barnegat Bay and its watershed by reducing the causes of water quality degradation to achieve swimmable, fishable and drinkable water, and to support aquatic life.

#### Water Quality Objectives:

1. Reduce sources of nutrients, contaminants, debris and other pollutant loadings from point and nonpoint source pollution.
2. Assess status trends of water quality throughout the watershed.
3. Conduct studies to improve scientific understanding of new and emerging issues pertaining to the chemical, physical, and biological conditions and dynamics in the Barnegat Bay and its watershed.
4. Increase public education, engagement, and stewardship regarding water quality in the watershed.

### 4.2 Introduction

#### *Water Quality and Other CCMP Goals*

NEPs were established in large part to address issues of water quality in estuaries of national significance. The ecology of the entire watershed, the health of people in all the communities and of the biotic resources living throughout the watershed, the economy of the region, and our quality of life are all dependent on good water quality. Water quality, because it is affected by land use and other human activities as well as by climatic changes, has become an increasing concern over the past few decades.

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The Barnegat Bay Partnership's CCMP goal for water quality is built upon the foundation provided by the Clean Water Act<sup>3</sup>, to restore and maintain the chemical, physical, and biological integrity of the nation's waters. This foundation translates into two fundamental aims: to eliminate the discharge of pollutants into the bay and its contributing watershed, and to achieve water quality levels that are fishable and swimmable. The steady population growth and coastal development over the past century has not been without adverse impacts to the environment. Perhaps most troubling is the bay's eutrophication, though concern about other issues, especially sea level rise and climate change have also increased.

*Eutrophication*

Eutrophication, an increase in the rate of supply of organic matter to an ecosystem, remains one of the most critical challenges facing Barnegat Bay, and has been the subject of much attention in recent years<sup>4</sup>. Human-related activities that increased soil erosion and nutrient pollutant loadings contribute greatly to the bay's eutrophication. Recent studies<sup>5</sup> have quantified the increasing nutrient load from lawn runoff, especially in the northern bay. Eutrophication can lead to a cascading chain of negative environmental conditions, including blooms of drift algae or phytoplankton, which can cause other changes in the bay such as increased turbidity, hypoxia (low dissolved oxygen) or anoxia (no dissolved oxygen). It can also result in other changes in aquatic communities including loss of shellfishes, eelgrass and other submerged aquatic vegetation. Changes in temperature and other water quality conditions, such as phosphorus levels, in freshwater rivers, creeks, and streams also may affect eutrophication and have other ecological impacts on the bay. Nutrient and sediment loadings pose challenges from the headwaters of the bay in the westernmost reaches of the watershed to the bay itself. Addressing eutrophication requires an overall reduction in the total nutrient loading to the bay and its tributaries throughout the watershed.

Over the past ten years, considerable effort has been expended to better understand the nutrient loadings to the Barnegat Bay and their impacts on the bay's dynamic conditions. Key components of this effort have included the following:

- a comprehensive water quality monitoring program (see interactive NJDEP website<sup>6</sup>),
- several research studies<sup>7</sup> focused on the major living resources of the bay (e.g., plankton in the water column, benthic communities living on or in the bottom sediments, fishes and motile invertebrates),
- other targeted studies<sup>8</sup> (nutrient history of the bay, critical habitats), and

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<sup>3</sup> <https://www.epa.gov/laws-regulations/summary-clean-water-act>

<sup>4</sup> [Kennish, M.J., Bricker, S.B., Dennison, W.C., Glibert, P.M., Livingston, R.J., Moore, K.A., Noble, R.T., Paerl, H.W., Ramstack, J.M., Seitzinger, S., Tomasko, D.A., and Valiela, I., 2007. Barnegat Bay-Little Egg Harbor Estuary: case study of a highly eutrophic coastal bay system: Ecological Applications, v. 17, no. 5, Supplement, p. S3-S16.](#)

[Baker, R.J., Wieben, C.M., Lathrop, R.G., and Nicholson, R.S., 2014. Concentrations, loads, and yields of total nitrogen and total phosphorus in the Barnegat Bay-Little Egg Harbor watershed, New Jersey, 1989-2011, at multiple spatial scales: U.S. Geological Survey Scientific Investigations Report 2014-5072, 64 p.](#)

<sup>5</sup> <http://dx.doi.org/10.3133/sir20145072>

<sup>6</sup> <http://www.state.nj.us/dep/barnegatbay/bbmapviewer.htm>

<sup>7</sup> Insert link

<sup>8</sup> Inset link

- the development of an integrated, hydrodynamic water quality model by the USGS (NJDEP, JCR volume<sup>9</sup>)

These investigations have been critical to helping improve understanding of the current nutrient loadings and concentrations, the condition of the bay's biological resources, and their relationships. Understanding those relationships is essential to develop a decision-making framework for protecting and restoring the bay and its resources.

Water quality standards provide the decision framework that is used to both determine the current condition of the bay and guide restoration efforts. New Jersey's Surface Water Quality Standards (SWQSS; N.J.A.C. 7:9B) do not currently include numeric nutrient criteria for Barnegat Bay, though criteria are available for other related conditions, such as dissolved oxygen and turbidity. These measurable conditions can be used as a substitute for nutrients, in that excessive nutrients in the water column will result in depleted dissolved oxygen and excessive turbidity due to algal blooms (i.e., the outcomes of the bay's excessive production). Currently, some parts of Barnegat Bay are impaired for dissolved oxygen and turbidity. Additionally, water chemistry is not the only indicator of condition. Whenever possible, water quality assessments include an evaluation of biological health and biodiversity in addition to water chemistry to obtain a more complete picture of the situation.

#### 4.3 Objectives

##### **Water Quality Objective 1. Reduce sources of nutrients, contaminants, debris and other pollutant loadings from point and nonpoint source pollution**

This will be addressed in a variety of ways including: establishment and implementation of TMDLs; development and implementation of Watershed Management Plans; and effective stormwater management. Selected actions include the following.

*Continue to support establishment of nutrient TMDLs and numeric nutrient criteria using existing and new science.*

A TMDL is a calculation of the maximum inputs of a particular pollutant from all contributing sources that the waterbody can assimilate without violating a water quality standard. Any Barnegat Bay nutrient TMDL should identify the nutrient load reductions needed to meet water quality standards throughout the Barnegat Bay. Through comprehensive monitoring, research findings, and modeling investigations, the NJDEP has been working with many partners to develop biological indicators and an appropriate numeric nutrient standard for Barnegat Bay. Benthic invertebrate research in Barnegat Bay has shown a strong correlation between total nitrogen (TN) concentration in the water column and the abundance (percentage) of sensitive benthic invertebrate species<sup>10</sup>. This relationship between the biological community and the nutrient levels is being

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<sup>9</sup> <https://nj.usgs.gov/projects/LJ00ETY/>

<sup>10</sup> Taghon et al., 2016



used to develop (1) a nutrient target to ensure sufficient survival and protection of sensitive invertebrate species, and (2) the means to assess aquatic life use in Barnegat Bay in the upcoming NJDEP Integrated Water Quality Assessment Report. Identifying a 'reference' or 'close-to-natural' condition is an important consideration when developing a nutrient standard. This reference condition can be defined as the lowest pollutant level the system can achieve with no anthropogenic (human-caused) pollutant inputs. Findings from this research and the USGS water quality model potentially ensure the development of a numeric nutrient standard that can serve as a target for the bay's restoration.

The USGS integrated water quality model<sup>11</sup> establishes a correlation between the loadings of pollutants from all sources and simulates a response in nutrient concentrations and other parameters in the bay. In addition, the model can be used to simulate various scenarios, including various climatic conditions (warm vs cold winters, wet vs dry years) or potential future conditions (turning off the Oyster Creek Nuclear Generating Station, or offshore inputs). NJDEP has indicated that this water quality model also will be used to develop a TMDL for nutrients in Barnegat Bay. Once this TMDL number is determined, reduction targets can be established to ensure total nitrogen concentrations are at levels that protect sensitive species and do not result in excessive algal growth. A TMDL would require load reductions from within the watershed and specific tributaries contributing to those portions of the bay not meeting the water quality targets.

#### Support establishment of Watershed Management Plans (WMPs)

A watershed management plan (WMP) identifies areas in need of restoration and protection at a smaller sub-watershed level. WMPs provide detailed technical assessment and management information, including the analyses, actions, participants, and resources related to developing and implementing the plan. WMPs that include information consistent with EPA guidance<sup>12</sup> are eligible for federal pass-through funding provided to New Jersey via CWA Section 319(h)<sup>13</sup> to implement plans. At present, only two WMPs, the 2013 Metedeconk River Watershed Protection and Restoration Plan<sup>14</sup> and the state-approved WMP for the Long Swamp Creek Watershed<sup>15</sup> have been developed in the Barnegat Bay watershed. Developing more WMPs identifies and grows funding for specific priority restoration activities.

#### Addressing nonpoint source pollution through soil restoration and fertilizer laws

Nonpoint source (NPS) pollution is caused by rainfall or snowmelt moving over and/or through the ground, where it picks up and carries various pollutants, and deposits them into lakes, rivers, wetlands, coastal waters and ground waters. Most naturally occurring soils within the Barnegat Bay watershed are relatively sandy, have minimal organic-matter content, and maintain an interconnected system of small, medium, and large pores equal to as much as half of the soil's total volume. In the simplest terms, healthy porous soils act like a sponge, exhibit virtually no runoff, and reduce NPS pollution by increasing plant uptake of water and nutrients applied in fertilizers.

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<sup>11</sup> [Insert citation or link](#)

<sup>12</sup> <http://www.state.nj.us/dep/wms/bears/npsrestgrants.html#/>

<sup>13</sup> [http://www.nj.gov/dep/grantandloanprograms/eps\\_nspc.htm](http://www.nj.gov/dep/grantandloanprograms/eps_nspc.htm)

<sup>14</sup> <http://www.state.nj.us/dep/wms/bears/docs/MetedeconkWbPlan.pdf>

<sup>15</sup> Add citation- no longer available on DEP website?

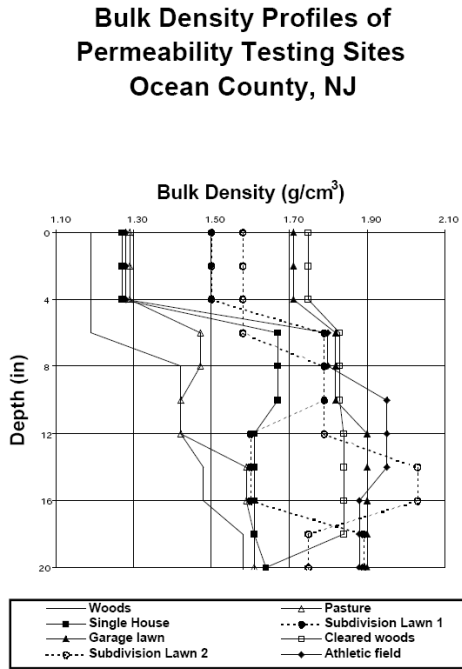


Figure 4.1 – Bulk Density Profiles of Permeability Testing Sites, Ocean

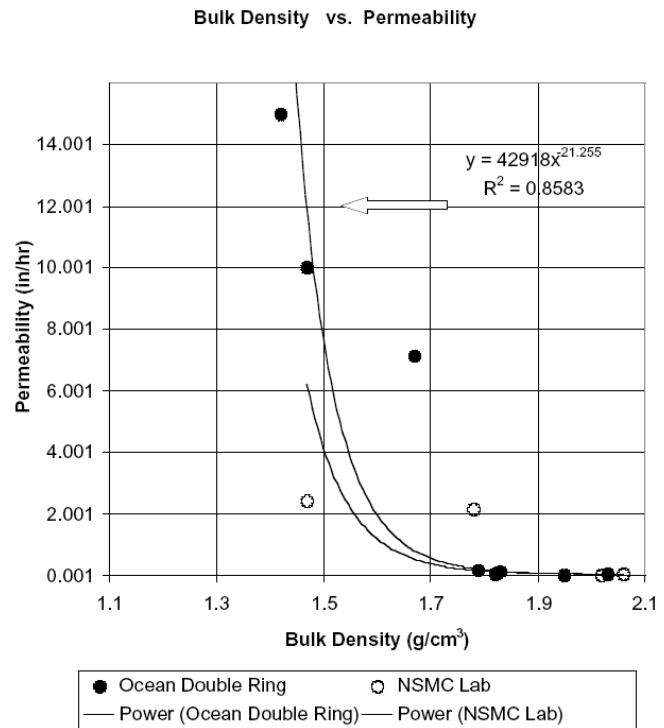


Figure 4.2 – Bulk Density vs Permeability

Common development activity often changes soil features and results in a loss of porosity and an increase in soil density or compaction. These factors affect how water and pollutants move over or through the ground. Once soil compaction has occurred, these areas become impervious with densities approaching concrete (Figures 4.1 and 4.2 below).

Farmers, residential homeowners, and managers of parks, playgrounds, and athletic fields all have experienced difficulty managing land areas that have been subjected to compaction. These compacted areas are plagued by surface ponding, poor plant growth, and localized flooding.

Perhaps most importantly, soil compaction affects the quantity and quality of water reaching the bay. With increasing soil compaction, NPS pollution to nearby waterbodies increases. The nutrients in fertilizers, instead of infiltrating into the ground and assimilating into plants, run over the ground and into waterbodies where they fuel the bay’s eutrophication. Protecting and improving soil functionality (i.e., reducing soil compaction and increasing water infiltration) is one of the most critical and basic concepts to ultimately improve water quality throughout the Barnegat Bay watershed.

Reducing nonpoint source pollution through municipal stormwater permit compliance and enforcement

The NJDEP’s Municipal Stormwater Regulation Program was initially developed in response to USEPA rules in 1999. NJDEP issues general permits authorizing stormwater discharges from Tier A and Tier B municipalities,

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as well as public complexes and highway agencies that discharge stormwater from municipal separate storm sewers (MS4s). Tier A municipalities, generally located within more densely populated regions of the state or along/near the coast, include most municipalities in the Barnegat Bay watershed. Public complexes include most colleges, prisons, hospitals and military bases. And highway agencies include county, state, interstate, or federal government agencies that operate highways and other roadways. For all of these permits, NJDEP has adopted stormwater rules to reduce stormwater volume, flow rates, associated erosion and flooding, and pollution loadings. The NJDEP and municipalities oversee stormwater permitting and enforcement. Maintenance of stormwater systems is the responsibility of the property owners, which includes state and county transportation departments, municipalities, companies, and private residents. Many towns have adopted stormwater ordinances as part of their municipal permits, requiring residents to clean up after their pets, place yard waste in a container for collection and manage dumpsters to contain waste and prevent leakage. These ordinances also prohibit feeding wildlife, littering, illicit connections to storm drains, and dumping to storm drains among other strategies to reduce stormwater pollution.

As part of its Phase 2 Plan for the Barnegat Bay, NJDEP has developed a Municipal Compliance and Assistance Program to identify compliance issues, demonstration projects, and the use of BMPs and other effective programs to help towns reduce stormwater loadings to the bay. Toms River has agreed to work with the NJDEP and other local partners as the pilot project for this effort. The NJDEP team will development recommendations and cost estimates to help the town ensure compliance with the municipal permit regulations and implement other enhancements (see Objectives 1-5 to 1-8 in Section 4.5) to reduce nonpoint source and address other local problems, such as nuisance flooding. The NJDEP Municipal Compliance and Assistance Program will also ensure mapping of all stormwater BMP's within each municipality and create a database that is periodically updated as part of the compliance effort. This database can be used in various ways, ensuring scheduled maintenance, promoting effective projects, and assessing improvements throughout the watershed.

*Addressing nonpoint source pollution through stormwater basin management and restoration.*

Stormwater basins are generally proposed as part of a large residential or commercial project to manage Stormwater on-site, which triggers compliance with the NJDEP Stormwater Management rules. Many people consider stormwater basins a way to also manage nutrients in stormwater; however, stormwater basins may be of several different types (e.g., retention, detention, or infiltration) which function in different ways to address specific problems. Most of the 2,000 or more stormwater basins constructed in Ocean County outside of the Pinelands Area, especially the older (pre-2004) stormwater basins, were primarily designed to control peak flows. These types of basins were designed to hold a substantial volume of water, which is slowly discharged from the basin to the downstream receiving system, such as a tributary or the bay. The primary role of these basins was to prevent flooding, especially flash flooding, and not to improve water quality. In contrast, all stormwater basins in the Pinelands Area are required to infiltrate the total runoff volume generated from the net increase in impervious surfaces from a 10-year, 24-hour storm and from which there shall be no direct discharge of stormwater to any wetland, wetlands transition area or surface water body.

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The performance of many stormwater basins can be expanded or enhanced in order for them to play a measurable role in stormwater runoff related nutrient load reductions to the bay. The Ocean County Department of Planning and the Ocean County Soil Conservation District identified numerous “sub-performing” stormwater basins in the Lower Toms River and Long Swamp Creek subwatersheds that had less than optimal recharge and infiltration performance. Restoration of these basins, which held water on a permanent or nearly permanent basis, was achieved by addressing soil compaction or impermeable soil layers within the basins with Section 319 grant funds. Several organizations assessed a number of problematic basins with BBP funding and then restored the basins to reduce flooding and improve nutrient management, also with Section 319 funds. One such example is located in Laurel Commons in Toms River. The NJDEP also funded renovation and/or construction of basins as part of New Jersey’s 2010 Barnegat Bay Initiative<sup>16</sup>, and the Brick Township MUA is also restoring basins as part of its Watershed Management Plan for the Metedeconk.

Restoration of even a fraction of the 2,000 basins in the Barnegat Bay watershed represents a considerable financial commitment. Thus, one important objective of the CCMP is to identify and map the location of all basins, develop and implement an assessment program, and prioritize basins for restoration to reduce nutrient and sediment loadings to the bay. In this way, the funding can be focused on the most problematic basins that are contributing the greatest pollutant loadings to the bay or causing other substantial problems such as flooding. By mapping and locating all basins, needed maintenance can also be identified and incorporated into NJDEP’s Municipal Stormwater Compliance Program.

*Addressing nonpoint source pollution from roadways and public works maintenance*

Roadways and related infrastructure regularly collect pollutants from the highways and adjacent lands in the form of de-icers, herbicides for roadside vegetation control, and from cars, trucks, and buses, including heavy metals from tires, brakes, and engine wear, and hydrocarbons from lubricating fluids. Because their impervious surfaces can generate considerable stormwater runoff, major roadways require considerable attention to stormwater management. The NJDEP Municipal Stormwater Regulation Program issues municipal separate storm sewer systems (MS4) permits to federal, state and county agencies which manage highways and related infrastructure. These permits enforce statewide basic requirements. For example, the requirements include specific construction and post-construction stormwater controls, illicit discharge detection and elimination, pollution prevention and good housekeeping, use of Best Management Practices (BMPs), and public education and outreach. They address the improper disposal of waste, solids and floatable controls, maintenance yard operations, and employee training.

Most importantly, the Highway MS4 requires that the municipality or highway agency develop a Stormwater Pollution Prevention Plan (SPPP), which describes how each agency will implement permit requirements<sup>17</sup>. Incorporation of this MS4 for each agency and municipality into the DEP’s Municipal Compliance and Assistance Program, together with the other non-point source objectives (Objectives 1-4 to 1-7), enables each

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<sup>16</sup> See <http://www.nj.gov/dep/barnegatbay/bbfh.htm>.

<sup>17</sup> <http://www.nj.gov/dep/dwq/highway/pdf/Chapter%202.pdf> for the required elements

town to ensure its permit compliance and build a catalog of issues (nutrient loading, flooding), solutions (e.g., stormwater source controls, basins, low-impact projects) and costs for prioritizing future funds.

*Addressing pollution from marinas and boating activities*

Marinas and boating activity can also result in stormwater-related pollution as well as boat-related contaminants and debris. The New Jersey Clean Marinas Program encourages and supports marina owners, boatyards, and boaters to adopt practices that help prevent harmful impacts to water quality and living resources. The program provides assistance to marina operators to reduce the sources of pollution, including sewage facility management, fueling operations, fish and solid waste management, and boat painting and cleaning<sup>18</sup>. See success stories below for a related effort.

*Addressing pollution from agriculture, livestock, pets, and wildlife*

In the watershed, livestock numbers are low, large-scale animal farms do not exist, and agriculture lands and grasslands comprise only 1% of the landscape. However, legacy nutrient inputs from extensive historic chicken and dairy farms will continue to impact water quality due to slow transport of some nutrients in groundwater. Pets and wildlife scattered throughout the watershed also contribute substantially to bacterial and pathogenic loadings in some areas, including parks, playgrounds and lakes, some of which can no longer be used for swimming and boating (e.g., Pine Lake). Approximately 90,000 dogs are kept as pets in Ocean County, generating about 15 million pounds of waste a year. High numbers of Canadian geese, estimated at close to 78,000 in NJ, produce an average of 1-3 pounds of feces a day, contributing to localized water quality impairments. Addressing these pollutant sources could substantially improve water quality in some bay tributaries and coastal lakes.

*Addressing point source pollution from sewage treatment, septic systems and Oyster Creek Nuclear Generating Station*

In contrast to diffuse non-point pollution, point sources, such as wastewater treatment facility outfall pipes, are confined, discrete sources of pollution regulated by permits. Barnegat Bay has few major point discharges. One of the largest is the Oyster Creek Nuclear Generating Station (Oyster Creek), which is being decommissioned in 2018 but has used the bay's water for cooling purposes and discharged chlorination by-products to the bay for decades. The Ocean County Utilities Authority (OCUA) also operates three wastewater treatment facilities with a total capacity of 84 million gallons per day, that serve most municipalities in Ocean County and five in Monmouth County. The OCUA plants remove over 90% of the pollutants from the sewage through its secondary treatment process before discharging through three ocean outfalls – all roughly a mile offshore. OCUA has an extensive preventative maintenance and capital repair and improvements program; however, challenges remain including the need to determine if water quality in Barnegat Bay would be improved by removing nitrogen and phosphorus from OCUA's offshore effluent discharge and an assessment of offshore discharge as a component of the offshore nutrient inputs.

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<sup>18</sup> <http://www.njcleanmarinas.org/>

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First, the amount of fats, oil and grease (FOGs) has increased in the wastewater received by OCUA treatment facilities in recent years. OCUA has addressed this problem in the Central Regional Treatment Facility by directing FOGs to a separate processor, concentrating the liquid waste into a more solid consistency and disposing the waste at the Ocean County Landfill. The OCUA has near-term goals to improve FOG handling capacity and convert FOG waste for energy production. Second, aging municipal infrastructure and private sanitary systems cause localized water-quality problems (e.g., Beachwood Beach, see below). Because some municipal maintenance programs are underfunded, ongoing efforts to identify problem areas and needed upgrades for local systems are important to improve water quality in the bay and at local pollution “hotspots.”

Lastly, a substantial number of septic systems may be contributing to water quality impairments in some areas. Septic systems are underground wastewater treatment structures, used in rural areas where centralized sewer systems do not exist. A typical system consists of a septic tank and an underground drainfield, which is a source of nutrient and may be a source of pathogen pollution to groundwater. The Ocean County Planning (OCPD) and Health Departments (OCHD) have developed an inventory of the roughly 22,500 septic systems in the bay watershed. Inventory data include block and lot location, installation date, maintenance updates, and abandonment information. These data can be used to develop the mandatory septic system maintenance program required by NJDEP’s Water Quality Management Planning rules<sup>19</sup>, to notify owners of septic systems installed after Jan. 1, 1990 of proper system operation and maintenance practices required by NJDEP’s Standards for Individual Sewage Disposal Systems<sup>20</sup>, to guide policy, implement ordinances, guide the approval process for areas under development, and to aid in other decision making. These data can also be used to provide the requisite annual report to NJDEP on the number of septic systems present in each municipality, the types and number of inspections performed on each system, the types and number of permits issued, the number type and apparent cause of non-compliant systems and a description of the areas known to have higher than normal rate of non-compliance<sup>21</sup>.

The data can target both areas with a history of failing systems and systems that are old or frequently fail that need to be updated and repaired. Remediating pollution from existing failing or improperly sited septic systems could be achieved by replacing them with a decentralized community treatment systems which incorporate biological nutrient reduction prior to local groundwater recharge (where system density would make a community system economically feasible) or by replacing them with nitrogen attenuating individual septic systems such as those in use in the Pinelands Area. Impacts from septic systems serving new development could be reduced by reducing the allowable septic nitrogen loadings to groundwater through revisions to the Ocean County Wastewater Management Plan.<sup>22</sup> Each of these actions could potentially eliminate some impairments in the watershed.

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<sup>19</sup> N.J.A.C 7:15-4.5(c)1.iv

<sup>20</sup> Detailed triennial written notifications are required by N.J.A.C 7:9A-3.14(a) and (b).

<sup>21</sup> Annual reports to the NJDEP are required at N.J.A.C 7:9A-3.14(d)

<sup>22</sup> See <http://www.planning.co.ocean.nj.us/watershed/wwmgt.htm>

Oyster Creek Nuclear Generating Station

The decommissioning the Oyster Creek Nuclear Generating Station (OCNGS) in 2018 changes both the flow of water and water temperature in the areas directly influenced by the plant. The plant's use of 1.4 billion gallons of bay water a day for cooling purposes will be reduced by 96% upon decommissioning. The closure of OCNGS will dramatically reduce thermal and chlorine pollution discharges and injuries and mortality to fish, plankton and other marine life during water intake. Toxic chlorine byproducts, including chloramines, are known to persist in the effluent resulting in long-term exposure to fishes and other marine life. Chlorine, along with mechanical damage during water uptake, transforms living plankton into nutrient-rich organic debris. Modeling has demonstrated that shutting down OCNGS may cause a shift that could change the biological community and alter some fish and shellfish distributions. A Pre- and Post-Closure Biological Monitoring Plan is being implemented to assess various impacts of closure on the ecosystem and nutrient dynamics. The project should include monitoring of biota as well as nutrients including chloramine and other chlorination by-products over several years of sampling: pre-closure (2018), one year transitional (2018-2019), and three to five years after closure. Longer term impact monitoring is highly recommended.

**Water Quality Objective 2 - Assess status and trends of water quality throughout the watershed.**

Knowing the status and trends in water quality provides the key foundation to protecting and restoring coastal ecosystems and to protecting public health. Without the proper quantity and caliber of data, it is difficult to accurately determine the true issues as well as if any actions being taken are addressing the problems. As recent studies in the Bay<sup>23</sup> have emphasized, assessing condition of water quality and other environmental parameter is dependent on having consistent, quality data collected over time.

For the past 16 years, the BBP's monitoring objective has been achieved through the publication of BBP's State of the Bay Reports (2005, 2011, 2016). Such reporting, required of all National Estuary Programs every five years, was established to take a comprehensive look at the status and trends of many bay characteristics and resources. In 2011, the BBP recognized some critical information gaps in its status and trends reporting. Many of these information gaps were addressed in the past 8 years, largely as a result of the NJDEP's comprehensive water quality monitoring network in the Barnegat Bay<sup>24</sup> and other targeted monitoring efforts. Monitoring remains essential to provide the framework for decision-making and serve as justification for the bay's protection and restoration. All current monitoring activities will be reviewed within the next year for consideration into a new BBP monitoring plan to strengthen SOTB reporting and provide better coordination with NJDEP reporting requirements.

Provided here is the status and trends information of the select water quality parameters from the BBP's 2016 State of the Bay Report. (See the report for additional information, including other water quality parameters such as temperature and pH).

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<sup>23</sup> Fertig, B, M.J. Kennish, G.P. Sakowicz, and L.K. Reynolds. 2014. Mind the data gap: identifying and assessing drivers of changing eutrophication condition. *Estuaries and Coasts* 37 (Suppl 1):S198-S221

<sup>24</sup> <http://www.nj.gov/dep/barnegatbay/plan-wqstandards.htm>

### **WATER QUALITY TRENDS**

For each topic below, a Water Quality Status and Trends graphic is provided. This graphic indicated the current status (Good, Average, Below Average), and well as the current trend in status as decreasing (left facing arrow), improving (right facing arrow) or varying (2 directional arrow)

#### **Nutrient Loading:**

**Nitrogen and phosphorus are recognized as the two primary drivers of the bay's eutrophication.**

From 1989-to date, estimates show an overall increase in nitrogen loading through time. Recent estimates of loading from the watershed have been more variable but slightly higher (up to 857,000 kg N/yr). There are also likely substantial inputs of nitrogen entering the bay from the ocean. This component of the load had not been assessed and included in prior estimates of total nutrient loading. Nitrogen loading is far higher in the northern bay due to increasing inputs of stormwater contributions from the developed landscape. Phosphorus loadings to the bay (17,000-32,000 kg) from northern bay tributaries are higher than from southern bay tributaries; however, the phosphorus concentrations show the reverse pattern in bay water. This discrepancy merits further study.

Status: Below average  
Trend:



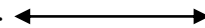
**Algal Blooms:** Algal blooms have been recorded occurring throughout the bay at various time and spatial scales during the 2011-2015 time-period, with the largest and most frequent blooms occurring in the northern portion of the bay. While routine monitoring for Brown Tide, a harmful algal bloom, was discontinued in 2004, studies have shown various small-scale blooms of Brown Tide during the 2011-2015 timeframe. Climate is predicted to become more variable in the northeastern US in the future; thus, the frequency and intensity of algal blooms may change in the northeast, especially in water usage in the bay increases with continuing population growth.

Status: Below Average  
Trend:



**Dissolved Oxygen:** Three of the nine assessment units in the estuary were listed as impaired for dissolved oxygen on the state's 2014 List of Water Quality Limited Waters<sup>25</sup>. Between 2011 and 2014 a total of 5 sampling locations had summer values below 4 milligrams per liter (mg/l), the level at which biota may begin to show signs of stress.

Status: Good  
Trend:



**Turbidity:** There are three sections of the estuary which were listed as impaired for turbidity on the state's 2014 List of Water Quality Limited Waters<sup>26</sup>. Turbidity in Manahawkin Bay limited light transmission to below one meter during the seagrass growing season for 4 of the 5 years evaluated, a condition that can be detrimental to seagrass growth. Long-term trends in turbidity are difficult to

Status: Average  
Trend:




<sup>25</sup> <http://www.nj.gov/dep/wms/bears/assessment.htm#/>

<sup>26</sup> <http://www.nj.gov/dep/wms/bears/assessment.htm#/>



discern due to confounding environmental factors, i.e., different sources of turbidity (e.g., phytoplankton, pump stations, discharges of groundwater) in different parts of the estuary.

**Bathing Beach Closures:** The Ocean County Health Department (OCHD) obtains and analyzes water samples from 35 public bathing beaches in the county on a weekly basis between Memorial Day and Labor Day. The number of closures at the county's public recreational bathing beaches varies annually, primarily due to the number, duration, and intensity of rainfall events.

Status: Good
Trend: 

**Water Quality Objective 3 - Conduct studies to improve scientific understanding of new and emerging issues pertaining to the chemical, physical and biological conditions and dynamic in the Barnegat Bay and its watershed**

Periodic assessment of monitoring data can reveal new or recurring problems and identify data gaps that need to be addressed to improve our understanding of the bay and guide decision making to protect and improve the bay. Several studies assessing nitrogen inputs to Barnegat Bay were conducted before 2010<sup>27</sup>, however, only one of these studies considered nitrogen inputs entering the bay through inlets. This was a 3-week study in early spring at Barnegat Inlet<sup>28</sup>. This intriguing study led the NJDEP to examine nutrients flowing through all inlets as part of its comprehensive water quality monitoring network. We now recognize significant periodic influx of nutrients through inlets and that the bay's total nutrient loadings are significantly higher than previously recognized. It is very likely that this source has long been stimulating the bay's eutrophication; however, it remains unclear how much of this source is natural (nutrient-rich deep waters that are upwelled in the summer) and how much may be due to local or other offshore discharges of secondary treated sewage effluents. There are also unexplained differences in the loading and concentration patterns of phosphorus to the bay. Resolving the questions regarding both nutrients is an important first step to reduce these nutrient loadings into the bay.

One emerging and complex issue is the source of turbidity in the bay. Turbidity is unquestionably a problem in some parts of the bay; it can contribute to eelgrass loss, death of phytoplankton and low dissolved oxygen. However, suspended sediments, which are a contributor to turbidity, may be a "solution" to another environmental concern (i.e., wetland loss) in other parts of the bay. For example, wetlands trap suspended sediments in the water column to grow laterally and vertically, that is, to keep pace with sea level rise. Turbidity in estuaries potentially has many sources, with both natural (e.g., phytoplankton production) and anthropogenic causes (stormwater discharges). Sometimes, considerable additional monitoring and

<sup>27</sup> Moser (1997), Castro et al (2001), Hunchak-Kariouk and Nicholson (2001), Bricker et al (2007), and Bowen et al (2007)

<sup>28</sup> Guo et al., 2001

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assessment<sup>29,30,31</sup> may be necessary to understand the many contributing sources of turbidity; moreover, addressing turbidity in different parts of the bay may require different solutions. This issue illustrates the importance of new science to address emerging issues.

The BBP STAC periodically examines monitoring, assessment, and research concerns, and revises its science prospectus to emphasize priority data gaps and emerging issues.

**Water Quality Objective 4 - Increase public education, engagement and stewardship regarding water quality in the watershed**

Public education and participation are central to the BBP's mission to protect and restore the water quality of the bay and its contributing watershed. The BBP's Communication and Outreach Plan, which provides a blueprint for collaborative partner outreach efforts, establishes clear objectives, approaches, and methods to engage distinct target audiences important to protecting water quality. The BBP's Communication and Education Committee (CEC) oversees implementation of the Communication Plan. The BBP's Communication and Education Grant Program funds projects that increase public understanding of human impacts on the bay, promote stewardship, and grow public participation in its protection and restoration. Through a grant from the NJDEP, the BBP developed the Jersey-Friendly Yards website as a comprehensive resource to help NJ property owners "landscape for a healthy environment" and cleaner water. The BBP will continue to grow this website as an important tool for engaging property owners in actions that can help improve water quality in the watershed.

**4.4 Previous Success**

Several distinct success stories stand out over the history of the BBNEP/BBP related to water quality improvements. Each of these successes serve as examples about how significant accomplishments may be achieved through working together toward shared goals.

- 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:

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<sup>29</sup> Ganju, N.K., Miselis, J.L., and Aretxabaleta, A.L., 2014. Physical and biogeochemical controls on light attenuation in a eutrophic, back-barrier estuary. *Biogeosciences Discussions*, 11(8), 12183-12221.

<sup>30</sup> Dickhudt, P.J., Ganju, N.K., and Montgomery, E.T. 2015, Summary of Oceanographic measurements for characterizing light attenuation and sediment resuspension in the Barnegat Bay- Little Egg Harbor estuary, New Jersey, 2013: U.S. Geological Survey Open File Report 2015-1146 18p. (<http://dx.doi.org/10.3133/ofr20151146>).

<sup>31</sup> Dickhudt, P.J., Ganju, N.K., Montgomery, E.T., and Martini, M.A., 2015, Oceanographic measurements for characterizing light attenuation and sediment resuspension in the Barnegat Bay- Little Egg Harbor estuary, New Jersey, 2013: U.S. Geological Survey data release, <http://dx.doi.org/10.5066/F7GB224S>.

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- 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.

- 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 a large number of 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.

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- 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 2014, 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.

- 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<sup>32</sup>. Much of this monitoring and research was later published<sup>33</sup>. In turn, this science helped generate considerable public support and guided additional efforts and investment in bay protection and restoration<sup>34</sup>.
- 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

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<sup>32</sup> [http://www.nj.gov/dep/barnegatbay/docs/barnegat\\_bay\\_10-ptsGOV.pdf](http://www.nj.gov/dep/barnegatbay/docs/barnegat_bay_10-ptsGOV.pdf)

<sup>33</sup> <http://www.jcronline.org/toc/coas//78>; <http://www.bioone.org/toc/coas/78>

<sup>34</sup> see Barnegat Bay: Moving Science into Action (Phase Two) <http://www.nj.gov/dep/barnegatbay/index.htm>

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 reaches of Barnegat Bay stand as a testament to the success of the Pinelands CMP.

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**4.5 Objectives and Actions for Sustainable Water Quality**

- **Timeframe** – The timeframe from adoption of the CCMP in which the action should be completed. Short (S) indicates a completion within 1-2 years, Medium (M) actions are completed within 3-5 years, and Long (L) actions take 5 or more years. On-going actions are considered Long.
- **Costs** – The anticipated costs for the action: \$ < \$100,000, \$\$ \$100,000 - \$500,000, \$\$\$ \$500,000 - \$1,000,000, \$\$\$\$ > \$1,000,000.

<b>Goal - To protect and improve water quality throughout Barnegat Bay and its watershed by addressing the causes of water quality degradation to achieve swimmable, fishable and drinkable water, and to support aquatic life.</b>					
<b>WQ Objectives</b>	<b>WQ Action ID</b>	<b>CCMP Action</b>	<b>Possible Partner Commitments</b>	<b>Time-frame</b>	<b>Cost?</b>
<b>1. Reduce sources of nutrients, contaminants, debris and other pollutant loadings from point and nonpoint source pollution.</b>					
	<b>WQ 1-1</b>	<p><b><u>Support development and implementation of a Barnegat Bay TMDL(s) (Total Maximum Daily Load), including the development and use of a Barnegat Bay validated biological indices of water quality, to address nutrient and other pollutant loadings and to guide science based future management decision.</u></b></p> <p><b>METRICS: Nitrogen &amp; other pollutant reductions (x%) to achieve ecosystem targets.</b></p> <p><b>MILESTONES:</b></p> <p>1-1a: Review relevant nutrient and other pollutant loadings and other information as available and make</p>	NJDEP, EPA, USGS, BBP	M	\$\$\$

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		<p>recommendations to establish and implement TMDL based on best available science;</p> <p>1-1b: Promote information exchange &amp; consensus building on implementation priorities and make recommendations based on best available science;</p> <p>1-1c: Promote, support and conduct monitoring, and planning to help inform and guide decision making</p> <p>1-1d: Promote adaptive, ecosystem-based management using best available science and giving due consideration to climate change to achieve nutrient reductions and ecosystem targets.</p>			
	<b>WQ 1-2</b>	<p><b><u>Develop/revise and implement Watershed Plans (i.e. WQMP/319 and Watershed Management Plans) at the sub watershed level.</u></b></p> <p><b>METRICS:</b> Number of plans developed, funded, and implemented together with estimated nutrient reductions.</p> <p><b>MILESTONES:</b></p> <p>1-2a: Using NJDEP WQ and other data, develop WQMP/319 and Watershed Management Plans</p> <p>1-2b: Identify, promote and support funding of plan development.</p> <p>1-2c: Implement plans and estimate nutrient and other pollutant reductions.</p>	EPA, NJDEP, NJDOT, Counties, Municipalities, Utility Authorities (208 Plan), BBP	L	\$\$\$\$

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	<p><b>WQ 1-3</b></p>	<p><b><u>Fully implement the Soil Restoration Law and associated comprehensive soil restoration procedures for various land use activities.</u></b></p> <p><b>METRICS:</b> Reduction in stormwater nutrient and other pollutant loads off the developed landscape.</p> <p><b>MILESTONES:</b>          1-3a: Implement existing and/or develop revised (county or statewide) soil restoration standard with supporting assessment and cost-benefit justification.          1-3b: Work with partners to promote review and consideration of soil restoration standard.          1-3c: Once adopted, assist with implementation of soil restoration standard.          1-3d: Promote and assist with periodic (every 5 years) assessment of nutrient loadings from the developed landscape.</p>	<p>NJDA, NJDEP, NJDOT, Counties, Municipalities, Soil Conservation Districts, Utility Authorities</p>	<p>M</p>	<p>\$\$</p>
	<p><b>WQ 1-4</b></p>	<p><b><u>Support implementation and enforcement of stormwater rules and ordinances at state, county and municipal levels.</u></b></p> <p><b>METRICS:</b> 100% Compliance with SW rules as reported by NJDEP Municipal Compliance Assistance Program Review to achieve X% nutrient reduction within 6 years (2 review cycles)</p> <p><b>MILESTONES:</b></p>	<p>NJDEP Municipal SW Compliance/Assistance Program: NJDEP, Counties, Municipalities, Soil Conservation Districts, Others</p>	<p>L</p>	<p>\$\$\$\$</p>



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		<p>1-4a: Develop Municipal Stormwater Compliance Assistance Program with Toms River as the pilot (include Objectives 1-5 to 1-3 below, where feasible). As part of the program, compile checklist of township problems, demonstration projects, use of BMPs and other novel, effective practices.</p> <p>1-4b: Develop recommendations and cost estimate for Toms River compliance/improvement.</p> <p>1-4c: Develop schedule of towns for review so that all towns are reviewed every three years. Develop draft annual funding commitment recommendations.</p> <p>1-4d: Initiate review and recommendations together with concurrent funding commitment to make improvements.</p> <p>1-4e: After 5 years, assess impact of enhancements and improvements.</p> <p>1-4f: Develop communication program for Toms River, revise for use within each town as completed.</p>			
	<p><b>WQ 1-5</b></p>	<p><b><u>Identify and map all stormwater basins; develop tools, assess, prioritize, and implement basin retrofits to reduce nutrient and sediment loadings to the bay. Incorporate into NJDEP Municipal SW Compliance/Assistance Program.</u></b></p> <p><b>METRICS:</b> Within 5 years, reduce stormwater basin loadings of nitrogen, phosphorus, and TSS by x% (different for each) from current load estimates. Within</p>	<p>NJDEP Municipal SW Compliance/Assistance Program: NJDEP, Counties, Municipalities, Soil Conservation Districts, Mosquito Commissions</p>	<p>L</p>	<p>\$\$\$\$</p>

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		<p>10 years, reduce nutrient levels by 2x% from current load estimates.</p> <p><b>MILESTONES:</b>          1-5a: ID and map all basins.</p> <p>1-5b: Develop basin assessment program (e.g., infiltration, nutrient management) and assessment schedule (Separate from or as part of WQ 1-1?)</p> <p>1-5c: Develop BMP manual with basin tools.</p> <p>1-5d: Develop and establish funding stream/commitment.</p> <p>1-5e: Implement assessment program ( assess 1/5 of all basins per year, schedule to address all existing basins over 20 years?)</p> <p>1-5f: Develop plans to improve at least 1-2 priority (worst) basins annually.</p>			
	<p><b>WQ 1-6</b></p>	<p><b><u>Identify sources and reduce pollution inputs from roadways and yard maintenance (pesticides, herbicides, fertilizer, deicer and automotive waste). Incorporate into NJDEP Municipal SW Compliance/Assistance Program</u></b></p> <p><b>METRICS:</b> Reduce chemical usage by responsible entities and reduce collected road waste (road sweeping and applications)</p> <p><b>MILESTONES:</b></p>	<p>NJDEP Municipal SW Compliance/Assistance Program: Counties, Municipalities, NJDOT</p>	<p>L</p>	<p>\$\$\$\$?</p>

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		<p>1-6a: Review chemical usage and application policies (provided via DOT/other permit requirement?) and pursue greener alternatives, where appropriate.</p> <p>1-6b: Review roadway waste, flooding, and other information (tributary data) to identify problem “hot spots” for each municipality or other responsible agency.</p> <p>1-6c: Develop and prioritize improvement plan with estimated cost for each municipality.</p>			
	<b>WQ 1-7</b>	<p><b><u>Map all stormwater BMP projects within the watershed.</u></b></p> <p><b><u>Incorporate into NJDEP Municipal SW Compliance/Assistance Program</u></b></p> <p><b>METRICS:</b> List of all BMP projects, with summary information regarding project type, features, etc.</p> <p><b>MILESTONES:</b></p> <p>1-7a: Develop information gathering process.</p> <p>1-7b: Develop mapping and informational template.</p> <p>1-7c: Acquire and update map and information annually as part of NJDEP Municipal SW Compliance/Assistance Program.</p>	NJDEP Municipal SW Compliance/Assistance Program: Counties, Soil Conservation Districts, RCE, BTMUA, BBP	M	\$
	<b>WQ 1-8</b>	<p><b><u>Identify sources and reduce pollution inputs from marinas and boating activities.</u></b></p>	NJDEP Clean Marina and Clean Vessel Program partners, OCHD,	L	\$\$\$\$

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		<p><b><u>Suggest marinas included as part of 1-1 MSW compliance program, where appropriate.</u></b></p> <p><b>METRICS:</b> reduction in pollution inputs from marinas and boats.</p> <p><b>MILESTONES:</b>          1-8 a-d: Identify and list marinas and their needed improvements, then estimate overall funding commitment, and implement improvements annually.</p> <p>1-8e: Assess pollution inputs from other boating sources (fuels, trash, derelict vessels).</p> <p>1-8f: Work with existing programs and partners to reduce pollution (e.g., trash).</p> <p>1-8g: Target/fund additional law enforcement, where necessary, at priority problems.</p>	<p>Counties, Utility Authorities, Municipalities, Marine Trades, EPA</p>		
	<p><b>WQ 1-9</b></p>	<p><b><u>Identify sources and reduce pollution inputs from livestock, agriculture and wildlife.</u></b></p> <p><b>METRICS:</b> Reduce nutrient inputs (nitrogen, phosphorus,) from livestock, etc. by x%.; reduce the number of listed waterbodies /stream segments impaired by pathogens (i.e., Canada geese) by two-thirds within 5 years and by X within 10 years.</p> <p><b>MILESTONES:</b>          1-9a: Assess nutrient inputs from livestock on farms, ranches, ag, and animal husbandry/other facilities.</p>		<p>L</p>	<p>\$\$\$</p>

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		<p>1-9b: Identify all waterbodies that are pathogen-impaired by Canada geese</p> <p>1-9c: Develop plans, including cost estimates, to reduce nutrient loading at operations identified in 1-9a with existing USDA, NRCS, NJDEP, NJDA, and other fund sources.</p> <p>1-9d: Implement plans as funds allow to achieve nutrient-reduction objective within 5 years; otherwise increase funds</p> <p>1-9e: Develop priority, schedule, and plans to remove listed pathogen impairments via goose control, buffers, and or other projects.</p> <p>1-9f: Identify funding streams and implement plans.</p> <p>1-9g: Delist waterbodies via state/federal review processes</p>			
<b>2. Assess status trends of water quality throughout the watershed.</b>					
	<b>WQ 2-1</b>	<p><b><u>Maintain, review, and revise as necessary the existing comprehensive water quality ambient monitoring program throughout the watershed.</u></b></p> <p><b>METRICS:</b> The extent of the bay and its tributaries that are covered by the existing comprehensive water quality monitoring program and the water quality</p>	NJDEP, USGS, BBP, JC NERR, OCHD, Monmouth University, Stockton University, BTMUA	L	\$\$\$\$

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		<p>parameters (e.g., DO, temperature) that are included in the program.</p> <p><b>MILESTONES:</b>          2-1a: Conduct periodic review of existing comprehensive monitoring plan findings, including identification of monitoring and data gaps and compilation of problem findings (e.g., exceedance of criteria).</p> <p>2-1b: Develop cost estimation, justification, and schedule of addressing data gaps in revised monitoring plan.</p>			
	<p><b>WQ 2-2</b></p>	<p><b><u>Continue to identify the current status and trends in water quality within the watershed (NJDEP Integrated Report, BBP State of the Bay Report), and identify pollutant sources and magnitudes.</u></b></p> <p><b>METRICS:</b> Completion of status and trends reporting in NJDEP Integrated Reports and BBP SOTB reports, including estimation of nitrogen and phosphorus source loading on regular schedule (i.e., at least every five years).</p> <p><b>MILESTONES:</b>          2-2a: Assemble BBP SOTB Workgroup one year prior to anticipated date of publication and develop SOTB QAPP.          2-2b: Complete draft SOTB report for external review.</p>	<p>NJDEP, BBP, USGS, BTMUA, others?</p>	<p>L</p>	<p>\$\$</p>

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		<p>2-2c: Revise report as per review and publish.</p> <p>2-2d: Hold SOTB Symposium.</p> <p>2-2e: Complete integrated report every other year, and review listings of impairments within BB.</p> <p>2-2f: Review “off-year” report for Barnegat Bay watershed.</p>			
	<p><b>WQ 2-3</b></p>	<p><b><u>Support the continuation of the existing beach monitoring program,</u></b></p> <p><b><u>Conduct and evaluate an expansion of monitoring to include known recreational areas of high public use, e.g., Tice’s Shoal, F-Cove, Pine Lake, Cedar Creek, etc.</u></b></p> <p><b>METRICS:</b> Number of recreational beaches of high public use with percentage of those covered by regular/periodic monitoring programs.</p> <p><b>MILESTONES:</b></p> <p>2-3a: Generate annual list of recreational beaches, including process to identify those receiving high public use.</p> <p>2-3b: Identify those to be assessed regularly; if 100% of high-use beaches are not monitored, develop justification for those to share with elected officials at state and local levels.</p> <p>2-3c: Develop agreed-upon signage program for non-monitored beaches.</p>	<p>OCHD, NJDEP</p>	<p>L</p>	<p>\$\$</p>

<p><b>3. Conduct studies to improve scientific understanding of new and emerging issues pertaining to the chemical, physical, and biological conditions and dynamics in the Barnegat Bay and its watershed.</b></p>					
	<p><b>WQ 3-1</b></p>	<p><b><u>Support completion and expansion of source tracking for bacteria, pathogens, and novel and other pollutants.</u></b></p> <p><b>METRICS:</b> Number of source-tracking studies conducted for bacterial, pathogenic, novel and other pollutants every 5 years.</p> <p><b>MILESTONES:</b>          3-1a: STAC periodically reviews available data of bacteria and pathogenic bacterial and novel contaminant “hotspots” and compile into draft report.          3-1b: STAC workgroup develops agreed-upon process (i.e., QAPP); prioritizes source-tracking problems into report, distributed to partners and local and state officials.          3-1c: Commit STAC funding, when feasible and available.</p>	<p>EPA, NJDEP, OCHD, Counties, Utility Authorities, Municipalities</p>	<p>L</p>	<p>\$\$</p>



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	<p><b>WQ 3-2</b></p>	<p><b><u>Continue to identify and address data gaps and water quality issues of emerging concern (e.g. coastal acidification, watershed salinity increases, etc.)</u></b></p> <p><b>METRICS:</b> Number of recognized data gaps and identified issues of emerging concern identified by partners and the public compiled and reviewed every 5 years.</p> <p><b>MILESTONES:</b>          3-2a: STAC workgroup compiles and reviews available data gaps into draft report.          3-2b: STAC workgroup prioritizes data gaps and issues with funding justification for partners and local and state officials.          3-2c: Commit STAC funding, when feasible and available.</p>	<p>BBP STAC</p>	<p>L</p>	<p>\$\$</p>
	<p><b>WQ 3-3</b></p>	<p><b><u>Continue to support research that identifies and quantifies the sources and fates of nutrients within the watershed and bay.</u></b></p> <p><b>METRICS:</b> Number of studies of sources and fates of nutrients conducted every 5 years.</p> <p><b>MILESTONES:</b>          3-3a: STAC workgroup compiles list of published studies of nutrient sources and fates within past 5 years, and summarizes data gaps for funding consideration with funding justification.</p>	<p>NJDEP, USGS, EPA, BBP</p>	<p>L</p>	<p>\$\$</p>

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		3-3b: Commit STAC funding, when feasible and available.			
<b>4. Increase public education, engagement, and stewardship regarding water quality in the watershed.</b>					
	WQ 4-1	<p><b><u>Develop and promote training and education/outreach programs to help municipalities address stormwater pollution issues and implement stormwater regulations.</u></b></p> <p><b>METRICS:</b> Number of municipalities receiving training and education/ outreach programs addressing stormwater pollution.</p> <p><b>MILESTONES:</b></p> <p>4-1a: Identify and review existing stormwater training and education/outreach programs for effectiveness.</p> <p>4-1b: Use existing and/or develop new training and education/outreach programs for key target audiences, including officials, residences, businesses, and schools.</p> <p>4-1c: Commit CEC funding, when feasible and available.</p>	NJDEP, JC NERR	M	\$
	WQ 4-2	<p><b><u>Share Barnegat Bay-friendly ordinances and establish a Jersey-Friendly Yards certification and training program for homeowners, businesses, and/or landscaping professionals to promote practices that reduce non-point source pollution.</u></b></p>	ANJEC, BBP, OCSCD, RCE	M	\$\$

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		<p><b>METRICS:</b> Adoption of ordinances, number of certifications, and number of education recipients implementing best practices.</p> <p><b>MILESTONES:</b>          4-2a: Review model ordinances, revise as needed, and distribute to municipalities.</p> <p>4-2b: Develop JFY certification and other education/outreach programs.</p> <p>4-2c: Implement programs with BBP/other funding (e.g., fees)</p>			
	<b>WQ 4-3</b>	<p><b><u>Implement components of the BBP Communications Plan related to water quality improvement.</u></b></p> <p><b>METRICS:</b> Number of BBP Comm. Plan components implemented and their effectiveness.</p> <p><b>MILESTONES:</b>          N/A: contingent on development of specific programs.</p>	BBP, Save Barnegat Bay, JCNEER, NJDEP	L	\$

## Chapter 5 – WATER SUPPLY GOALS, OBJECTIVES AND ACTIONS

### Highlights

- Maintaining adequate flow of freshwater to the Bay from streams and groundwater is critical to its health.
- The Barnegat Bay watershed provides important water supplies for human and non-human uses, and these supplies are vulnerable to sea-level rise, storm surges, saltwater intrusion, drought, and contamination.
- Central objectives are to coordinate, support, and supplement programs to maintain, plan, regulate, conserve, and reuse water supplies.

### 5.1 Goal

To ensure adequate water supplies and flow in the Barnegat Bay Watershed for ecological and human communities now and in the future.

#### Water Supply Objectives:

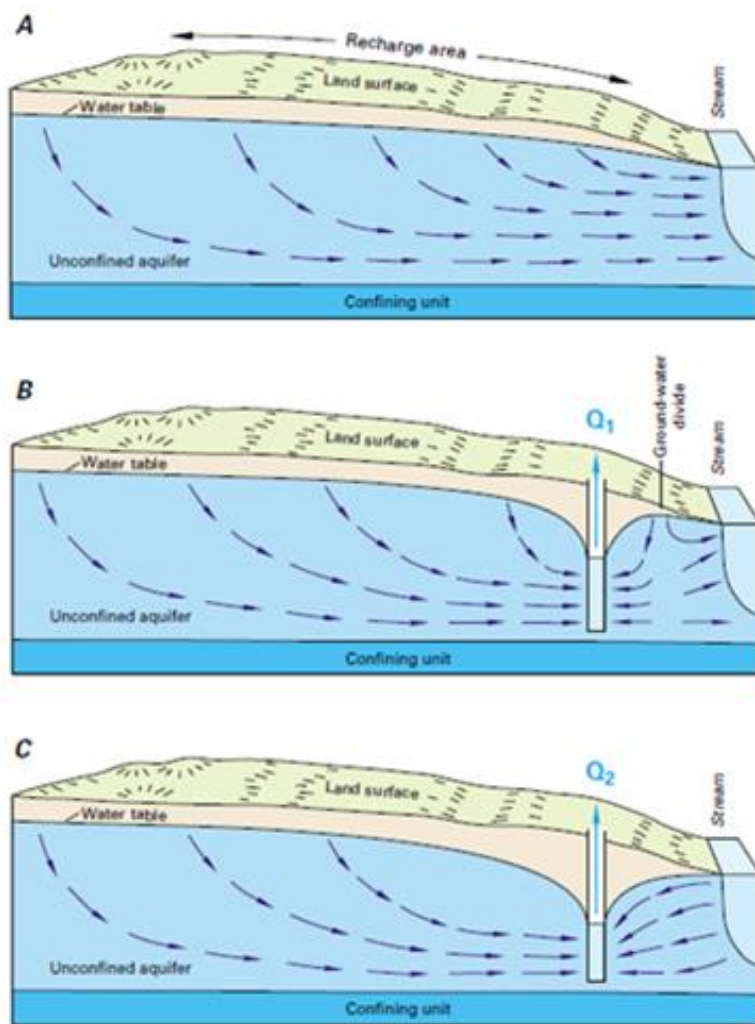
1. Protect, maintain and enhance existing water supply and surface and ground water flow
2. Prevent degradation of water supplies
3. Monitor and assess status and trends of water supply throughout the watershed.
4. Review existing literature/successful pilots and conduct studies to improve scientific understanding of new and emerging issues pertaining to water conservation, advanced potable treatment options, and reuse
5. Educate consumers regarding water supply issues and indoor/outdoor water conservation and reuse

### 5.2 Introduction

The Barnegat Bay watershed provides the source of fresh water that is vital to the bay and the region's inland ecosystems, as well as to the human population that resides in and visits the watershed. This freshwater supply serves several critical functions. Freshwater inputs to the bay are critical for maintaining healthy salinity levels that supports the estuarine ecosystem. Freshwater flowing in rivers and streams carries with it nutrients that are important for the living resources of the bay and sediment that nourishes coastal wetland habitats. The freshwater flowing into the bay from streams and groundwater helps to flush out contaminants and waste products, which helps to maintain healthy water quality. The watershed also provides an important water supply for human uses. Some of the freshwater flowing in the Metedeconk River is diverted and treated for human use. Fresh groundwater also flows from the Kirkwood-Cohansey aquifer system into streams, wetlands, and the bay, and some

of this natural groundwater flow is diverted for human use by water-supply wells tapping the aquifer system. Some of the groundwater in deeper, confined aquifers is also diverted for human use.

The cycle of freshwater flow involves several stages, such as precipitation, direct runoff, infiltration, groundwater flow, and streamflow, before reaching the bay or water-supply intakes and wells for human use. Management issues arise at each stage of the water cycle and require consideration in planning efforts to ensure that these critical water supplies can be sustained in the face of increasing pressures from human activity and the effects of the changing climate. Climate change is expected to affect water supplies primarily through sea level rise and altered weather patterns (e.g., warmer temperatures, stronger storms, and more severe droughts and floods). Climate change presents a relatively new challenge for water resource managers, who must continually integrate the latest scientific understanding of the issue into their work.



**Streamflow Requirements:**

Managing streamflow is essential to ensuring that the rate of freshwater flow is adequate to support aquatic and estuarine habitats as well as human uses. Low stream flow can result in the loss of suitable habitat for freshwater invertebrate and fish species. If streamflow entering the bay is inadequate, bay salinity increases, and waste materials and nutrients are not adequately flushed. These low-flow conditions can contribute to the incidence of harmful algal blooms (HABs), such as Brown Tide. The bay is especially vulnerable to these effects during drought conditions, which are expected to occur more frequently in the future as a consequence of climate change. NJDEP’s water-supply planning policies are designed to help ensure that stream flows are adequate to avoid unacceptable ecological impacts. However, current diversions of freshwater flows are already impacting flows in headwaters streams and, in the absence of measures to mitigate impacts, increases in

Figure 5.1 - Effect of groundwater withdrawals on water levels and streams  
 USGS circular pg 15: <https://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf>

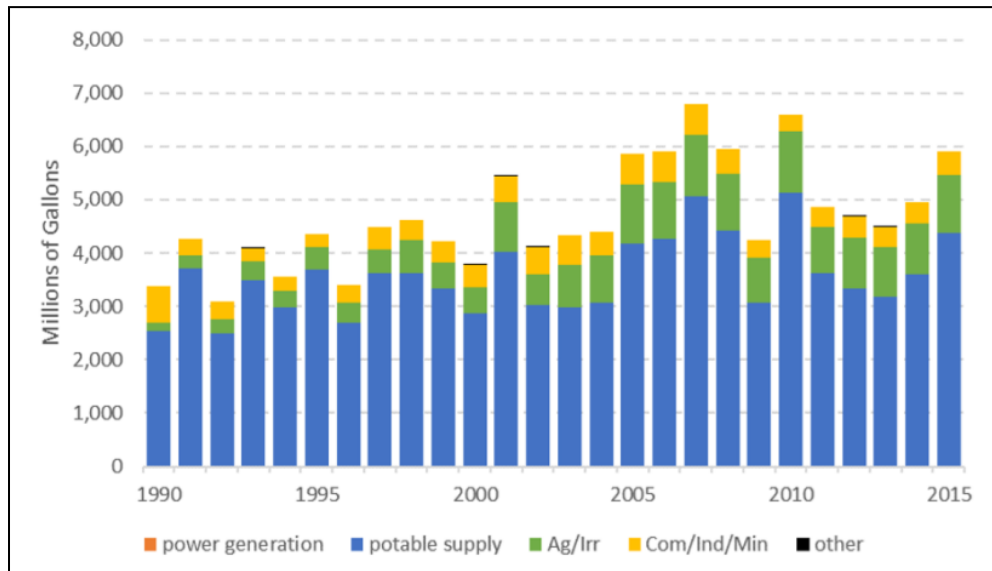
water demands for human use will exacerbate these impacts. Freshwater wetlands in the watershed are also vulnerable to the effects of excessive diversions. Extensive investigation conducted as part of the Kirkwood-Cohansey Project has demonstrated that a substantial percentage of wetlands in a given watershed can be altered or converted to uplands when even a small percentage of groundwater recharge has been diverted by pumping. Flow conditions are monitored in several of the bay's major tributary streams, and regular assessments of these conditions are needed to ensure that adequate flows are maintained.

**Stream base flow:** Streams flowing into the bay receive inputs from stormwater runoff and from the underlying Kirkwood-Cohansey aquifer system in the form of groundwater seepage. The groundwater seepage component of streamflow is called base flow. During periods of low or no precipitation, the flow in streams consists entirely of base flow. Base flow is critical to the health of Barnegat Bay because it constitutes 82 percent of the flow in streams that flow into the bay<sup>35</sup>, provides necessary habitat for freshwater inhabitants and it provides nutrients during drought periods when surface runoff is minimal. Monitoring and periodically assessing base flow is an important component of a program to track and manage the health of the bay.

**Precipitation, runoff, and infiltration:** Precipitation over the watershed follows four pathways of the hydrologic cycle: The water evaporates, transpires from vegetation, becomes runoff, or infiltrates the ground and becomes aquifer recharge. The proportions of these pathways are important because they affect the seasonality of flow to streams and the bay. Aquifer recharge is critical to the bay because most of the freshwater flowing into the bay previously flowed as groundwater before flowing into streams or directly into the bay. If evaporation and transpiration from vegetation (including irrigated lawns and other turfed areas) is high, then aquifer recharge is reduced. In the absence of effective stormwater management, land uses with a high percentage of impervious surfaces produce more runoff, leaving less water available for aquifer recharge. Land use regulations which minimize impervious surfaces, incorporate green infrastructure, and require the infiltration of storm runoff can lessen this effect.

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<sup>35</sup> Watt, M.K., Johnson, M.L., and Lacombe, P.J., 1994, Hydrology of the unconfined aquifer system Toms River, Metedeconk River, and Kettle Creek basins, New Jersey, 1987-90: U.S. Geological Survey Water-Resources Investigations Report 93-411, 5 pls. Hunchak-Kariouk, K., and Nicholson, R.S., 2001, Watershed contributions of nutrients and other nonpoint-source contaminants to the Barnegat Bay-Little Egg Harbor estuary, in Kennish, M.J., 2001, ed., Barnegat Bay-Little Egg Harbor estuary and watershed assessment: Journal of Coastal Research, Special Issue 32, p. 28-82.  
Gordon, A.D., 2004, Hydrology of the unconfined Kirkwood-Cohansey aquifer system, Forked River and Cedar, Oyster, Mill, Westecunk, and Tuckerton Creek Basins and adjacent basins in the southern Ocean County area, New Jersey, 1998-99: Water-Resources Investigations Report 2003-4337, 5 pl.



**Figure 5.2 - Water withdrawals by water-use category in the Barnegat Bay watershed by water-use category**

**Effect of groundwater withdrawals and offshore discharge on base flow:**

Water withdrawals from wells tapping the unconfined Kirkwood-Cohansey aquifer system in the Barnegat Bay watershed intercept groundwater that would otherwise either flow directly into the bay or to streams that flow into the bay. As a result of the withdrawal, water levels in nearby wetland habitats can be lowered and less freshwater flows naturally to the bay. Water used within the watershed is withdrawn from the unconfined aquifer and also from deeper confined aquifers and surface water. The water that is used in areas that are serviced by sanitary sewers is collected, treated, and discharged to the ocean through three offshore outfalls. The total average rate of this ocean discharge is 129 million gallons per day, which is equivalent to about 21% of the freshwater flow to the bay<sup>36</sup>. This water would have naturally flowed into the Bay but is instead lost from the system. This percentage is higher during drought conditions, when natural freshwater flows to the bay are lower than average and during summer months when withdrawals for human uses are higher than average. This means that the effect of diverting water from the natural flow in the watershed is greatest during drought and summer.

**Importance of Soil and Riparian Zones: Soil:<sup>37</sup>**

Soil is perhaps the most important watershed component because of the role it plays in controlling the quantity, quality and timing of freshwater that flows to the bay. Protecting and restoring soil health will maximize its role in controlling flooding, attenuating pollution, and recharging groundwater. The

<sup>36</sup> New Jersey Department of Environmental Protection, 2017, New Jersey Water Supply Plan 2017-2022: 484p., Appendix A, p. A.154.

<sup>37</sup> **May need permission to use Figure 5.3**

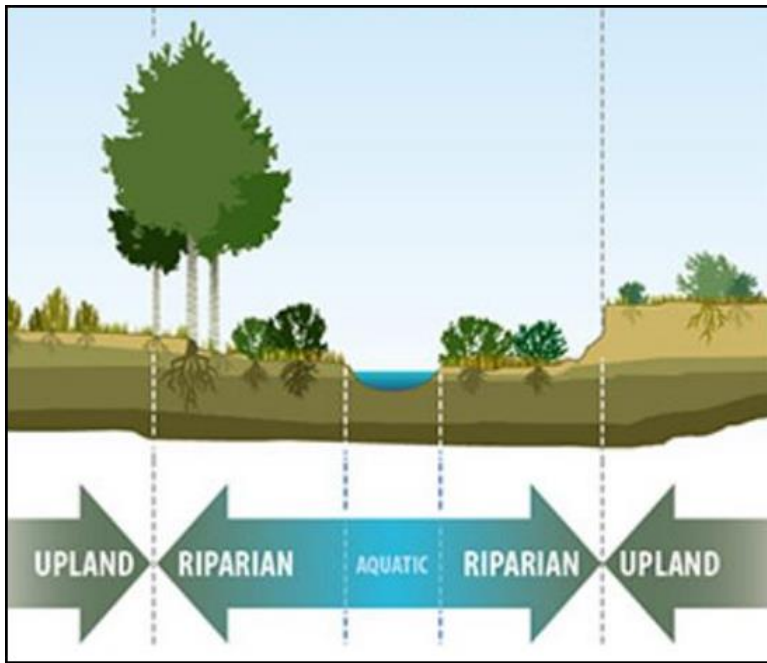


Figure 5.3 - Configuration of upland, riparian, and aquatic zones within a watershed.

texture, structure, organic content, and consistency of soil controls how much precipitation runs off the land and how much infiltrates the land surface. Undisturbed soils in most upland areas of the watershed are permeable and allow high rates of infiltration. Soils in lowland and wetland areas, and soils that have been compacted or covered with building material (such as pavement or buildings) are less permeable, such that more precipitation runs off the land and less infiltrates the ground. Undisturbed soils also retain sediment and pollutants that could otherwise run off into streams. In riparian zones, soils and natural vegetation are especially important in retaining sediment and pollutants and preventing them from entering streams and the bay.

**Riparian Zone:** The riparian zone is defined as those land areas that are adjacent or hydrologically connected to surface waters such as streams, rivers, lakes or reservoirs. Sometimes it is described as the floodplain or buffer. Riparian areas differ from the uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Riparian ecosystems support high levels of biodiversity.

Riparian zones perform a variety of functions with environmental, economic and social value. Examples include providing habitat for aquatic and terrestrial organisms, trapping and removing sediments and pollutants from stormwater runoff, stabilizing streambanks and reducing channel erosion, and storing flood waters and decreasing potential for property damage. Because they provide all of these services and more, maintaining a healthy riparian zone can be considered an economical means to ensure future water quality and natural flows. Healthy riparian zones in the watershed are critical to the protection of downstream ecosystems, such as the Barnegat Bay.

Intensive activities in riparian zones can lead to altered streamflow and serious losses of stream habitat and water quality. Waterways in developed areas often become degraded following the removal of riparian vegetation and increases in stormwater runoff. Other common problems associated with disturbed riparian zones include sedimentation, streambank erosion, changes in the amount and timing of water flows, and increases in the frequency and magnitude of flood events.

Protecting riparian buffers is often mandated through regulations at various levels of government. In the Barnegat Bay watershed, the State of New Jersey requires riparian buffers to protect surface waterways under the Stormwater Management Rules (N.J.A.C. 7:8) and the Flood Hazard Area Control Act Rules,



(N.J.A.C. 7:13). The most stringent standards, with minimum buffers of 300 feet, are applicable to waterways designated as Category One (or C1) which are subject to an anti-degradation policy and intended to be protected from measurable changes in water quality. Wetlands protection regulations require similar buffers or transition areas. The Pinelands Commission requires a 300-foot buffer adjacent to all waters in the Pinelands area. Some municipalities also mandate riparian buffers in their local codes.

Intact riparian zones that are presently in forest or wetland vegetation should receive high priority in conservation planning and open space preservation. Restoration of select riparian zones adjacent to areas of intensive agriculture, managed lawns and other residential/commercial development would benefit the Barnegat Bay estuary.

**Sustaining Water Supplies for Human Use:** Water supplies for human uses are vulnerable to several threats that may affect their quality and quantity. These include effects of sea-level rise and increasing risks of storm surges, saltwater intrusion of aquifers, drought, and contamination from human and natural sources. The level of vulnerability depends primarily on the type and location of the source. In the Barnegat Bay watershed, surface water and shallow aquifers are the most vulnerable supplies, while deeper confined aquifers tend to be least vulnerable. Protecting existing and future water supplies from these threats and building water-supply resilience can help to avoid the need for new supplies that could potentially divert additional freshwater flow from Barnegat Bay.

Human activities present the greatest threats to water supplies. Water pollution is the most significant problem caused by humans and can come from both point and nonpoint sources. Pollutants may be released from point sources as accidental spills, or deliberate or unintentional discharges, and directly affect a waterway or shallow groundwater. Groundwater contamination plumes are particularly difficult to manage and can take decades to properly clean up. Due to the close connection between the shallow aquifer and streams, groundwater contamination can also affect surface waterways. Nonpoint sources of pollution introduce small amounts of contaminants throughout a watershed which make their way into streams and rivers or infiltrate into the sandy shallow aquifer. Examples include chloride from winter road salting; fertilizers and pesticides from lawns and agricultural areas, oil and chemicals from urban runoff, and bacteria from pet waste and septic systems. There are many types of known pollutants that water suppliers must monitor for regularly. In addition, water suppliers must be constantly vigilant for contaminants of emerging concern, such as pharmaceutical and personal care products that may be introduced to our waters through direct and indirect wastewater discharges.

Human activities also affect water quantity. Water withdrawals must be carefully managed to ensure sufficient water remains for downstream uses and ecological needs. In some cases, withdrawals must be prioritized so that critical needs, such as providing drinking water or crop irrigation, are satisfied before discretionary uses, like lawn irrigation. Alteration of the watershed can also affect water quantity. Creation of impervious surfaces and stormwater conveyance systems may reduce the ability of stormwater to soak into the ground and replenish the shallow aquifer, leading to faster runoff during storms and lower river and groundwater levels during dry periods when the water is needed most.

Aside from human activities, natural environmental conditions can sometimes affect water supplies. The presence of naturally occurring radionuclides or metals in aquifers can render a water supply well unusable without expensive treatment. Forest fires may cover large areas and disrupt water quality.

Water supplies are particularly vulnerable to weather events, like significant storms and droughts. On a larger scale, there is considerable concern about how sea level rise will affect coastal water supplies. Similarly, there is uncertainty about how climate change will affect rainfall patterns, droughts and seasonal water availability. Many utilities are making infrastructure improvements to become more resilient to these potential long-term water supply complications.

Some water purveyors develop source water protection programs to help safeguard the water quality and quantity of their supplies. These programs can be very effective and rely on collaboration with the communities where the supplies are located, for example a watershed or wellhead protection area, to institute protective measures. Such programs can have substantial ancillary benefits in terms of environmental protection, sustainability, ecosystem health, human health, social value and the economy. They also leverage and reinforce various surface and groundwater protection programs above.

### 5.3 Objectives

#### **Water Supply Objective 1 - Protect, maintain and enhance existing water supply and surface and groundwater flow:**

Actions that help protect, maintain, enhance, and monitor streamflow and groundwater flow will help ensure adequate hydrologic support for aquatic, wetland, and estuarine habitats as well as the water-supply needs of the human population. Sound, science-based water-supply planning is a critical element of the plan for achieving this objective. The water-supply planning process and CCMP actions need to be designed and conducted in consideration of hydrologic conditions that are likely under projected changes in future climate and sea level conditions. Selected actions include:

#### *Assess and implement existing shallow groundwater protection programs including wellhead protection and rainwater and treated wastewater recharge*

Programs to protect shallow groundwater can help to protect the integrity of freshwater inputs to the bay. The New Jersey Source Water Assessment Program (SWAP) provides for the protection and benefit of public water systems and to increase public awareness and involvement in protecting the sources of public drinking water. Local land use ordinances can prevent activities that could potentially release contaminants or otherwise impact surface water or groundwater. Wellhead protection ordinances, for example, utilize information from the SWAP to restrict land use activities in established wellhead protection areas. Stormwater regulations require recharge of clean stormwater runoff into the ground through surface basins, underground infiltration systems or green infrastructure. Wastewater disposal to surface water or groundwater from commercial and industrial activities is regulated by NJDEP. There are opportunities to treat wastewater and recharge it back into the shallow aquifer to improve groundwater levels and reduce freshwater losses to Barnegat Bay. Other NJDEP regulations, such as those governing land use and water allocation, serve to protect groundwater resources. The effectiveness of these programs can be tracked and evaluated through sustained long-term surface water and groundwater monitoring. Research on contaminant sources, transport, and fate provide technical guidance for these programs.

Determine minimum ecological flow requirements for streams, rivers and wetlands within the watershed.

Maintaining an adequate flow of freshwater to the Bay is critical to its health. Programs, policies, and regulations that sustain water supply for human use can also sustain water supplies for the bay. Programs that protect and restore natural soils and riparian zones also help to maintain water supplies. Comprehensive water-supply planning can help sustain natural flows by limiting withdrawals from surface water and unconfined aquifers. Reclamation and reuse of wastewater can help offset some of the effects of water transfer out of the watershed. Research and monitoring can help enhance our understanding and management of freshwater resources, conservation issues, advanced treatment options, and water reuse.

Fresh water is withdrawn from surface waterways and groundwater for a variety of purposes, including public supply, agriculture, landscape irrigation, commercial and industrial uses, mining, and power generation. Withdrawals have generally increased over the past several decades, and this increase is closely linked to population growth. Water withdrawals for human use in the Barnegat Bay watershed during 1990-2015 were compiled for the New Jersey Water Supply Plan. The compilation distinguishes total withdrawal (which includes water returned to the watershed after use) from consumptive water loss from the watershed (which is most relevant to estuary health). Consumptive water loss trended upward from 3.4 bgy (billion gallons per year) in 1990 to 5.9 bgy in 2015 (an increase of 74%), with a peak of 6.8 bgy in 2007<sup>38</sup>. Almost all of the consumptive loss is from public supply uses. In recent years, NJDEP has advanced a methodology to better account for ecological flow requirements in water supply planning<sup>39</sup>.

Support comprehensive planning that will guide sustainable water supply management, and to the maximum extent possible, maintain natural hydrology.

The New Jersey Water Supply Management Act (N.J.S.A. 58:1A-1 et. seq.) declares that the State's water resources are public assets held in trust and managed for the residents by the New Jersey Department of Environmental Protection (NJDEP). The 1981 Act requires that a New Jersey Statewide Water Supply Plan (NJSWSP) be developed and periodically revised by NJDEP. The first NJSWSP was developed in 1982 and periodic updates have been completed since that time, including a major revision in 1996. In October 2017, NJDEP released the New Jersey Water Supply Plan 2017-2022, representing the second comprehensive revision to the NJSWSP. The most recent revision is intended to be a living document with updates on a continuous cycle<sup>40</sup>.

The State-level water-supply planning process aims to plan for adequate water supplies in the future and can help address water-supply vulnerabilities. A part of this planning process is to determine the water availability in each of 20 statewide Water Management Areas, one of which is the Barnegat Bay watershed. Current and projected water demands in HUC11 subwatersheds are compared with available water to determine if a water-supply deficit exists. The regional analysis of the Barnegat Bay watershed indicates that there is a net surplus of available water overall, but the analysis of the individual HUC11 subwatersheds indicates that the Toms River, Metedeconk River, and Kettle Creek are currently overstressed. Increases in water demand could increase this stress. While the population of Ocean County has continued to grow, the rate of this growth has decreased since 1990, according to the

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<sup>38</sup> Insert citation

<sup>39</sup> <http://www.njgeology.org/pricelst/tmemo/tm13-3.pdf>

<sup>40</sup> NJ Water Supply Plan is <https://www.nj.gov/dep/watersupply/pdf/wsp.pdf>

U.S. Census. However, in some water-stressed parts of the county, the rate of population growth has increased dramatically since 1990. If this accelerating growth pattern in these areas continues, then larger increases in future water demand for human use would place even greater stresses on local wetlands and stream habitats and on the freshwater flow to Barnegat Bay. The statewide Water Supply Plan includes provisions for mitigating water-supply deficit areas through reductions in water use, increased storage, and increased recharge. The WSP also proposes policies for water-supply improvement.

Comprehensive planning encompasses not just water supply, but land use, transportation, housing, utilities, open space, and other aspects of community development. Comprehensive planning typically takes place at the municipal level. The State-level water supply plan provides important information for comprehensive planning. It is now more critical than ever that comprehensive planning account for limited water availability and the sustainable use of water supplies in order to provide for the growing human population and the Barnegat Bay's environment.

### **Water Supply Objective 2 - Prevent degradation of water supplies**

Water supply for habitats and human uses are threatened by sea-level rise, storm surges, saltwater intrusion of aquifers, drought, and contamination from human and natural sources. Protecting existing and future water supplies from these threats helps protect habitats and the human population. Building water-supply resilience to threats, including threats posed by the changing climate, can avoid the need for new supplies for human use that could potentially divert additional freshwater flow from Barnegat Bay. Selected actions include:

#### **Inventory and promote municipal land use regulations that emphasize water supply protection as a primary goal.**

Numerous municipalities have adopted local ordinances aimed at protecting water supplies, including mandatory riparian buffers, wellhead protection areas, and outdoor irrigation restrictions. Similarly, the Pinelands Commission developed an especially protective Model Stormwater Control Ordinance<sup>41</sup> to ensure that the site of proposed stormwater BMP's is properly assessed and that BMPs are properly maintained. A stormwater ordinance that emphasizes the use of Green Infrastructure is under development for the Metedeconk River watershed. Such ordinances serve as a model for towns that have yet to embrace these effective strategies.

#### **Identify, implement and support voluntary and mandated conservation and infiltration practices and regulation to maintain and restore base stream flows and natural hydrology.**

Maintaining an adequate flow of freshwater to the Barnegat Bay is critical to its health. Programs, policies, and regulations that sustain water supply for human use can also sustain water supplies for the bay. Expanded initiatives aimed at promoting water conservation and reducing water demands will result in less water withdrawals and leave more water draining to the bay. Enhancing groundwater recharge in developed areas by taking advantage of the

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<sup>41</sup> [http://www.nj.gov/dep/stormwater/docs/071906\\_pinelands\\_ordinance.pdf](http://www.nj.gov/dep/stormwater/docs/071906_pinelands_ordinance.pdf)

watershed's sandy, well-drained soils to capture rainwater near where it falls, and eliminating runoff to constructed stormwater systems, will help maintain natural hydrology and maintain baseflow. Simple and effective measures to address this action, such as rain barrels, rain gardens, soil restoration and native, drought-tolerant landscaping plants, can be applied on virtually any property throughout the watershed.

### **Water Supply Objective 3 - Monitor and assess status and trends of water supply throughout the watershed**

The status and trends of flows and human water use need to be monitored and assessed in order to understand their relation to the health of the bay. Monitoring will also allow for the anticipation of challenges that may result from detrimental conditions and trends that may be due to human activities in the watershed and those that may occur as result of a changing climate. Monitored hydrologic conditions need to include both stream flow and groundwater. Selected actions include:

*Continue, and if possible expand, stream flow monitoring throughout the watershed to assess the effects of changing precipitation patterns, water use and development.*

The United States Geological Survey maintains a network of stream gauging stations that measure the rate of flow in some of the major streams in the watershed on a continuous basis. However, flows in many smaller streams, as well as groundwater inputs, are not monitored but have been estimated. The average annual rate of fresh water flows to Barnegat Bay, including all streamflow and groundwater inputs, is estimated to total about 220 billion gallons per year. During drought periods, the rate of fresh water flows is only about one third to one half of this rate. Baseflow accounts for 67%-94% of total streamflow at the monitored streams. Studies have shown that in recent decades, baseflow has significantly declined in the northern streams. Recent trends in streamflow in the watershed have not been evaluated. Stream flow monitoring is critical to understanding the influences of human activities and climate change in the watershed.

*Assess water-supply trends and effects of current and projected surface and groundwater withdrawals*

Approximately one-fifth of the freshwater flow from the watershed does not reach the bay because it is withdrawn for use, collected in the sanitary sewer system for treatment, and ultimately discharged offshore. Fresh water is a limited resource in the Barnegat Bay watershed. Water resource managers must clearly understand how water is being used, how much is required for human and environmental needs, and how current and future withdrawals affect this balance. Assessing water supply trends and limitations at a finer scale than has been done historically will help enhance our understanding of freshwater resources and advance the necessary, perhaps innovative, solutions that will improve water supply management.

### **Water Supply Objective 4 - Review existing literature/successful pilots and conduct studies to improve scientific understanding of new and emerging issues pertaining to water conservation, advanced potable treatment options, and reuse.**

Selected actions include:

*Actions to reduce water demand can help mitigate the effects of water diversions for human use.*

Water conservation, advanced treatment, and reuse have been successfully implemented in other regions, and understanding the transferability of other approaches for reducing water demand are likely to benefit water supply planning in the Barnegat Bay watershed. Reducing water demand is especially important in the face of changing climatic conditions that may place additional stresses on water supplies and the bay.

*Identify infrastructure, research and piloting options for the use of advanced treatment at wastewater treatment plants and water reuse, including wastewater and gray water, within the watershed.*

There are opportunities to reuse water in the Barnegat Bay watershed. Examples include irrigation or groundwater recharge with treated wastewater or gray water. A major impediment is the cost of the necessary water treatment and/or infrastructure improvements. However, water scarcity is becoming increasingly problematic in regions around the globe and innovative, cost-effective solutions are continually being developed. Similarly, green building has become a major sustainability initiative in recent years with water saving measures being a key focus. The completion of small water reuse demonstration projects will help raise public awareness of the region's freshwater limitations and promote more widespread application of water reuse systems.

**Water Supply Objective 5 Educate consumers regarding water supply issues and indoor/outdoor water conservation and reuse**

Building consumer knowledge of water conservation and water-supply protection can help promote and leverage actions designed to reduce water demand and improve water-supply protection. Educated consumers are more likely to support and participate in conservation and protection programs. Public education is also an important component to building resilience to climate change. Selected actions include:

***Disseminate educational materials related to best practices for water conservation activities.***

Community awareness is the first step towards improving water conservation. There are many available sources of public outreach materials geared towards water conservation, and programs are in place within the Barnegat Bay watershed to educate the public and build awareness about the need to conserve water. There are also opportunities to leverage other environmental education programs and public venues to promote water conservation. Substantial reductions in water demands can be achieved if the people who live, work, or otherwise spend time in the watershed are aware of the simple things they can do in their daily lives to conserve water.

**5.4 Previous Successes**

Much progress has been made toward the goal of ensuring adequate water supplies and flow in the Barnegat Bay Watershed. Some of the highlights of this progress are described below:

- Water Conservation: Water conservation initiatives, including effective outreach programs and the widespread use of low-flow plumbing fixtures and appliances, have reduced per capita water consumption.

- Replacing aging water systems: Water purveyors in the Barnegat Bay watershed now routinely use leak detection systems and replace aging pipes that may leak and waste water.
- 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 Township 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.
- Water-supply studies: Several scientific, watershed-scale studies have been conducted by the USGS in cooperation with 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.
- Hydrologic monitoring: Streamflow and groundwater levels at many sites in the Barnegat Bay watershed have been monitored on a continuous or recurring basis by the USGS, in cooperation with 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.
- 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
- Expansion of public outreach: Numerous agencies and organizations (e.g., EPA, NJDEP, Pinelands Commission, BBP, water utilities, NGOs, etc.) have developed and implemented

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outreach programs to educate the public about water resources and their conservation and protection. These programs have been very effective and are being continually expanded.

- 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 Plan.

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**5.5 Objectives and Actions for Sustainable Water Supply in the Barnegat Bay Watershed**

- **Timeframe** – The timeframe from adoption of the CCMP in which the action should be completed. Short (S) indicates a completion within 1-2 years, Medium (M) actions are completed within 3-5 years, and Long (L) actions take 5 or more years. On-going actions are considered Long.
- **Costs** – The anticipated costs for the action: \$ < \$100,000, \$\$ \$100,000 - \$500,000, \$\$\$ \$500,000 - \$1,000,000, \$\$\$\$ > \$1,000,000.

<b>Goal - To ensure adequate water supplies and flow in the Barnegat Bay Watershed for ecological and human communities now and in the future.</b>					
<b>WS Objective</b>	<b>WS Action ID</b>	<b>CCMP Action</b>	<b>Lead Partners</b>	<b>Time-frame</b>	<b>Costs</b>
<b>1. Protect, maintain and enhance existing water supply and surface and ground water flow</b>					
	<b>WS 1-1</b>	<p><b><u>Assess and implement existing shallow groundwater protection programs including wellhead protection and rainwater and treated wastewater recharge</u></b></p> <p><b>METRIC:</b> The number of shallow groundwater protection programs, including local ordinances and project sites</p> <p><b>MILESTONES:</b> 1-1a: Assess programs already in place</p>	NJDEP, Municipalities, Utilities	L	\$\$\$\$

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		<p>1-1b: Identify areas where programs could be located</p> <p>1-1c: Implement programs</p> <p>1-1d: Evaluate results</p>			
	<b>WS 1-2</b>	<p><b><u>Determine minimum ecological flow requirements for streams, rivers and wetlands within the watershed.</u></b></p> <p><b>METRIC:</b> Number of waterways with minimum ecological flows determined</p> <p><b>MILESTONES:</b>          1-2a: Compile available data and determine where sufficient data exists and where there are data gaps          1-2b: Address data gaps          1-2c: Perform ecological flow assessments          1-2d: Peer review and publishing of assessments</p>	NJDEP, USGS, Pinelands Commission	S	\$\$\$
	<b>WS 1-3</b>	<p><b><u>Assess and rank streams in the watershed for water supply capability related to streamflow, surface and shallow groundwater withdrawal capacity, and ecological impact.</u></b></p> <p><b>METRIC:</b> Number of assessments completed by HUC14 watershed</p>	NJDEP	S	\$\$ or \$\$\$

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		<p><b>MILESTONES:</b>          1-3a: Compile available data</p> <p>1-3b: Address data gaps</p> <p>1-3c: Perform assessments and rank areas in terms of capacity and ecological impact</p> <p>1-3d: Publish information to inform regulatory decision-making and guide mitigation</p>			
	WS 1-4	<p><b><u>Support comprehensive planning that will guide sustainable water supply management, and to the maximum extent possible, maintain natural hydrology.</u></b></p> <p><b>METRICS:</b> Percentage of a Barnegat Bay-specific water supply plan completed; Percentage of a Barnegat Bay-specific water supply plan implemented</p> <p><b>MILESTONES:</b>          1-4a: Identify plan elements and additional detail needed beyond the existing NJDEP Statewide Water Supply Plan</p> <p>1-4b: Develop plan with stakeholder involvement</p> <p>1-4c: Implement plan with stakeholders and through the regulatory process</p>	NJDEP, Water/WW Utilities, Pinelands Commission	L	\$\$\$ or \$\$\$\$

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		1-4d: Review progress, revise and update plan			
	<b>WS 1-5</b>	<p><b><u>Promote and support land use activities that enhance water supply protection and minimize water withdrawals and usage, especially in the most stressed water supply planning areas as identified in the State Water Supply Master Plan</u></b></p> <p><b>METRICS:</b> Stabilized water demand figures; Acres of land uses with low water demand</p> <p><b>MILESTONES:</b>          1-5a: Examine/classify land use activities and stressed areas          1-5b: Examine/classify per capita and regional water demands          1-5c: Identify and implement land use changes necessary to stabilize water demands          1-5d: Evaluate and revise approaches, as necessary</p>	NJDEP, Municipalities, Land Conservancies	L	\$\$
<b>2. Prevent degradation of water supplies</b>					
	<b>WS 2-1</b>	<p><b><u>Inventory and promote municipal land use regulations that emphasize water supply protection as a primary goal.</u></b></p>	NJDEP, BBP	S	\$

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		<p><b>METRIC:</b> Number of municipalities inventoried; number of new municipal regulations/ordinances</p> <p><b>MILESTONES:</b>          2-1a: Identify local regs/ordinances that are effective in protecting water supplies</p> <p>2-1b: Identify municipalities where these regs are in place          2-1c: Identify water supply sources by municipality</p> <p>2-1d: Target promotion of land use regulatory improvements where improvements can be made and with respect to the local water supply source(s)</p> <p>2-1e: Update inventory and re-promote where needed</p>			
	<p><b>WS 2-2</b></p>	<p><b><u>Identify and acquire open space to support water supply protection, encourage natural recharge and reduce consumption.</u></b></p> <p><b>METRIC:</b> Acres of open space preserved</p> <p><b>MILESTONES:</b>          2-2a: Identify and prioritize parcels/tracts with water supply protection value for preservation</p>	<p>NJDEP (through Environmental Infrastructure Trust), Counties, Municipalities, Land Conservancies</p>	<p>L</p>	<p>§</p>

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		<p>2-2b: Develop/maintain GIS database of preserved open space and identified tracts</p> <p>2-2c: Screen parcels for willing sellers for conservation and prioritize these for acquisition</p> <p>2-2d: Update database and maintain periodic outreach to owners</p>			
	WS 2-3	<p><b><u>Establish and enforce 300-foot riparian buffers and pursue opportunities for green/blue acres acquisitions in buffer areas and floodplains.</u></b></p> <p><b>METRIC:</b> Number of new 300' riparian buffers established; existing natural buffers acreage; buffer/floodplain acres acquired via green/blue acres programs</p> <p><b>MILESTONES:</b></p> <p>2-3a: Identify 300' riparian buffer and floodplain areas in GIS database</p> <p>2-3b: Identify i) riparian areas without protection, ii) riparian areas with protection that have been illegally disturbed</p> <p>2-3c: Work with municipality or State to i) establish new 300' protective buffers, and ii) restore or provide mitigation for protected</p>	NJDEP, Municipalities, Green/Blue Acres, Land Conservancies,	M	\$\$

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		<p>buffer areas that were illegally disturbed</p> <p>2-3d: Evaluate and pursue opportunities for green/blue acres preservation</p> <p>2-3e: Update/maintain GIS database</p>			
	<b>WS 2-4</b>	<p><b><u>Identify, implement and support voluntary and mandated conservation and infiltration practices and regulation to maintain and restore base stream flows and natural hydrology.</u></b></p> <p>METRIC: Number of ongoing conservation programs and regulations identified, implemented, and supported</p> <p>MILESTONES:          2-4a: Identify effective water conservation and infiltration practices and programs, both voluntary and mandatory          2-4b: Build upon existing programs to incorporate new practices, increase effectiveness and expand coverage across the Barnegat Bay watershed</p>	<p>NJDEP, Municipalities, Utilities, Pinelands, USEPA WaterSense</p>	L	\$
	<b>WS 2-5</b>	<p><b><u>Inventory and evaluate municipal ordinances, rate structures and other available information for opportunities to better ensure judicious water usage and incentivize water conservation at</u></b></p>	<p>NJDEP, Municipalities, Utilities</p>	M	\$\$

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		<p><b><u>the household and community levels; including metering all water usage.</u></b></p> <p>METRIC: Water use in developed and developing areas</p> <p>MILESTONES:          2-5a: Develop list of strategies to decrease water usage at the household and community level</p> <p>2-5b: Pursue opportunities/partners to implement these strategies</p> <p>2-5c: Evaluate success</p>			
<b>3. Monitor and assess status and trends of water supply throughout the watershed.</b>					
	<b>WS 3-1</b>	<p><b><u>Conduct shallow aquifer protection monitoring.</u></b></p> <p>METRIC: Collection of monitoring data</p> <p>MILESTONES:          3-1a: Identify representative sites and install monitoring wells</p> <p>3-1b: Collected groundwater quality and water level data at appropriate intervals</p> <p>3-1c: Evaluate data, identify areas of concern, adjust monitoring as necessary</p>	USGS, NJDEP	L	\$\$\$



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		3-1d: Institute groundwater protections/mitigation where needed			
	<b>WS 3-2</b>	<p><b><u>Continue to monitor water use trends.</u></b></p> <p><b>METRIC:</b> Availability of current database of water use trends for the Barnegat Bay watershed</p> <p><b>MILESTONES:</b>          3-2a: Maintain or, if necessary, expand upon collection of water use data</p> <p>3-2b: Periodically evaluate trends</p> <p>3-2c: Publish results to inform water supply planning and conservation programs</p>	NJDEP	L	\$\$\$
	<b>WS 3-3</b>	<p><b><u>Continue, and if possible expand, stream flow monitoring throughout the watershed to assess the effects of changing precipitation patterns, water use and development.</u></b></p> <p><b>METRIC:</b> Number of stream gauging stations in the Barnegat Bay watershed</p> <p><b>MILESTONES:</b>          3-3a: Maintain existing gauging stations</p>	USGS, NJDEP	L	\$\$\$\$

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		<p>3-3b: Identify areas where new stations, either temporary or permanent, would provide beneficial data and secure funding for installation and maintenance</p> <p>3-3c: Publish gauging station data on USGS website consistent with current practice, including a monthly summary of freshwater flows to the bay</p>			
	WS 3-4	<p><b><u>Assess water-supply trends and effects of current and projected surface and groundwater withdrawals</u></b></p> <p><b>METRIC:</b> Number of completed assessment reports on the effects of existing and projected water withdrawals</p> <p><b>MILESTONES:</b>          3-4a: Develop current and projected water withdrawal estimates          3-4b: Identify and address data gaps          3-4c: Evaluate trends and effects (ecological, social, etc.) at appropriate spatial scales, from local to watershed-wide</p>	NJDEP, USGS	M	\$\$\$
4. Review existing literature/successful pilots and conduct studies to improve scientific					

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<p><b>understanding of new and emerging issues pertaining to water conservation, advanced potable treatment options, and reuse</b></p>					
	<p><b>WS 4-1</b></p>	<p><b><u>Identify infrastructure, research and piloting options for the use of advanced treatment at wastewater treatment plants and water reuse, including wastewater and gray water, within the watershed.</u></b></p> <p><b>METRIC:</b> Completed report on advanced wastewater treatment and reuse options</p> <p><b>MILESTONES:</b>          4-1a: Identify possible applications of advanced wastewater treatment and water reuse in the watershed, drawing from available literature          4-1b: Identify and address, where possible, data/information gaps and barriers to implementation          4-1c: Identify specific sites for pilot/research projects and corresponding infrastructure improvement needs and budgetary cost estimates</p>	<p>EPA, USGS, NJDEP, OCUA</p>	<p>S</p>	<p>\$\$</p>

	<b>WS 4-2</b>	<p><b><u>Conduct research on the effects of sea level rise, salt water intrusion, and deicer/chloride on regional water supply and ecology.</u></b></p> <p><b>METRIC:</b> Completed report(s) documenting threats and mitigation options</p> <p><b>MILESTONES:</b>          4-2a: Identify areas of vulnerability and existing or potential water quality impairment          4-2b: Identify research questions          4-2c: Secure funding, conduct research and report findings</p>	EPA, USGS, NJDEP, BTMUA, OCUA, BBP		
<b>5. Educate consumers regarding water supply issues and indoor/outdoor water conservation and reuse</b>					
	<b>WS 5-1</b>	<p><b><u>Promote water reuse demonstration projects for stormwater, graywater and wastewater.</u></b></p> <p><b>METRIC:</b> Number of demonstration projects completed.</p> <p><b>MILESTONES:</b>          5-1a: Identify feasible demonstration projects</p>	EPA, NJDEP, Counties, Municipalities, MUAs, PPA	L	\$\$\$\$

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		<p>5-1b: Leverage existing programs, or create new ones, to complete demonstrations with appropriate public education and outreach</p> <p>5-1c: Periodically update list of what is feasible to incorporate advances in understanding/technology</p>			
	<b>WS 5-2</b>	<p><b><u>Disseminate educational materials related to best practices for water conservation activities.</u></b></p> <p><b>METRIC:</b> Number of materials distributed, people reached, and/or conservation improvements made</p> <p><b>MILESTONES:</b>          5-2a: Inventory available education materials and develop new materials, as necessary</p> <p>5-2b: Distribute materials to the public and incorporate into existing programs</p> <p>5-2c: Evaluate effectiveness and revise program, as necessary</p>	USEPA WaterSense, NJDEP, BBP, Utilities	S	\$
	<b>WS 5-3</b>	<p><b><u>Develop program to educate stakeholders on the source and value of their water.</u></b></p> <p><b>METRIC:</b> Completion and implementation of program</p> <p><b>MILESTONES:</b></p>	NJDEP, BBP, Utilities, PPA (Save the Source Campaign), USEPA WaterSense	S	\$

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		<p>5-3a: Inventory available education materials and develop new materials, as necessary</p> <p>5-3b: Develop education strategy</p> <p>5-3c: Implement program, evaluate effectiveness and revise, as necessary</p>			
	<b>WS 5-4</b>	<p><b><u>Implement components of the BBP Communications Plan related to water supply protection.</u></b></p> <p><b>METRIC:</b> Water supply protection components being implemented</p> <p><b>MILESTONES:</b>          5-4a: Identify components and whether revisions/updates are necessary</p> <p>5-4b: Leverage partners to carry out implementation</p>	<p>BBP, Save Barnegat Bay, NJDEP, JC NERR,</p>	\$	\$

## Chapter 6 – LIVING RESOURCES GOALS, OBJECTIVES and ACTIONS

### Highlights

- The Barnegat Bay ecosystem is comprised of a wide diversity of habitats, from submerged aquatic vegetation to low-lying coastal and freshwater wetlands, to uplands of pine and oak forests.
- The protection and/or restoration of priority habitats serves as a means of improving water quality, protecting water supplies, and ensuring the necessary spaces for fish and wildlife.

### 6.1 Goal

To protect, restore, and enhance habitats in the Barnegat Bay and its watershed as well as ensuring healthy and sustainable natural communities of plants and animals both now and in the future.

Living Resources Objectives:

1. Develop and implement Habitat Protection and Restoration Plans for ecologically sensitive habitats
2. Restore and maintain sustainable populations of fish and wildlife
3. Monitor and assess status and trends of living resources throughout the watershed.
4. Conduct studies to improve scientific understanding of living resources and ecologically sensitive habitats.
5. Increase education and public outreach related to habitats and living resources

### 6.2 Introduction

Natural ecological systems are composed of both physical habitats and the organisms that dwell within them. Estuarine habitats and the living resources they shelter - at the intersection of freshwater and marine waters - prove the most dynamic and complex ecosystems to study, maintain, and manage. This is due to the daily, monthly, and seasonal fluctuations in physical conditions such as tide, salinity, and dissolved oxygen, as well as the complex life histories of the resident and migratory populations of fish, shellfish, and wildlife that shelter, breed, and feed within the estuary.

The Barnegat Bay watershed is composed of eleven rivers and streams that empty into the Barnegat Bay-Manahawkin Bay-Little Egg Harbor estuary including a continuum of overlapping and interdependent habitats extending from upland forests through freshwater streams and lakes, through

tidal wetlands and salt marshes, to small tidal embayments and the bay proper. The estuarine habitats of Barnegat Bay include barrier beaches and dunes, submerged aquatic vegetation beds, intertidal sand and mudflats, salt marsh islands, fringing tidal salt marshes, freshwater tidal marsh, and palustrine wetlands. These habitats also support a multitude of environmentally sensitive living resources including shellfish beds, waterfowl nesting grounds, and finfish nurseries.

The following habitats were identified as the highest priority for action.

### **Forested Areas**

Nearly 40% of the land area of the Barnegat Bay watershed is classified as upland forest, including the western portion of the watershed that lies within the Pinelands Area containing the Pine Barrens ecosystem and hard wood and cedar swamps. . The Pine Barrens include nearly contiguous stands of pure pitch pine (*Pinus rigida*), mixed pine species stands, pine-oak stands, and finally mixed oak stands. While not entirely undeveloped, the Pine Barrens are one of the few comparatively “natural” landscapes remaining on the eastern seaboard. The pitch pine dominated forests are fire-dependent; they have developed adaptations that allow them to recover quickly from fire events and outcompete hardwood species for space and light. The changes in fire regime associated with human development and fire control are thought to be contributing to the transition from pine to oak-dominated forests in the region. Forest area within the watershed is typically lost due to conversion to agricultural or suburban land use. The southern pine beetle (*Dendroctonus frontalis*), a destructive beetle common in the southeastern US, was found within the Pine Barrens in 2010, and poses a significant threat to pine trees.

### **Freshwater Wetlands**

The Barnegat Bay watershed has approximately 67,000 acres of freshwater wetlands, comprised of emergent, scrub-shrub, and forested types. Generally found at low points in the landscape, these wetlands can be fed from ground water sources, or are located adjacent to rivers, streams, and creeks. Freshwater wetlands act as “natural sponges”, holding excess flood water and filtering nutrients that might otherwise end up in our waterways and the bay. They are also home to a wide variety of wildlife, including some of our more well-known threatened and endangered species, such as the Pine Barrens tree frog (*Hyla andersonii*) and swamp pink (*Helonias bullata*). Freshwater wetland loss within the watershed is typically associated with human development of the land, either for agricultural or residential purposes. Reductions in groundwater flow is also of concern for wetlands in more developed areas of estuary.

### **Coastal Wetlands**

Salt marshes are among the most productive habitats in the world and perform a wide variety of vital ecosystem services. They buffer inland areas from tidal and storm damage, store water to protect against flooding, serve as important spawning and nursery habitats for valuable fishery species and other wildlife, including waterfowl, trap pollutants and help sustain water quality, support recreation, and provide aesthetic value. Salt marshes are clearly critical to the overall ecology of Barnegat Bay. A 2012 study valued the ecosystem services of saltwater wetlands in Barnegat Bay at \$155 million per



year. Salt marshes within the Barnegat Bay estuary are dominated by salt marsh grasses such as salt marsh cordgrass (*Spartina alterniflora*), salt hay (*Spartina patens*), and salt marsh spike grass (*Distichlis spicata*). Marshes fringe a majority of the bay, consisting of back barrier marshes, as well as expansive tracts of marshes adjacent to the landward side on the western edge of the bay. However, salt marshes are being lost at an accelerating rate. Possible reasons for the losses include erosion from boat traffic, wind-generated wave energy, sea level rise, or human alteration of the landscape that was originally delineated as wetlands.

While a majority of the coastal wetlands in the Barnegat Bay consist of salt marshes, also present are Atlantic white cedar (*Chamaecyparis thyoides*) stands. Atlantic white cedar stands can be found in the riparian zones immediately adjacent to freshwater streams and swamps, primarily in the portion of the watershed containing the Pinelands Area.

They help maintain the productivity of wetland communities, provide habitat for wildlife and plant life, including threatened and endangered species, and add to the diversity within the watershed. Once common throughout the region, white cedar populations are in decline due to loss of habitat, wildfire, deer browsing, salt water inundation, and illegal harvesting.

#### **Submerged Aquatic Vegetation**

Seagrasses serve as habitat and food for many recreationally and commercially important estuarine and marine species (e.g., bay scallop [*Argopecten irradians*], blue mussel [*Mytilus edulis*], blue crab [*Callinectes sapidus*], and weakfish [*Cynoscion nebulosus*]). Seagrass beds also play a significant role in nutrient cycling, carbon sequestration, filtering of essential elements, and wave dampening. In addition, seagrasses are excellent indicators of water and sediment quality as they indicate changes in water quality and benthic attributes. Seagrasses also play an important role in sediment stabilization, which is of particular importance in the southern portions of Barnegat Bay where there is higher turbidity as seagrass populations have declined. Seagrasses are impacted by water nutrient levels, elevated water temperatures, ice scouring, damage from boat props and anchors, disease and light intensity fluctuations caused by dredged or storm-tossed sediments, and algal blooms or overgrowth. By assessing the condition of seagrass beds over time, it is possible to establish accurate trends in estuarine condition. Within Barnegat Bay, eelgrass (*Zostera marina*) dominates the seagrass beds south of Toms River, while mixed eelgrass and widgeon grass (*Ruppia maritima*) beds are found in the central and northern portions of the bay. The difference reflects different and changing conditions in parts of the bay. Although the ecological roles of both of these species are not entirely recognized and may differ somewhat, both are considered desirable.

An additional concern is the potential effects of climate change and sea level rise on the Barnegat Bay ecosystem. A report published by the Union of Concerned Scientists summarized the potential impacts

of climate change on New Jersey<sup>42</sup>. They noted that “spring is arriving earlier, summers are growing hotter, and winters are becoming warmer and less snowy.” Average temperatures across the northeast have risen more than 1.5 degrees Fahrenheit (°F) since 1970 with a 20 to 30 percent increase in winter precipitation<sup>43</sup>. The frequency and severity of heavy rainfall events is expected to increase, as well as an increase in the frequency of short-term droughts. In addition, under these projections, New Jersey’s densely populated coast faces substantial increases in the extent and frequency of coastal flooding, erosion, and property damage.

### **Sustaining the ecological integrity of the estuary**

Healthy estuaries ensure the survival of many species of fish, birds, mammals and reptiles<sup>44</sup>. They provide vital nesting and feeding habitats as well as maintaining a healthy environment by filtering out sediments and pollutants from rivers and streams. Some organisms like hard clams and oysters live year-round in the estuaries, whereas, others like horseshoe crabs and striped bass use them to complete a small part of their life cycle. Estuaries also provide stopovers for migratory bird species such as snow geese and mallard ducks. In addition to providing shelter and food for living resources, estuaries deliver important ecosystem services.

Ecosystem services are fundamental life-support processes upon which all organisms depend<sup>45</sup>. One of the common ecosystem services supplied by estuaries include water filtration. For example, salt marshes filter and remove pollutants from the water such as herbicides, pesticides, and heavy metals as well as excessive sediments and nutrients. A recent salt marsh sedimentation in Barnegat Bay study showed that a significant amount of nitrogen (79 %) and phosphorus (54 %) runoff from upland sources (e.g., fertilizer, storm water) were trapped in the marsh sediments<sup>46</sup>. Removing these excess nutrients reduces the effects of eutrophication on the surrounding bay waters (i.e., harmful algal blooms, anoxia, and fish kills). Another ecosystem service that coastal wetlands play is habitat protection. Wetlands not only protect birds and fish from physical harm but also people. Not only do salt marshes act as buffers to stabilize shorelines and protect sensitive natural habitats (e.g., bird nesting and fish breeding areas), but they also protect human communities from floods and storm surges.

### **Sustaining commercial/recreational fisheries and wildlife resources**

Estuaries provide habitat for more than 75 percent of the U.S. commercial fish catch, and an even greater percentage of the recreational fish catch<sup>47</sup>. Estuaries are also important recreational areas. Millions of people visit estuaries each year to boat, swim, watch birds and

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<sup>42</sup>UCS 2007 -

[https://www.ucusa.org/sites/default/files/legacy/assets/documents/global\\_warming/pdf/confronting-climate-change-in-the-u-s-northeast.pdf](https://www.ucusa.org/sites/default/files/legacy/assets/documents/global_warming/pdf/confronting-climate-change-in-the-u-s-northeast.pdf)

<sup>43</sup> Add citation

<sup>44</sup> USEPA 1993

<sup>45</sup> Daily et al., 1997

<sup>46</sup> Velinsky et al 2017

<sup>47</sup> National Safety Council’s Environmental Center, 1998

other wildlife, and fish. In fact, a recent NJDEP study on valuing New Jersey's natural capital, found that wetlands and marine ecosystems supply the highest eco-service values; and that the annual value of the goods provided by New Jersey's natural capital is estimated to be \$2.8 - \$9.7 billion. Overall the study concluded that estuarine commercial-recreational use of the natural resources along with wildlife-related tourism plays a significant role in New Jersey's economy<sup>48</sup>.

Underpinning this natural capital are the environmentally sensitive habitats that fish, birds and wildlife use to sustain their populations. However, many of these habitats are at risk, such as seagrass beds. For example, seagrass beds and other types of submerged aquatic vegetation (SAV) support many commercially, recreationally, and ecologically important shellfish and finfish species. Larvae and juveniles of many important commercial and sport fish such as bluefish (*Pomatomus saltatrix*), summer flounder (*Paralichthys dentatus*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), herrings (Clupeidae) and many others appear in eelgrass beds in the spring and early summer<sup>49</sup>. Studies from the lower Chesapeake Bay found that SAV beds are important for the brooding of eggs and for fishes with demersal eggs and as habitat for the larvae of spring-summer spawners such as anchovies (*Anchoa* spp.), gobies, (*Gobiosoma* spp.), weakfish (*Cynoscion regalis*), silver perch (*Bairdiella chrysoura*)<sup>50</sup>. Heckman and Thoman<sup>51</sup> concluded that SAV beds are also important nursery habitats for blue crabs (*Callinectes sapidus*). According to Peterson<sup>52</sup> and Kenworthy<sup>53</sup> shallow dwelling hard clams (*Mercenaria mercenaria*) may be protected from predation by the rhizome layer of seagrass beds.

In addition, SAV, like the grass in a meadow, serve as the base of the food web supplying food to grazers and energy to the entire ecosystem. Approximately 75% (6000 ha) of the seagrass beds in New Jersey occur in the Barnegat Bay Estuary<sup>54</sup>. Unfortunately, major declines in biomass and percent SAV cover have been reported in some sectors of the estuary since the 1970s<sup>55</sup>. A more recent study revealed an ongoing decline in biomass and percent cover of bay bottom<sup>56</sup> attributed to increasing eutrophication due to shading of the shallow SAV beds by

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<sup>48</sup> NJDEP 2007 <http://www.nj.gov/dep/dsr/naturalcap/nat-cap-1.pdf>

<sup>49</sup> Fonseca et al 1992

<sup>50</sup> (Stephan and Bigford 1997)

<sup>51</sup> Heckman and Thoman (1984)

<sup>52</sup> Peterson (1982)

<sup>53</sup> Kenworthy (1988)

<sup>54</sup> (Fertig et al., 2014)

<sup>55</sup> (Bologna, Wilbur, and Able 2001; Lathrop and Bogner, 2001; Lathrop et al., 2001)

<sup>56</sup> (Kennish, Haag, and Sakowicz, 2010)

algal blooms and attached microalgae on the stems. Additionally, the composition of seagrass beds in the bay appear to be changing, which can affect the ecosystem services provided.

**Effects of depletive land uses on the ecological functions of estuarine habitats (e.g., deforestation, wetland in-filling, bulkheading, etc.)**

The watershed has experienced rapid development over past decades, especially in the northern reaches of the bay. Over the past several decades, the population in Ocean County has increased over 175% from 1970 to 2017. Land-use changes between 1986 and 2017 reveals an increase in urban land of 12.4% and 14.1% in the Toms River and Metedeconk River watersheds, respectively. Percentage increases in urban land among the other freshwater watersheds evaluated range from 0.3% to 9.4%. This urbanization has largely occurred in upland forest and wetlands, converting them into developed landscapes. This rapid human development of the shoreline and the watershed is associated with environmental consequences, including increased nutrient loading and a higher percentage of impervious surface, which in turn increases surface runoff and the transport of pollutants to the estuary. Bulkheading severely limits the bay's connection to the uplands and eliminates areas that could become marsh as sea level rises. The effects of these land use changes on the functioning of the ecosystem can be severe.

**Effects of depletive land uses (e.g., deforestation, wetland in-filling, bulkheading, etc.) on the populations of shellfish and wildlife in the watershed.**

The Barnegat Bay estuary has historically supported high rates of primary production and large stocks of the commercially valuable hard clam and oyster, although a marked historical decline of stocks has been observed<sup>59</sup>. Although over-fishing cannot be ruled out as a primary factor in this decline, several other possible causes have been suggested, including a shift in food availability to lower quality sources associated with increased eutrophication, and the reduced ability of young clams and oysters to successfully survive their first year due to poor habitat. Human activity may also impact hard clam populations via physical disturbance, caused by dock construction, dredging, and boat scarring.<sup>60</sup>

Additionally, a recent Barnegat Bay study showed that the bay nettle (*Chrysaora chesapeakei*) jellyfish populations have been on the increase for many years and might be expanding their range toward the southern end of the bay<sup>61</sup>. This may be due the increase in hard, untreated structures across the bay (e.g., bulkheads, plastics, docks, etc.) that the adult forms need for attachment.

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<sup>57</sup> U.S. Census Bureau, 2010

<sup>58</sup> NJDEP Bureau of Geographic Information System, 2016

<sup>59</sup> see Bricelj, Kraeuter, and Flimlin, 2017

<sup>60</sup> Lathrop and Haag, 2011

<sup>61</sup> Bologna et al., 2017; Gaynor et al., 2017

The reduction in forested area within the watershed also has adverse effects on terrestrial and aquatic wildlife. There is the obvious loss of habitat and food sources for species that depend on trees and tree products. But there are also indirect adverse effects, such as the change in stream temperatures due to the loss of riparian shading, or increased stream and bay turbidity due to increased erosion.

**Climate Change and Sea Level Rise impacts on habitats and natural populations of fish and wildlife.**

Climate change and sea level rise can have significant impacts on habitats and natural populations of fish and wildlife. These changes will stress both the natural and managed ecosystems in Barnegat Bay and should be taken into consideration for any reassessments of the many wildlife and forest management plans and strategies currently in place.

Empirical data from Barnegat Bay supports these concerns. Marshes must be replenished naturally with sediments transported onto the surface by tides or else succumb to erosion or subsidence. A recent salt marsh study in Barnegat Bay<sup>62</sup>, showed that sedimentation rates were barely keeping up with the measured rate of sea-level rise recorded by nearby tide gauges. This relatively low rate of accretion renders the marshes in Barnegat Bay vulnerable to inundation and erosion should the rate of sea-level rise accelerate in the future. In addition, a recent study of water-quality data from the 1970s through 2013, to determine if significant changes and trends occurred over decadal spans, showed increasing trends for temperature and salinity<sup>63</sup>. This may be due to increasingly warmer summers (i.e., climate change) and sea level rise (i.e., salt water intrusion).

In the face of these trends, a management strategy for protecting natural ecosystems and living resources beyond their current condition, and in keeping with climate change and sea level rise predictions, is in order.

**LIVING RESOURCE TRENDS**

**Wetland area**

There were approximately 22,795 acres of tidal wetlands and 67,034 acres of freshwater wetlands within the Barnegat Bay watershed in 2012. This represents a loss of 238 acres of tidal wetland area and 284 acres of freshwater wetland area since 2007. The rate of tidal wetland loss has been increasing over the past 20 years, while that of freshwater wetland loss has been decreasing<sup>64</sup>. The Barnegat Bay Watershed is also faced with the challenges of the vertical loss of wetlands due to subsidence, flooding and vegetation loss due to scouring, and the horizontal loss of shorelines and inter-tidal habitat replaced by bulkheading.

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<sup>62</sup> Velinsky et al 2017

<sup>63</sup> Goodrow et al 2017

<sup>64</sup> Barnegat Bay Partnership 2016

### **SAV**

A comprehensive evaluation and delineation of SAV beds has not been performed since 2009, when they covered approximately 14% of the estuarine bottom. From a bay-wide perspective, eelgrass biomass reached its lowest level in 2009, and though the 2015 levels were encouraging, they do not represent a statistically significant improvement from the lows of the late 2000's<sup>65</sup>.

### **Open space**

Between January 1, 2010 and September 30, 2015, approximately 11,114 acres in the Barnegat Bay watershed were acquired by federal, state, county, local, and non-governmental agencies, bringing the total acreage of publicly-owned land to over 141,935 acres<sup>66</sup>.

### **Hard clam population**

Bay-wide surveys for hard clams conducted in 2011 (Little Egg Harbor) and 2012 (Barnegat Bay) estimated a standing stock of approximately 224 million clams. Overall, the abundance of hard clams in Barnegat Bay in 2012 was down approximately 23% from the last survey completed in 1985/1986. For Little Egg Harbor, the overall abundance in 2011 was down approximately 57% compared with the 1985/1986 survey. However, the abundance of hard clams in Little Egg Harbor increased 32% between 2001 and 2011<sup>67</sup>.

### **Fish communities**

Estuarine fish communities in Barnegat Bay have a typical diversity of species, with no substantial changes in diversity across the regions of the bay or sampling period for 2010-2015<sup>68</sup>. However, recent studies are showing a trend of southern species moving north, indicating a change in the natural range of some species likely attributable to climate change<sup>69</sup>.

## **6.3 Objectives**

Until a few decades ago, many estuarine wetland areas were drained and converted into uplands for development whereas bay bottoms were filled or dredged to facilitate human uses thereby decreasing the productivity of these important habitats. Since then environmental laws and regulations have come into existence, which slowed this destructive process. However, there is still a need to sustain both terrestrial and subaqueous estuarine habitats, such as forests, wetlands, and submerged aquatic vegetation. In addition, there is a need to assess habitat vulnerabilities from threats such as development, pollution, invasive species, sea level rise, storm surge, and drought.

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<sup>65</sup> Barnegat Bay Partnership 2016

<sup>66</sup> Barnegat Bay Partnership 2016

<sup>67</sup> Dacanay

<sup>68</sup> Barnegat Bay Partnership 2016

<sup>69</sup> Able et al. 2013

**Living Resources Objective 1. Develop and implement Habitat Protection and Restoration Plans for ecologically sensitive habitats.**

The Barnegat Bay ecosystem is comprised of a wide diversity of habitats, from submerged aquatic vegetation to low-lying coastal and freshwater wetlands, to uplands of pine and oak forests. The protection and/or restoration of priority habitats serves as a means of improving water quality, protecting water supplies, and ensuring the necessary spaces for fish and wildlife.

To maximize the efficient use of scarce resources in protecting and restoring these valuable habitats, it is necessary to develop Habitat Protection and Restoration plans. The first step in the creation of these Plans would include the compilation of existing data and maps; without knowing where the habitats are, and what their status is, it would be difficult to properly manage them. There will undoubtedly be information about these ecologically sensitive habitats that is missing, thus the acquisition of necessary data would be the second step. As the currently available and newly collected data is brought together, it will be entered into a web-accessible database that can be updated as new plans are formulated and habitat protection and restoration activities occur. Ideally, working together partners will develop a plan for protecting and managing habitats on a sub-watershed basis through coordination and collaboration across municipal boundaries. This includes the promotion of novel management strategies for ecologically sensitive areas. Over the course of the next 2 years, a comprehensive Habitat Protection/Restoration Strategy will be developed, taking into consideration the future potential risks associated with climate change and sea level rise (i.e., inundation, erosion, salinity change, drought, etc.).

**Living Resource Objective 2. Restore and maintain sustainable populations of fish and wildlife**

While protecting existing habitats and improving degraded ones will aid in the restoration and maintenance of populations of fish and wildlife, there are several specific actions that can be undertaken that will enhance the sustainability of these populations against future adverse impacts and climate change.

These specific actions include the development of a multi-use management plan for bay resources, the restoration of fish passage and riparian habitats, implementation and update of the New Jersey State Wildlife Action Plan, and the monitoring and management of invasive and nuisance species. The development of a multi-use management plan that supports aquaculture, commercial and recreational harvest, recreation, and restoration will help minimize user group conflicts within the bay. This planning process will also help us to envision what the bay may look like in the future. In addition, the restoration of fish passage and riparian habitats, as well as the creation of wildlife habitat corridors, will allow aquatic and terrestrial wildlife to move between habitats in a changing environment. Suitable passage corridors, be they rivers and streams, or forests and fields, ensure that fish and wildlife can access the habitats they need for the different stages of their life history. The BBP will also participate in the implementation and periodic update of the New Jersey State Wildlife Action Plan, which provides the linkages between watershed, statewide, and regional approaches to managing our wild resources.

Lastly, the monitoring, management, and control of invasive and nuisance species, through ecologically appropriate methods, will give our plants and wildlife the space they need to rebuild.

**Living Resource Objective 3. Monitor and assess status and trends of living resources throughout the watershed**

Without appropriate monitoring, it will be difficult to tell if our restoration and protection efforts are working, and if not, what steps should be taken to get back on track. To this end, several monitoring actions related to the distribution and function of key habitat (e.g., SAV, coastal wetlands, riparian and tidal buffers) and the abundance of wildlife (i.e., commercially, recreationally, and ecologically important aquatic species, pollinator and migratory species, threatened and endangered species) are proposed. The assessment of the ecological impact(s) associated with the closure of Oyster Creek Nuclear Generating Station is also included within this Objective.

In order to determine if we are meeting our ecosystem goal related to SAV, it will be necessary to assess their distribution and abundance through coordinated, regular surveys. These surveys would be done via aerial assessment of the SAV bed size and locations, as well as on-the-ground demographic assessments of bed condition to evaluate their structure and function. The same is true of coastal wetlands, which are currently monitored by the BBP and our partners through the Mid Atlantic Coastal Wetlands Assessment program (MACWA). Continuation of this program will allow us to evaluate our progress in protecting and restoring this vital habitat.

**Living Resource Objective 4. Conduct studies to improve scientific understanding related to living resources and ecologically sensitive habitats**

To develop the appropriate habitat and living resources protection, restoration, and management plans described above, it is imperative that the interactions between living resources and their habitats is understood, and how they both might respond to any management changes undertaken, or their response to climate change. This understanding should be based in and supported by scientific studies, such as the identification and documentation of appropriate mechanisms and strategies to support restoration of sensitive habitats; the assessment of stream connectivity throughout the watershed; and the documentation of the life history and ecology of key living resources.

While the means to effectively restore many terrestrial habitats is well known, the restoration of subtidal (SAV) and intertidal (coastal wetland) habitats is still relatively new. Different restoration techniques and styles will need to be tested and verified to determine the best way to move forward with limited restoration funds. We will also need to identify and prioritize those waterways that are limiting fish passage, and therefore connectivity, before we begin to design and implement restoration actions, so that we target those with the biggest opportunities for improvement. Lastly, we need to know how the fish and wildlife species we are targeting for protection and restoration may respond to our actions, and the future impacts of climate change, to ensure that the activities we undertake will have a positive result.



**Living Resource Objective 5. Increase education and public outreach related to habitats and living resources.**

Sharing information and educating the public will ensure that watershed residents and visitors understand and support the previously mentioned Objectives and Actions, as well as whether they are met. This will be accomplished through a suite of outreach activities focusing on the following areas: science-based decision-making; habitat and living resource restoration activities; the functional role of critical bay habitats and the early life stages of estuarine species; the impacts of climate change on the living resources of the bay; and regulations and best practices for responsible use of ecologically sensitive areas.

At times there seems to be a disconnect between how science is used in habitat and living resource protection and restoration, and how the public perceives how it is used. It is critical that the public understands the important role that science plays in informing decisions related to habitat and living resources, and that they support the use of the best available information. Similarly, an educated public is in a better position to make wise choices regarding the protection of living resources held in the common trust, or how their actions impact the natural environment.

**6.4 Previous Successes**

Despite the challenges that habitat and living resources within the Barnegat Bay watershed face, there have been several successes over the past several years.

- **Preserved Open Space** – Through a variety of public and private partnerships, open space preservation continues throughout the watershed, with more 20,000 acres protected over the past ten years, 11,000 of those from 2011-2016. In addition, and thanks to cooperation between the BBP and USDA Natural Resource Conservation Service, there is now a map of the soils that lie at the bottom of the bay to guide future seagrass and shellfish restoration efforts.
- **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 management. 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<sup>70</sup>.

- **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 2017, 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 most responsive habitat types 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 was 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 protecting and enhancing wetlands on a long-term basis.

Over the last few years, BBP has partnered with the Partnership for the Delaware Estuary (PDE) to work cooperatively to establish an integrated wetlands monitoring and assessment network in New Jersey. The monitoring project utilizes the United States Environmental Protection Agency’s (USEPA) three-tier wetlands guidance for the development of a 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 XX number of continuously monitored sites XX number are in the Barnegat Bay Watershed. The BBP and the PDE are working closely with the NJDED, USEPA Region 2, US Fish and Wildlife Service and other partners.

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<sup>70</sup> <http://www.nj.gov/dep/barnegatbay/docs/poster.pdf>

**6.5 Objectives and Actions for Sustainable Living Resources in the Barnegat Bay Watershed**

- Timeframe – The timeframe from adoption of the CCMP in which the action should be completed. Short (S) indicates a completion within 1-2 years, Medium (M) actions are completed within 3-5 years, and Long (L) actions take 5 or more years. On-going actions are considered Long.
- Costs – The anticipated costs for the action: \$ < \$100,000, \$\$ \$100,000 - \$500,000, \$\$\$ \$500,000 - \$1,000,000, \$\$\$\$ > \$1,000,000.

<b>Goal - To protect, restore and enhance habitats in the Barnegat Bay and its watershed to ensure healthy and sustainable natural communities of plants and animals now and in the future</b>					
<b>LR Objectives</b>	<b>LR Action ID</b>	<b>CCMP Action</b>	<b>Lead Partner (s)</b>	<b>Time-frame</b>	<b>Costs</b>
<b>1. Develop and implement Habitat Protection and Restoration Plans for ecologically sensitive habitats</b>					
	<b>LR 1-1</b>	<p><b><u>Compile existing data and maps; determine and collect missing data for ecologically sensitive habitats and associated buffers.</u></b></p> <p><b>METRICS:</b> The number of complete maps of ecologically sensitive areas</p> <p><b>MILESTONES:</b></p> <p>1-1a – Identify relevant ecologically sensitive areas</p> <p>1-1b – Compile existing maps and data</p> <p>1-1c – Collect missing data</p> <p>1-1d – Update and publish mapping</p>	NJDEP*, Pinelands Commission	S	\$

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	<b>LR 1-2</b>	<p><b><u>Develop and implement conservation/restoration plans for ecologically sensitive terrestrial, coastal and aquatic habitats.</u></b></p> <p><b>METRICS:</b> The acreage of ecologically sensitive areas conserved/restored</p> <p><b>MILESTONES:</b>          1-2a – Develop conservation/restoration plans          1-2b – Identify funding sources and procure funds where needed          1-2c – Implement plans          1-2d – Assess implementation and conduct adaptive management</p>	NJDEP*, USFWS	L	\$\$\$
	<b>LR 1-3</b>	<p><b><u>Create a web-accessible database of habitat protection and restoration activities.</u></b></p> <p><b>METRICS:</b> A complete, web-accessible database</p> <p><b>MILESTONES:</b>          1-3a – Compile existing information from partners and agencies          1-3b – Develop web-based database          1-3c – Publish database</p>	BBP, NJDEP, USFWS, Counties	S	\$
	<b>LR 1-4</b>	<p><b><u>Encourage the protection and management of habitats on a sub-watershed basis through coordination and collaboration across municipal boundaries.</u></b></p> <p><b>METRICS:</b> The acreage of habitat managed across municipal boundaries</p> <p><b>MILESTONES:</b></p>	BBP, Counties, Municipalities	M	\$

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		1-4a – Identify sensitive habitat areas crossing municipal borders (see 1-2) 1-4b – Meet with municipal officials/planners/engineers  1-4c – Develop cross-border management plans			
	<b>LR 1-5</b>	<b><u>Promote management of ecologically sensitive and other target areas.</u></b>  <b>METRICS:</b> The number of acres under active conservation management  <b>MILESTONES:</b> 1-5a – Identify currently owned sensitive areas not actively managed  1-5b – Develop and implement parcel specific management plans	NJDEP*, USFWS, NJMTA, PPA, Land Conservancies,	L	\$\$
<b>2. Restore and maintain sustainable populations of fish and wildlife</b>					
	<b>LR 2-1</b>	<b><u>Develop a bay-wide multi-use management plan that supports sustainable aquaculture, commercial and recreational harvest, recreation, and restoration.</u></b>  <b>METRICS:</b> A bay-wide multi-use management plan for Barnegat Bay resources  <b>MILESTONES:</b> 2-1a – Create a plan development process  2-1b – Hold stakeholder meetings  2-1c – Integrate existing data and stakeholder comments  2-1d – Publish final plan	NJDEP*, BBP, RCE, NJSGC,	M	\$\$

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	<b>LR 2-2</b>	<p><b><u>Restore fish passage and other riparian habitats to improve habitat quality and connectivity.</u></b></p> <p><b>METRICS:</b> The number of river miles reconnected/number of fish passage barriers removed/improved. The acreage of riparian habitats improved/restored.</p> <p><b>MILESTONES:</b>          2-2a – Identify barriers to fish passage and riparian habitats in need of improvement          2-2b – Develop plan(s) for passage/habitat improvement          2-2c – Identify funding source(s) for activities          2-2d – Implement improvement plans</p>	BBP, NOAA, NJDEP, USFWS, NJDOT	L	\$\$\$
	<b>LR 2-3</b>	<p><b><u>Participate in the implementation and periodic update of the New Jersey State Wildlife Action Plan.</u></b></p> <p><b>METRICS:</b> The number of SWAP projects/actions completed in the watershed</p> <p><b>MILESTONES:</b>          2-3a – Identify applicable projects within the SWAP          2-3b – Identify resources required for implementation          2-3c – Implement plans</p>	NJDEP, BBP	L	\$\$
	<b>LR 2-4</b>	<p><b><u>Create and restore wildlife corridors for habitat quality and connectivity.</u></b></p> <p><b>METRICS:</b> Acreage of wildlife corridors created/restored</p> <p><b>MILESTONES:</b>          2-4a – Identify potentially suitable areas for acquisition /restoration</p>	TPL, USFWS, Counties	L	\$\$\$\$

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		2-4b – Develop restoration/acquisition plans 2-4c – Implement plans			
	<b>LR 2-5</b>	<b><u>Monitor, manage, and control invasive and nuisance species through ecologically appropriate methods</u></b>  <b>METRICS:</b> Reduction in amount of invasive and nuisance species  <b>MILESTONES:</b> 2-5a – Identify invasive/nuisance species 2-5b – Prioritize management activities 2-5c – Implement management activities 2-5d – Assess outcomes and conduct adaptive management	NJDEP, USFWS, BBP	L	\$\$\$
<b>3. Monitor and assess status and trends of living resources throughout the watershed.</b>					
	<b>LR 3-1</b>	<b><u>Assess distribution and abundance of SAV through coordinated, regular surveys to evaluate their structure and function.</u></b>  <b>METRICS:</b> Completion of distribution and demographic surveys  <b>MILESTONES:</b> 3-1a – Develop regularly scheduled survey protocol and identify stable funding source 3-1b – Conduct aerial survey 3-1c – Conduct demographic surveys	NJDEP*, BBP, Stockton University	L	\$\$

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	<b>LR 3-2</b>	<p><b><u>Continue the ongoing Mid Atlantic Coastal Wetlands Assessment program (MACWA) to evaluate the condition and function of wetlands.</u></b></p> <p><b>METRICS:</b> Completion of annual MACWA activities</p> <p><b>MILESTONES:</b>          3-2a – Coordinate annual field activities          3-2b – Conduct fieldwork and data analysis          3-2c – Prepare annual and multi-year reports</p>	BBP, NJDEP*, EPA	L	\$\$\$
	<b>LR 3-3</b>	<p><b><u>Update and/or complete mapping of riparian and tidal wetlands buffers to evaluate and monitor status and health</u></b></p> <p><b>METRICS:</b> A current map of riparian and tidal wetland buffers</p> <p><b>MILESTONES:</b>          3-3a – Evaluate current mapping for deficiencies          3-3b – Utilize existing data or collect new data to address deficiencies          3-3c – Publish updated mapping</p>	NJDEP*	S	\$
	<b>LR 3-4</b>	<p><b><u>Continue to monitor and assess the status of commercially, recreationally, and ecologically important aquatic species.</u></b></p> <p><b>METRICS:</b> Population status information available for fish and shellfish species.</p> <p><b>MILESTONES:</b>          3-4a – Evaluate data collection activities for important species, and modify if necessary</p>	NJDEP*, NOAA, BBP, Stockton University	L	\$\$\$



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		3-4b – Collect, analyze, and publish data			
	<b>LR 3-5</b>	<p><b><u>Monitor and assess target animal and plant species, such as pollinator and migratory species, threatened and endangered species, and plant communities of special importance (see Habitat Plan)</u></b></p> <p><b>METRICS:</b> Population status information available for target species</p> <p><b>MILESTONES:</b>          3-5a – Evaluate data collection activities for important species, and modify if necessary</p> <p>3-5b – Collect, analyze, and publish data</p>	NJDEP, Pinelands Commission, USFWS,	L	\$\$\$
	<b>LR 3-7</b>	<p><b><u>Monitor and assess the impact of the closure of the Oyster Creek Nuclear Generating Station on living resources in the Barnegat Bay.</u></b></p> <p><b>METRICS:</b> A final report on the ecosystem effects of the OCNGS closure</p> <p><b>MILESTONES:</b>          3-7a – Develop monitoring plan          3-7b – Collect and analyze data          3-8c – Write final report and recommendations</p>	NJDEP*	L	\$\$
<b>4. Conduct studies to improve scientific understanding of living resources and ecologically sensitive habitats.</b>					
	<b>LR 4-1</b>	<p><b><u>Conduct studies that identify and document appropriate mechanisms and strategies to support restoration of ecologically sensitive habitats identified in Obj. 1.</u></b></p>	NJDEP*, NJS GC, BBP, Stockton University	L	\$\$\$

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		<p><b>METRICS:</b> The number of completed studies, including recommendations</p> <p><b>MILESTONES:</b>          4-1a – Determine area(s) of need and develop study plan(s)          4-1b – Collect and analyze data          4-2b – Prepare recommendations and distribute to practitioners</p>			
	LR 4-2	<p><b><u>Identify and assess habitat suitability, connectivity, and barriers to fish passage (e.g. North Atlantic Aquatic Connectivity Collaborative approach.)</u></b></p> <p><b>METRICS:</b> The number of connectivity/passage assessments conducted at potential stream barriers</p> <p><b>MILESTONES:</b>          4-2a – Identify potential barriers to fish passage          4-2b – Prioritize assessment areas based on habitat suitability          4-2c – Conduct assessments</p>	BBP, NJDEP	M	\$\$
	LR 4-3	<p><b><u>Conduct studies that identify and document the life history and/or ecology of pertinent living resources.</u></b></p> <p><b>METRICS:</b> The number of studies conducted</p> <p><b>MILESTONES:</b>          4-3a – Identify potential study subjects          4-3b – Collect and analyze data          4-3c – Disseminate findings</p>	NJDEP, NOAA, USFWS, Pinelands Commission, BBP, JC NERR	L	\$\$

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<b>5. Increase education and public outreach related to habitats and living resources</b>					
	<b>LR 5-1</b>	<p><b><u>Disseminate information to promote an understanding of science-based decision-making in the management of habitats and living resources</u></b></p> <p><b>METRICS:</b> Number of educational materials and reports (e.g., State of the Bay) distributed; number of science workshops and conferences; pre- and post-program evaluations to measure changes in understanding</p> <p><b>MILESTONES:</b>          5-1a: Inventory existing materials          5-1b: Develop and distribute new materials as necessary          5-1c: Provide science workshops/conferences</p>	All partners	M	\$
	<b>LR 5-2</b>	<p><b><u>Develop educational materials, programs, and online resources to promote restoration of habitats and living resources (e.g. living shorelines, shellfish)</u></b></p> <p><b>METRICS:</b> Number of materials/resources developed, number distributed, number of programs and people reached, program evaluations</p> <p><b>MILESTONES:</b>          5-2a: Inventory existing programs and materials/resources          5-2b: Identify needs and target audiences          5-2c: Develop and distribute new materials/resources as needed          5-2d: Develop and provide new programs as needed</p>	ReClam the Bay, NOAA, BBP, NJDEP	M	\$
	<b>LR 5-3</b>	<p><b><u>Develop materials, programs, and online resources to educate about the functional role of critical bay habitats, such as seagrass beds and wetlands, and the early life stages of estuarine-dependent species.</u></b></p>	BBP, JC NERR, NJDEP	S	\$

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		<p><b>METRICS:</b> Number of educational materials/resources developed, number distributed, number of programs and people reached, program evaluations</p> <p><b>MILESTONES:</b>          5-3a: Inventory existing materials/resources          5-3b: Identify needs and target audiences          5-3c: Develop and distribute new materials/resources as needed          5-3d: Develop and provide new programs as needed</p>			
	LR 5-4	<p><b><u>Produce educational materials and online resources about the impacts of climate change on the living resources of the bay.</u></b></p> <p><b>METRICS:</b> Number of educational materials/resources produced, number distributed, number of people reached</p> <p><b>MILESTONES:</b>          5-4a: Inventory existing materials/resources          5-4b: Identify needs and target audiences          5-4c: Develop and disseminate new materials/resources as needed</p>	BBP, JC NERR		
	LR 5-5	<p><b><u>Promote an improved understanding of the economic and ecological importance of fisheries through fisheries programs and activities.</u></b></p> <p><b>METRICS:</b> Number of fisheries programs/activities, number of people reached, program evaluations</p> <p><b>MILESTONES:</b>          5-5a: Inventory existing programs/activities          5-5b: Identify needs and target audiences          5-5c: Develop new programs/activities as needed</p>	NOAA, NJDEP	M S	\$ \$

	<p><b>LR 5-6</b></p>	<p><b><u>Promote education and enforcement of regulations and best practices for responsible use of ecologically sensitive and target areas (e.g. personal watercraft and boating, off-road vehicles)</u></b></p> <p><b>METRICS:</b> Number of educational materials/online resources developed, number distributed, number of programs/people reached, program evaluations</p> <p><b>MILESTONES:</b>          5-6a: Inventory existing programs and materials/resources          5-6b: Identify needs and target audiences          5-6c: Develop and distribute new materials/resources as needed          5-6d: Develop and provide new programs as needed</p>	<p>PPA, NJDEP*, Land Conservancies, BBP-CEC, JC NERR, Marine Trades Association, NJ Sea Grant Consortium, Ocean County Tourism, Natural Lands Trust, BBP-CEC</p>	<p>M</p>	<p>\$\$</p>
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DRAFT

## Chapter 7 LAND USE GOALS, OBJECTIVES, and ACTIONS

### Highlights

- The Barnegat Bay watershed has experienced intense growth and development over the last half century.
- With more than 33% of the watershed being developed the pressure on the region's natural resources is challenging, at the least.
- The ability to sustain the health, diversity and economic importance of the watershed's natural resources while continuing to manage development is a shared responsibility between local, county, regional and state land use managers.
- Land use managers are also challenged by the impacts of sea level rise on the sustainability and resilience of the watershed's natural resources, built communities, citizens and economy.

### 7.1 Goal

To improve and sustain collaborative regional approaches to responsible land use planning and open space protection in the watershed that protect and improve water quality, water supply, living resources, soil function and hydrology.

#### Land Use Objectives:

1. Work to raise the level of awareness and provide technical support to state, counties and municipalities to reflect and complement the CCMP goals and objectives in plans and land use practices
2. Encourage economically and environmentally sustainable land use development and redevelopment techniques and solutions that conserve, restore and enhance Barnegat Bay resources
3. Support open space acquisition, planning and management for people and nature.
4. Support the conservation, protection and restoration of wetlands
5. Conduct studies to improve scientific and societal understanding of the impacts of current and future land use practices to the Barnegat Bay and watershed
6. Increase education and outreach efforts targeted at sustainable land use practices for public and private land

### 7.2 Introduction

While New Jersey has a history of strong environmental regulations<sup>71</sup>, development, especially in coastal counties has resulted in the loss of critical resources and the conversion of forests and

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<sup>71</sup> wetland regulations (freshwater 1996 and Tidal/coastal 1970)

agricultural lands. It has been calculated that 20% (33,853 acres) of upland Pine Barrens forest was lost between 1972 and 1995<sup>72</sup> (heaviest period of development in the watershed). Recognizing these losses, regulations and local planning and zoning have tried to slow the loss of these natural features. However, the incremental loss or development impact to these features continues as the Barnegat Bay Watershed experiences a growing population, infill, and development of vacant land. Development or conversion of these lands negatively impacts water supply, water quality, wildlife habitat, connectivity and changes the landscape affecting the character of the watershed and the quality of life of its residents.

The Barnegat Bay watershed possess a rich mosaic of land cover, a vibrant tourist and natural resource driven economy, and continued growth and development pressure. Residential and commercial development in the watershed has contributed to the fragmentation of habitat, loss and conversion of wetlands, forest, agriculture and water dependent land uses, negatively impacted surface and ground water, contributed nonpoint sources of pollution and exacerbated storm water runoff and soil compaction. The 37 municipal governments, 2 county governments, state, federal and regional entities must work collaboratively to balance and sustain the natural and built assets of this vital watershed.

Challenged by the intense development and volume of people, the shared resources of the Barnegat Bay watershed require collaboration amongst those agencies with management responsibility and authority. Careful planning, stewardship, and sound and collaborative decision making at all levels of government will balance sustainable economic growth, natural resource protection, and community resilience and will maintain the quality of life in the Barnegat Bay Estuary watershed. New Jersey is fortunate that there are existing mechanisms, tools and authorities that can be used to facilitate achieving the Land Use goal of the CCMP. The Objectives and Actions supporting this Goal also strive to inhibit the contribution and impacts of pollution and loss of habitat from current and future land use activities while being cognizant of the economic drivers of development.

Currently environmental protection, economic development and resilience are not fully integrated into local community planning and development. The actions of the Barnegat Bay CCMP recognize existing tools, plans, programs and efforts, and advocates for greater collaboration at all levels of government. The actions of the CCMP also support the watershed's coastal communities in their efforts to enhance and supplement existing land use practices and developing, adopting and implementing new sustainable policies, plans and strategies that conserve, restore and enhance natural resources and lead to more resilient communities.

This Land Use section addresses the challenges related to land use management, development, and sustainability in the Barnegat Bay watershed by:

- Promoting the collective integration of environmental protection, economic development and resiliency through sustainable approaches to local community planning, decision-making and development.

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<sup>72</sup> TPL 2020 Plan

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- Focusing on cross-jurisdictional collaboration by using the strengths of each municipality and agency to support initiatives, share experiences and knowledge and take advantage of economies of scale.
- Ensuring that decision-making is informed by sound science and current data.
- Suggesting innovative strategies to stem the loss of (or balance where appropriate) the watershed's natural resources and their ecosystem services to sea level rise and continued development.

Land Use and Climate Change:

The Barnegat Bay, its rivers and creeks, salt marshes, beaches, forests and communities must respond to changing climate conditions and stressors. These stressors are transforming the economic and ecological vitality of the Bay and creating new management challenges including those that impact fisheries, public health, natural resources and community infrastructure.

Rising air temperatures, increasing precipitation, acidifying coastal waters, rising sea levels and warming ocean temperatures are contributing to water pollution problems, habitat degradation and the proliferation of non-native species. Barnegat Bay residents, planners and land managers must be able to respond to a changing and uncertain environment.

The Barnegat Bay CCMP has outlined objectives that will monitor and be responsive to changing conditions. Efforts are underway to monitor the health and status of coastal wetlands to inform restoration activities. This Land Use Goal also contains objectives to assist Barnegat Bay communities become more resilient to the impacts of a changing climate and the resulting conditions.

LAND USE STATUS AND TRENDS

**Shoreline Hardening** - Approximately 45 percent of the bay's shoreline has been hardened/ bulk headed. While bulkheads protect personal and commercial properties. Due to habitat loss and fragmentation hardened shorelines have a negative impact on the biological functions and diversity.

**Protected Areas** - Between January 1, 2010 and September 30, 2015, approximately 11,114 acres in the Barnegat Bay watershed were acquired by federal, state, county, local, and non-governmental agencies for conservation purposes. These purchases bring the total acreage of publicly-owned land in the watershed to over 141,935 acres, or nearly 41% of the watershed's land area.

**Land Use/Land Cover** - Urban land use in the watershed has continued to increase, from approximately 22% of the watershed in 1986 to approximately 32% in 2012. As of 2012 urban land use occupied approximately 110,665 acres of the Barnegat Bay watershed, excluding water. Including all altered land uses (*i.e.*, urban + barren + agriculture lands), the total altered land area is 121,347 acres, or nearly 35%.

**Wetland Area** – There were approximately 22,795 acres of tidal wetlands and 67,034 acres of freshwater wetlands within the Barnegat Bay watershed in 2012. This represents a loss of 238 acres of tidal wetland area and 284 acres of freshwater wetland area since 2007. The 238 acres of tidal wetlands lost during the most recent study period (2007-2012) was substantially higher than the previous five-year study period, suggesting that the pace of loss is accelerating.



### **7.3 Objectives**

To advance an ecosystem-based approach to managing the estuary, its natural and human resources require collaboration and governance among cross-jurisdictional partners and stakeholders.

Thoughtful and collaborative decision-making results in better outcomes and decisions, can avoid conflicts between stakeholders, and results in a better understanding of the Estuary's natural resources and the services they provide. Communities that are more agile and comprehensive in their planning can be more resilient to environmental changes and natural (episodic) damages such as sea level rise and storm surge.

#### **Land Use Objective 1. Work to raise the level of awareness and provide technical support to state, counties and municipalities to reflect and complement the CCMP goals and objectives in plans and land use practices**

Sustainable land use and community growth are regional concepts. To achieve sustainability and resilience in the Barnegat Bay watershed the 37 communities, 2 counties, state agencies and other decision makers that share this resource must work together to identify and address issues that affect all jurisdictions. The Actions that will address this Objective focus on facilitating the incorporation of the BBP CCMP goals and objectives into existing state (CZMP, Water Quality/Water Supply) and local policies and plans through a collaborative and shared learning process. This is further supported through regulatory programs and is intended to be adaptive and innovative to new and emerging land use and natural resource issues.

As an example, future predicted changes in land use must be addressed. Lakewood is the fastest growing municipality in the state and is anticipated to become the third largest city in the state by 2030. The continued rapid urbanization of Lakewood Township will have a significant impact on the Metedeconk River and the northern part of the bay. Lakewood's growth should be recognized as placing a strain on water resources and having the potential to have downstream impacts on the bay unless addressed.

#### **Land Use Objective 2. Encourage economically and environmentally sustainable land use development and redevelopment techniques and solutions that conserve, restore and enhance Barnegat Bay resources**

Environmental protection, economic development and resilience need to be fully integrated at all levels of community planning and development. The actions in this objective recognize the special land uses within the watershed; the challenges they face and the opportunities necessary to continue to thrive. These Actions include supporting Barnegat Bay communities in developing, implementing and adopting evidence-based sustainable policies, plans, tools and solutions that conserve, restore and enhance Barnegat Bay natural and built resources.

Sea level rise, shoreline erosion, development pressure, and recent and future storm impacts will also have a direct impact on the character of water dependent facilities along the Barnegat Bay shoreline. Historically, the Barnegat Bay watershed was known for its fishing, shellfishery, hunting, trapping, waterfowl, birding and boating activities; many of the traits that contribute to the current tourism economy and quality of life Bay residents. The combined pressures previously mentioned have

resulted in the loss of the waterfront services that supported these activities. Often water-dependent services were incompatible with encroaching development, were severely impacted by storm events and/or were lost or converted to non-water dependent uses. Retaining water-dependent land uses is critical to maintaining the character of the Barnegat Bay, providing public access, retaining a commercial and recreation driver of the economy and providing opportunities for implementing adaptation strategies to enhance shorelines.

**Land Use Objective 3. Support open space acquisition, planning and management for people and nature.**

Open space and public access provide multiple values including land for recreation, protecting water supply, water quality and habitat; buffer development from environmental impacts and enhance and preserve the cultural and scenic elements of our landscape. Open space and public access are community assets and a green infrastructure. Whether for resource conservation and protection, active or passive recreation these assets must be actively managed and maintained. Ease of access and use by the public strongly influences the quality of the open space, the user experience and as an economic driver of tourism. As development, tourism and recreation demand increase so do the pressures of competing interests on these lands. The Actions that address this Objective focus on the increased need for open space and public access in the watershed; as well as facilitating the sustainability and management of the existing open space and public access assets for people and nature.

As the impacts of climate change and sea level rise become more pronounced strategies to utilize open space to adapt to these changes have become main stream. Open space is no longer only for recreation and aesthetic appreciation but also being utilized to counter the effects of heat islands, as 'sponge parks' to retain and dissipate flood waters and to provide areas for wetlands migration. Open space acquisition and conservation is still a major component of land use planning/management in New Jersey and will play a greater role as planning for resilience becomes integral to the watershed's coastal communities.

**Land Use Objective 4. Support the conservation, protection and restoration of wetlands**

The societal benefits of wetlands (freshwater, salt marsh or forested) have been well documented. In addition to the cultural and recreational benefits their contribution to performing ecological services can no longer be discounted. Recently, a study calculated the economic benefit of the presence of wetlands towards reducing storm impacts on built infrastructure. It is estimated that the Barnegat Bay watershed has lost in excess of 28% of its tidal wetlands to development (Rutgers 2017). Increasing sea level rise, edge erosion, human induced impacts (ditching, OMWM), development (subsidence due to ground-water withdrawal and diminished recharge) and environmental impacts (loss of sediment supply) continue to stress wetland resources, threaten their integrity, the ecosystem services they provide and the adjacent built environment. Efforts to restore lost wetlands are costly and often cannot replace or replicate their natural function

While New Jersey has had strong environmental regulations<sup>73</sup> specific to both coastal and freshwater wetlands the state has and continues to experience a loss of these important features. It is estimated that the Barnegat Bay watershed lost as much as 6% or 4,633 acres of freshwater wetlands between 1972 and 1995; 28% of the Barnegat Bay salt marshes were eliminated or impacted by mosquito control ditching and development prior to 1970; 71% of the Barnegat Bay shoreline was developed or altered with 40% due to bulkhead stabilization of the shoreline. A 2017 *Scientific Reports* article reported that during Hurricane Sandy marshes prevented USD\$425 million in direct flood damages to property in New Jersey alone.<sup>74</sup> It was further reported that in Barnegat Bay, marshes annually reduce flood losses by 16 percent compared to areas where marshes have been destroyed or developed. In the highest risk areas, that is, those less than five feet above sea level, marshes reduce risks to property by as much as 70 percent.

Wetlands long appreciated for their habitat and aesthetic value are now also recognized for the economic value of the ecosystem services they provide for carbon sequestration and as previously cited for their value in reducing flood losses to development. The Barnegat Bay watershed still retains expanses of protected wetlands but also has lagoon communities interspersed in the wetland expanses and development along remaining shorelines. The sustainability of wetlands and the ecosystem services they provide present a key challenge to land use and natural resource managers alike. Resource managers are concerned with sustaining the health and integrity of the wetlands for their natural resource values; land managers are concerned with the same factors but for the ecosystem services that sustain existing development. These concerns are not mutually exclusive, nor are the strategies to achieve sustainability different; the challenge will be in balancing the goals of achieving sustainability and managing expectations.

The protection of wetlands has been identified as an Objective in the Land Use section of the CCMP because their importance to the coastal communities of the watershed. They have aesthetic and economic value for habitat, recreation, tourism, commerce and for the ecosystem services they provide in reducing floods. A recent report by the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel (October 2016) (STAP) identified that “New Jersey coastal areas are likely (about 67% probability) to experience SLR of 0.6 to 1.0 ft. (7.2-12”) between 2000 and 2030, and 1.0 to 1.8 ft. (12-21.6”) by 2050.”<sup>75</sup> The flood reduction services of wetlands in the Barnegat Bay will only increase as sea level rises. The advance of sea level rise on adjacent waterfront communities of the Barnegat Bay watershed is a key challenge to land use planners and managers; sustaining existing wetlands must be addressed in resilience planning and strategy development.

#### **Land Use Objective 5. Conduct studies to improve scientific and societal understanding of the impacts of current and future land use practices to the Barnegat Bay and watershed**

The Barnegat Bay Partnership recognizes the importance and linkages of sound science to land-use decision making and management that is adaptive to changing pressures (development, economic) and influences (climate change) while being responsive to protecting the natural environment and societal and economic needs of the residents of the watershed. The studies identified in this section are important to help inform land use decision-makers in achieving progress towards the goals and objectives of maintaining sustainable and resilient communities and natural resources within the

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<sup>73</sup> wetland regulations (freshwater 1996 and Tidal/Coastal 1970)

<sup>74</sup> [www.lloyds.com/coastalresilience](http://www.lloyds.com/coastalresilience) - Coastal Resilience and Flood Damage Reduction August 2017

<sup>75</sup> Rutgers University, New Jersey Climate Adaptation Alliance, Science and Technical Advisory Committee (2016) Integrating Climate Science into Coastal Resilience Planning and Decision Making in New Jersey

watershed. The Actions that address this Objective focus on establishing a collaborative, science-based approach at all levels of government to achieve the conservation and protection of existing wetlands as well as support the identification and restoration of wetlands, shorelines and riparian corridors within the estuary watershed.

### **Land Use Objective 6. Increase education and outreach efforts targeted at sustainable land use practices for public and private land**

Land use managers (including municipalities, counties, regional agencies, developers) and citizens need assistance in acquiring, translating and applying the best available science to develop and implement strategies and practices that support healthy natural resources, ecosystem services and balance the impacts of development in the Barnegat Bay watershed. Increased education and outreach of land use practices will help communities prepare for climate change impacts and resulting cultural, economic and ecological changes/disruptions.

#### **7.4 Previous Successes**

- **Ocean County Natural Lands Trust:** Open Space protection has long been a priority in New Jersey and recognized as ‘green infrastructure’ supporting water quality, habitat, wildlife, recreation and tourism. Established in 1997, the Ocean County Natural Lands Trust has establishment of 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;
  - Buffering areas that are not compatible with development.

The program generates over \$8 million annually for natural lands acquisitions and farmland preservation. OCNLT also coordinates and leverages funding with State, Federal and Private programs including NJDEP Green Acres and Blue Acres Program, Pinelands Commission, US military and private land trust organizations. 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. This brings the total acreage of publicly owned land in the watershed to over 141, 935 acres.<sup>76</sup> This includes buffers around Joint Base Fort Dix Maguire Lakehurst, the Brick Township portion of the Edwin B. Forsythe National Wildlife Refuge at Reedy Creek, and the Barnegat Township portion of the Forsythe Refuge at Good Luck Point. All acquired through a collaborative and coordinated approach to conservation, and preservation of the watershed’s natural resources.

- **Metedeconk River Greenway and Turkey Swamp County Park Expansion** - Monmouth County Park System successfully created a Metedeconk River Greenway and expanded the portion of Turkey Swamp County Park that is within the Metedeconk Watershed (which is part of the Barnegat Bay system). The Metedeconk Greenway is a 444-acre greenway which plays an important role of

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<sup>76</sup> Barnegat Bay Partnership, State of the Bay Report 2016

protecting water quality and wildlife habitat along the Metedeconk River. Turkey Swamp County Park is a 2,266-acre wooded park which was acquired and developed for camping and outdoor activities. This site features a 17-acre lake for fishing, boating, and ice-skating. The park also features miles of trails, an archery range and playgrounds.

- **Municipal Ordinances:** 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 Ordinance ([http://www.nj.gov/dep/stormwater/docs/071906\\_pinelands\\_ordinance.pdf](http://www.nj.gov/dep/stormwater/docs/071906_pinelands_ordinance.pdf)) to ensure that the site of proposed stormwater BMP's is properly assessed and that BMPs are properly maintained.
- **Getting to Resilience:** This online self-assessment process is a tool to assist communities to reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. 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. And utilizing the resilience recommendations, communities can prioritize the next steps and plan for future municipal actions.
- **Open Space / Blue Acres** - Many additional acres of land have been protected within the Barnegat Bay Watershed, including critical wetlands restoration at the Forsythe National Wildlife Refuge which added 17.6 acres at Good Luck Point, 27.26 acres at Brick A, and 67.28 acres at Brick B.
- **Pinelands** – Fifty-three municipalities within 7 counties in the Pinelands Area have incorporated the Comprehensive Pinelands 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 BB CCMP in their municipal plans as well.
- **TPL 2020** - TPL 2020 - The Trust for Public Land (TPL) has worked with local partners in New Jersey's Barnegat Bay region to preserve this nationally recognized refuge and recreational destination. TPL's Century Plan (1995) identified 75,930 acres in the Pinelands, along the coastal shoreline, and among bay islands that were considered to be the most important to the Barnegat Bay ecosystem. Almost 24,000 of the 75,930 identified acres have been protected, however much work remains to be done to protect the remaining identified acres before more are lost to development. TPL 2020 is a recommitment to the importance of land protection within the Barnegat Bay region, and includes a summary of the watershed conditions as well as an explanation of the land conservation goals drawn up by a steering committee convened by TPL<sup>77</sup>.
- The BB 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 \$XXXX.00 in X # of**

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<sup>77</sup> <http://cloud.tpl.org/pubs/local-nj-barnegat-bay-2020.pdf>

research projects in the BB under the Governor's Barnegat Bay Action Plan (2012-2015). These research projects were intended to inform science-based decision making.

- **Municipal Public Access Plans** - 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. Towns 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
- **Metedeconk Watershed Restoration Plan** - Brick Township Municipal Utility Authority Municipal Utility Authority 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.

DRAFT

**7.5 Objectives and Actions for Sustainable Land Use Planning in the Barnegat Bay Watershed**

- Timeframe – The timeframe from adoption of the CCMP in which the action should be completed. Short (S) indicates a completion within 1-2 years, Medium (M) actions are completed within 3-5 years, and Long (L) actions take 5 or more years. On-going actions are considered Long.
- Costs – The anticipated costs for the action: \$ < \$100,000, \$\$ \$100,000 - \$500,000, \$\$\$ \$500,000 - \$1,000,000, \$\$\$\$ > \$1,000,000.

<b><i>Goal - To improve and sustain collaborative regional approaches to responsible land use planning and open space protection in the watershed that protect and improve water quality, water supply, living resources, soil function and hydrology.</i></b>					
<b>LU Objective</b>	<b>LU Action ID</b>	<b>CCMP Action</b>	<b>Lead Partner (s)</b>	<b>Time-frame</b>	<b>Costs</b>
<b>1. Work to raise the level of awareness and provide technical support to state, counties and municipalities to reflect and complement the CCMP goals and objectives in plans and land use practices</b>			County Planning Offices, Municipalities, NJDEP, Sustainable Jersey, JC NERR, Pinelands Commission		
	<b>LU 1-1</b>	<b>Align and expand existing municipal plans, BMPs, incentive programs and other related planning tools (e.g. Ocean County All-Hazards Mitigation Plan, GTR and Sustainable Jersey).</b>  <b>METRICS:</b> Number of municipalities participating in the process to align and expand existing plans to incorporate CCMP goals; number of municipalities participating in GTR, CRS, SJ  <b>MILESTONES:</b>	BBP, NJDEP, County and Local Planning and OEM, Pinelands Commission, Sustainable Jersey	1-a L	\$\$

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		1-a. At least 3 adjacent or mutually interested municipalities per year will be engaged; more if volunteer; all by 2028			
	<b>LU 1-2</b>	<p><b>Identify regulatory gaps and overlaps and promote planning tools (such as draft ordinances, policies and model language) that support sustainable land use development practices</b></p> <p><b>METRICS:</b> Compilation of current municipal policies, ordinances, model language, assessment tools by Barnegat Bay municipalities</p> <p><b>MILESTONES:</b>          1-2a - Compilation of current municipal, county and Pinelands CMP land use policies, ordinances, tools. Completed by 2020          1-2b - Development of a Barnegat Bay -wide assessment of the above compilation (gaps and overlaps) by municipality. Completed by 2021          1-2c - Preparation of resource library of model ordinance, tools and policies Completed by 2022</p>	NJDEP – (Nutrient TMDL, GAP 2.0, Restoration Enhancement Strategy) ANJEC; County and Municipal Planning; Pinelands Commission	1-2a S 1-2b S 1-2c M	\$\$
	<b>LU 1-3</b>	<b>Coordinate with municipal, county, regional) and state planning representatives to develop a Land Use Element</b>	County Planning Offices, Municipalities, NJDEP, Pinelands Commission	1-3a S M/T1-3b S	\$\$- \$\$\$



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		<p><b>(including Working Waterfronts, Regional Resilience, Restoration and Enhancement activities/targets) for inclusion in their planning documents.</b></p> <p><b>METRICS:</b>          Active participation by representatives of county, municipal and state planning agencies. Compilation of policies, ordinances and planning tools that reflect comprehensive/regional approach for Barnegat Bay Land Use Element.</p> <p><b>MILESTONES:</b>          1-3a Convene an intergovernmental working group; Participation by representatives of all communities and effected county and state agencies (including utilities) – Completion by 2019</p> <p>1-3b - Completion of Framework Document by 2020</p> <p>1-3c -Preparation of Draft Barnegat Bay -wide comprehensive/regional <i>Land Use Element</i> by 2022</p> <p>1-3d - Adoption by appropriate county, municipal and state agencies of Barnegat Bay-wide</p>	<p>DF – 1-3d Crosswalk with Communications Plan – Marketing the <i>Land Use Element</i> – can be adopted by reference, MOA and/or as part of MLUL.</p>	<p>1-3c M</p> <p>1-3d L</p>	
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		comprehensive /regional <i>Land Use Element</i> by 2025			
	<b>LU 1-4</b>	<p><b>Develop a BBP Recognition Award Program (including potential for funding availability-to award recipients) for municipalities who are implementing CCMP Actions and coordinating in the development of the Barnegat Bay -wide <i>Land Use Element</i>.</b></p> <p><b>METRICS:</b>          Number of Communities participating in and demonstrating a commitment to adopting CCMP goals and objectives through ordinances, planning and implementation initiatives.</p> <p><b>MILESTONES:</b>          1-4a - Guidelines for Recognition Award Program completed by 2019          1-4b - Recognition awards provided by 2020          1- 4c - Participation/awards to all municipalities in Barnegat Bay Watershed for their participation by 2028</p>	BBP	1-4a S 1-4b S 1-4c L	\$-\$\$
<b>2. Encourage economically and environmentally sustainable land use development and redevelopment techniques and solutions that conserve,</b>					

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<p><b>restore and enhance Barnegat Bay resources</b></p>					
	<p><b>LU 2-1</b></p>	<p><b>Support and encourage land use practices that incorporate BMPs such as Low Impact Development (LID) and Sustainable Jersey actions; these practices should minimize soil disturbance, minimize forest and wetland loss, protect soil integrity recharge, and promote nature-based infrastructure.</b></p> <p><b>METRIC:</b> Progress towards adoption of land use practices (including nature-based infrastructure) that incorporate LID, minimize soil disturbance, protect soil integrity and recharge areas.</p> <p><b>MILESTONES:</b>          2-1a - Decrease the area of effective impervious cover in the watershed by 10 percent by 2033 relative to a 2015 baseline.           2-1b - Adoption of new or revised ordinance and policies that will encourage redevelopment and limit loss of vegetative cover.</p>	<p>County Planning Offices, Municipalities, NJDEP, JC NERR, Pinelands Commission, Pinelands Preservation Alliance</p>	<p>2-1a L 2-1b M</p>	<p>\$ - \$\$</p>

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	<p><b>LU 2-2</b></p>	<p><b>Support the development of localized and/or regional adaptation plans for vulnerable, low-lying communities (e.g. communities experiencing repetitive losses).</b></p> <p><b>METRICS:</b> The number of communities that are developing specific (adaptation) plans, adopting ordinances or more progressive sea level rise projections to deal with repetitive losses in low lying communities</p> <p><b>MILESTONES:</b>          2-2a - Bay-wide Assessment of potential restoration projects/project sites Completed by 2021</p> <p>2-2 b - Number of restoration, enhancement or adaptation projects implemented</p> <p>2-2c - Number of communities adopting at least the 2030 Rutgers SLR Projection through ordinance for a Bay-wide resiliency target – at least 3 communities/year with all communities by 2028</p>	<p>BBP, NJDEP, County and Local Planning, Sustainable Jersey, NGO Partners (ALS, SBB, NJCF, NJF, TNC)</p>	<p>2-2a M          2-2b M          2-2c M-L</p>	<p>\$\$</p>
	<p><b>LU 2-3</b></p>	<p><b>Promote innovative zoning and land use management techniques such as: transfer of development rights (TDR), rolling easements, acquisition (fee simple and easements), buy-outs, strategic</b></p>	<p>County Planning Offices, Municipalities, NJDEP, JC NERR, UCI, NJ Future, Sustainable Jersey, ANJEC; Pinelands Commission</p>	<p>2-3a S          2-3b S          2-3c M</p>	<p>\$\$</p>

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		<p><b>retreat, non-contiguous density transfer, center-based development and septic density.</b></p> <p><b>METRICS:</b> Increased community resilience, sustainability and safety; foster preparedness and information sharing among local decision makers to climate change, sea level rise and other coastal hazards (low-lying communities; lessen/eliminate repetitive losses)</p> <p><b>MILESTONES:</b>          2-3a Compilation of current ordinances and municipal policies already in place – see target 1-2          2-3b Preparation of draft assessment of current ordinances and municipal policies (above) – see Target 1-2, 1-3          2-3c Municipal, County and Agency adoption of innovative zoning and land use management techniques – See target 1-3, 1-4</p>			
	<p><b>LU 2-4</b></p>	<p><b>Provide landowners with existing information and modeling tools that identify hazard vulnerability, adaptation and response actions</b></p> <p><b>METRICS:</b>          Improved homeowner knowledge and decision making in response to climate impacts and coastal hazard events; property maintenance and</p>	<p>BBP, NJSGC</p>	<p>2-4a M          2-4b M          2-4c M/L</p>	<p>\$\$</p>

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		<p>renovation; interaction with local government</p> <p><b>MILESTONES:</b>          2-4a - Develop a Land-owner self-assessment tool (and potential funding opportunities/tax incentives) to encourage adoption of resiliency and climate adaptation strategies and responses (GTR for Landowners) and to foster their understanding of municipal responsibilities – help Municipalities reach their CRS, SJ, GTR goals – Completed 2022</p> <p>2-4b - Presentations to homeowners owners, neighborhoods, OEM and municipal representatives Completed in 2023</p> <p>2-4c - 25% of full-time or waterfront homeowners attend presentations; ask for assistance; implement actions – can track similar to Clean Marina Program (Pledge and Implementation then Recognition Award)</p>			
	<b>LU 2-5</b>	<p><b>Promote land use practices that ensure that water supply reserves are not exceeded and are distributed equitably.</b></p> <p><b>METRICS:</b>          Increased understanding of the land use practices that lead to</p>	BBP, Pinelands Commission, NJDEP, Counties, Municipalities, Utilities	2-5a M	\$

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		<p>conservation, reclamation and recharge of water resources</p> <p><b>MILESTONES:</b>          2-5a - Work with local, county and state government entities and the public to identify, implement and advance land use practices including the use of gray water and other water conservation practices (metering, recharge, stormwater retrofits, limiting the loss of natural infiltration areas rain gardens etc.) to ensure water supply reserves are not exceeded and are equitably distributed.</p>			
	<b>LU 2-6</b>	<p><b>Promote land use practices that ensure water-dependent uses are recognized and remain a priority and that other authorized waterfront uses are compatible in order to lessen the conflicts between development and commercial and recreational activities.</b></p> <p><b>METRICS:</b>          Increased understanding of the scope and challenges of the marine-dependent coastal economy of Barnegat Bay; Community (government) support for policies and decisions that promote investment in and continuation of marine industry and water dependent activities.</p>	BBP, NJDEP, NJS GC, NJDOT/OMR, Counties, Municipalities	2-6a S 2-6b S 2-6c M 2-6d L	\$-\$\$

		<p><b>MILESTONES:</b></p> <p>2-6a - Completion of a report on the distribution of water dependent industries, economic significance, threats and conversion to other uses. Completed by 2020</p> <p>2-6b - Identify Working Waterfront Preservation models that have been successful in stemming the loss of marine dependent activities Completed by 2022</p> <p>2-6c - Outreach and engagement with business owners, neighborhoods, legislators, municipal finance representatives on implementation of Preservation models and opportunities to preserve sustainable working waterfronts and water dependent activities. Completed in 2023</p> <p>2-6d - Implement a Barnegat Bay-wide Working Waterfront Preservation Element (including ordinances, funding mechanisms) recognizing the historic, cultural, recreational, economic, environmental contribution and climate impacts of the working waterfront to Barnegat Bay with full adoption as a MLU Element in the Watershed by 2028.</p>			
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	<p><b>LU 2-7</b></p>	<p><b>Conserve and enhance forestry areas with multiple ecosystem benefits</b></p> <p><b>METRICS:</b> Acres of forest conserved</p> <p><b>MILESTONES:</b>          2-7a Using updated LU/LC identify contiguous forest areas; those in active Forest Practice and those that are protected; available for preservation</p> <p>2-7b Identify LU Ordinances and Policies that guide management, protection and sustainable forestry practices to limit clear-cutting and encroachment of development; promote water quality, wildlife habitat and natural vegetative cover.</p> <p>2-7c Quantify/calculate the contribution of forest canopy to air quality in the Barnegat Bay Estuary Watershed; Qualify forest diversity</p> <p>2-7d Coordinate efforts to maintain forest extent and health via stewardship programs, forest management practices, land conservation programs and the Pinelands Comprehensive Management Plan</p>	<p>Crosswalk with water quality/water supply</p> <p>BBP, NJDEP, NJDoAg, NRCS, EPA, Counties, Municipalities, Pinelands Commission</p>	<p>2-7a S</p> <p>2-7b S</p> <p>2-7c S/M</p> <p>2-7d M</p> <p>2-7e M</p>	<p>\$ - \$\$</p>
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		2-7e Promote crop diversity and water management as strategies against climate-related impacts to agriculture/forestry.			
<b>3. Support open space acquisition, planning and management for people and nature.</b>					
	LU 3-1	<p>Convene intergovernmental working group to review all existing public and private planning documents (such as Green Acres Inventory, County and Municipal Open Space Inventories, TPL 2020 Plan, municipal master plans, CIPs, and All Hazard Mitigation Plans, Conservation Blue Print initiative) and holdings, in order to coordinate future efforts to maximize ecological services of preserved lands.</p> <p><b>METRICS:</b> Convene workgroup</p> <p><b>Milestone:</b></p> <p>3-1a Identify participants, invite and convene working group to format inventory by 2019</p>	County Planning Offices, Municipalities, NJDEP, USFWS, Land Conservancies, BBP, JC NERR, TPL, Pinelands		\$
				3-1a S	

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	<p><b>LU 3-2</b></p>	<p><b>Compile a comprehensive inventory of open space and lands held in permanent and temporary easements</b></p> <p><b>METRICS:</b> Comprehensive Inventory completed</p> <p><b>MILESTONES:</b>          3-2a - Compile and use existing datasets (a GIS based-see OASIS) comprehensive inventory of permanent and temporary open space and easements held in conservation status by 2023</p> <p>3-2b - Work with and encourage ANJEC and municipal Environmental Commissions to update their Community Natural Resource Inventory – Minimum of 5 communities/year [starting in 2019]</p>	<p>County Planning Offices, Municipalities, NJDEP, USFWS, Land Conservancies, BBP, JC NERR, TPL, Pinelands  <a href="https://www.njmap2.com/blueprint/">https://www.njmap2.com/blueprint/</a></p>	<p>3-2a M          3-2b S</p>	<p>\$ - \$\$</p>
	<p><b>LU 3-3</b></p>	<p><b>Promote acquisition and management of lands towards achieving community and natural resource protection and resilience and a landscape that supports recreation and the cultural heritage of the Barnegat Bay through implementation of current and future watershed-wide open space plans.</b></p> <p><b>METRICS:</b> Acres protected  <b>MILESTONES:</b></p>	<p>County Planning Offices, Municipalities, NJDEP, USFWS, Land Conservancies, BBP, JC NERR</p>	<p><b>M/T3-3a          M/L</b></p>	<p><b>\$</b></p>

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		3-3a - Conserve an additional XX acres of land through acquisition, easement or conservation dedication (scenic areas, special areas, no take, conservation management, farmland and forest preservation) within the watershed by 2033, while maintaining the total area of protected lands identified in 2018			
	LU 3-4	<p><b>Promote the expansion of the NJDEP Environmentally Sensitive Areas Plan</b></p> <p><b>METRICS:</b> Expansion of Environmentally Sensitive Areas Plan</p> <p><b>MILESTONES:</b>          3-4a - Support the identification and designation of Environmentally Sensitive areas within the Barnegat Bay – <i>NJDEP Restoration, Enhancement &amp; Protection Strategy</i>.</p> <p>3-4b - Assist in the public awareness of resource protection issues, targeted public education campaigns, resource and site monitoring</p>	NJDEP, NOAA, USF&WS	3-4a S/M 3-4b S/M/L	\$

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<p><b>4. Support the conservation, protection and restoration of wetlands</b></p>					
	<p><b>LU 4-1</b></p>	<p><b>Promote the understanding of the balance of wetlands and nearshore areas as natural habitats and the functions they provide to the ecosystem and development.</b></p> <p><b>METRICS:</b> Increased wetlands acres protected</p> <p><b>MILESTONES:</b>          4-1a Identify and conserve open space landward of coastal wetlands to allow for natural transition upland.</p> <p>4-1a Enhance the resiliency of coastal / Barnegat Bay habitats (wetlands, forests) by prioritizing open space protection and management to protect the remaining high-value undeveloped lands and promote Blue Acres Acquisitions for future resilience.</p> <p>4-1b Enhance the resiliency of wetland and edge habitats and existing waterfront development by promoting natural and nature-</p>	<p>NJDEP, NPS, NOAA, USF&amp;WS, BBP, ALS, TPL, TNC, OCNLT, EPA, NRCS</p>	<p>4-1a S/M</p> <p>4-1a Ongoing</p> <p>4-1b Ongoing</p>	<p>\$\$ -          \$\$\$</p>

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		based infrastructure, living shorelines and dunes over hard structures (bulkheads, sea walls).			
	<b>LU 4-2</b>	<p><b>Coordinate opportunities to conserve, protect restore and create wetlands through the use of innovative strategies, tools and funding opportunities (such as: TDR, Acquisition, Easement, Mitigation, Adaptation, Beneficial Reuse of Dredge Material, Infrastructure Trust, Jersey-Friendly Yards Program)</b></p> <p><b>METRICS:</b> Identification of priority wetlands for restoration</p> <p><b>MILESTONES:</b>          4-2a Identify opportunities for the creation of wetlands as an adaptation strategy to minimize shoreline erosion and net loss of wetlands</p> <p>4-2b Identification and continued monitoring of the rate of (localized) shoreline loss (due to slr, erosion, boat wakes) and promote a coordinated and collaborative approach among agency and local partners to</p>	NJDEP, NPS, NOAA, USF&WS, BBP, ALS, TPL, TNC, OCNLT, Pinelands Commission, NRCS	4-2a S 4-2b S/M – ongoing 4-2a Ongoing 4-2b Ongoing 4-2c M 4-2d Ongoing 4-2e Ongoing 4-2f M/Ongoing	\$\$

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		<p>shoreline restoration – natural and nature-based solutions</p> <p>4-2c Through regulation, ordinance and LU Policy support adoption of riparian corridor protection measures</p> <p>4-2d Through regulation and LU policy and management support adoption of salt marsh buffers – allow for landward migration of wetlands, protect wetlands from NPSP, protect development from storm surge run-up</p> <p>4-2e Promote the protection of forested wetlands for infiltration, WQ and habitat diversity</p> <p>4-2f Promote the coordination of comprehensive monitoring and reporting on wetlands mitigation, restoration – maintain a registry of projects for when funding becomes available)</p>			
	<b>LU 4-3</b>	<p><b>Promote a balanced, collaborative and coordinated approach to the dredging of the Barnegat Bay, disposal and beneficial re-use of dredge materials</b></p> <p><b>MILESTONES:</b>          4-3a – Participate in Sediment Management efforts that includes representatives from federal, state, local agencies, commercial</p>	BBP, NJDEP, NJDoT, USACE, NRCS, NOAA, USGS, Counties, Municipalities, Commercial Interest Groups	<p>4-3a S</p> <p>4-3b M</p> <p>4-3c M</p>	\$

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		<p>(boating and fisheries) and wildlife interests to identify issues of concern, needs and opportunities to be addressed in a Barnegat Bay -specific Sediment Management Plan.</p> <p>4-3b - Develop a sediment management plan for the Barnegat Bay. That includes potential for beneficial reuse of dredge materials</p> <p>4-3c - Establish a baseline/timeline for projects in the Barnegat Bay</p>			
<b>5. Conduct studies to improve scientific and societal understanding of the impacts of current and future land use practices to the Barnegat Bay and watershed</b>					
	<b>LU 5-1</b>	<p><b>Identify the social, economic and environmental impediments and solutions for implementing sustainable land use practices on existing and future private developments – including green and gray infrastructure strategies in relation to SLR and climate change, repetitive losses and ‘Willingness to Pay’ and contingent valuation studies.</b></p> <p><b>METRICS:</b> Completion of report/study</p>	<p>County Planning Offices, Municipalities, NJDEP, JC NERR, BBP, EPA, NOAA, Universities</p>	<p>5-1a S/M</p> <p>5-1b M</p> <p>5-1c M</p>	<p>\$\$</p>



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		<p><b>MILESTONES:</b></p> <p>5-1a: Conduct cost benefit analysis of various land use practices including implementation of green and gray infrastructure strategies</p> <p>5-1b: Update and expand a “Willingness to Pay” social science study to investigate citizens’ thoughts regarding the cost of sustainable land use practices.</p> <p>5-1c: Complete Cost Benefit Analysis and Willingness to Pay Study.</p>			
	LU 5-2	<p><b>Support the development of an updated Land Use Land Cover Map including analysis of LU/LC Change, analysis of impervious surface; shoreline (land/water interface); V Datum.</b></p> <p><b>METRICS:</b> Creation of LU/LC Map</p> <p><b>MILESTONES:</b></p> <p>5-2a: Work with NJDEP, NOAA, EPA and others to update and maintain an updated Land Use/Land Cover Map, LU/LC Change and Shoreline Analysis (update data every 5 years- 2015 as baseline).</p> <p>5-2b: (From above) Update existing build out analysis and impervious surface analysis.</p>	County Planning Offices, Municipalities, NJDEP, JC NERR, USGS, NOAA, EPA	<p>M/T5-2a S</p> <p>M/T5-2b S</p> <p>M/T5-2c S/M</p> <p>M/T5-2d S</p> <p>M/T5-2e S/M</p> <p>M/T5-2f M – Ongoing</p> <p>M/T5-2g S-ongoing</p> <p>M/T5-2h S/M</p>	\$\$\$\$

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		<p>5-2c: Set a milestone (target) for reducing hardened shoreline throughout the Watershed</p> <p>5-2d - Work with Federal Partners (NOAA/USGS) to update the V Datum for the estuary;</p> <p>5-2e - Make above available for planning, project development, project implementation to inform flooding, sea level rise, FEMA FIRMs</p> <p>5-2f - Conduct outreach to local government and community to inform them of data and how it may affect them</p> <p>5-2g - Work with partners (NOAA, EPA, NJDEP and others) to monitor and document actual sea level rise (can use information to compare and adjust local projections)- See M/T4-2b</p> <p>5-2h - Update/Improve/Promote use of NJDEP CZM Coastal Atlas</p>			
<p><b>6. Increase education and outreach efforts targeted at sustainable land use practices for public and private land</b></p>					

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	<p><b>LU 6-1</b></p>	<p><b>Promote comprehensive land use planning and inclusion of CCMP land use goals into local and regional planning documents.</b></p> <p>METRIC: Number of local and regional planning agencies including CCMP land use goals in their planning documents.          MILESTONE:          6-1 a: Engagement of county and municipal planning departments in discussions about CCMP land use goals.</p>	<p>OCPD, MCPD, Municipalities, BBP, NJDEP, Pinelands Commission, NGO Partners (including TNC, ALS, SBB)</p>	<p>Ongoing</p>	<p>\$\$</p>
	<p><b>LU 6-2</b></p>	<p><b>Develop and coordinate workshops for specific audiences on sustainable land use practices, e.g. low impact development (LID) and soil restoration techniques.</b></p> <p>METRICS: Number of workshops, number of workshop attendees, number of individuals or entities implementing sustainable land use practices post-workshop          MILESTONES:          6-2a: Inventory existing workshops          6-2b: Develop new workshops for specific audiences as needed</p>	<p>NJDEP, OCSCD, BBP, JC NERR, NRCS, Sustainable Jersey</p>	<p>Ongoing</p>	<p>\$\$</p>

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	<p><b>LU 6-3</b></p>	<p><b>Disseminate information and provide workshops that help watershed communities plan and prepare for climate change/sea-level rise.</b></p> <p><b>METRICS:</b> Number of watershed communities implementing actions to address climate change impacts.</p> <p><b>MILESTONES:</b>          6-2a: Inventory existing materials and workshops          6-2b: Develop new materials and workshops for specific audiences as needed</p>	<p>JC NERR, BBP, Sustainable Jersey, NJSGC</p>	<p>Ongoing</p>	<p>\$\$</p>
	<p><b>LU 6-4</b></p>	<p><b>Maintain and expand the Jersey-Friendly Yards website as a comprehensive source of information about sustainable landscaping practices for watershed property owners.</b></p> <p><b>METRIC:</b> Number of watershed property owners implementing JFY best management practices.</p> <p><b>MILESTONES:</b>          6-4a: Development of JFY certification programs for specific target audiences, such as residents, schools, and businesses.          6-4b: Enrollment of individuals or entities in certification programs.</p>	<p>BBP, NJDEP, OCSCD, RCE</p>	<p>Ongoing</p>	<p>\$\$</p>

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	<b>LU 6-5</b>	<p><b>Promote the understanding of the ecosystem services and economic value of wetlands and other natural habitats.</b></p> <p>METRIC: Number of educational materials distributed; number of programs delivered.</p> <p>MILESTONES:          6-5a: Inventory available education materials and develop new materials, as necessary          6-5b: Development and delivery of programs.</p>	NJDEP, BBP, JC NERR	Ongoing	\$
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## Chapter 8 Monitoring Plan

The Barnegat Bay Partnership and many of its partners, especially the NJDEP, routinely conduct and support monitoring throughout the watershed to help track the health of various conditions within the bay and watershed, as well as to identify emerging issues. Much of this monitoring information is incorporated into the BBP's State of the Bay Reports, which were published in 2005, 2011, and 2016; other monitoring information is incorporated into the NJDEP's Integrated Water Quality Report. 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 bay, especially the NJDEP's Comprehensive Baywide Water Quality Monitoring (see <http://www.nj.gov/dep/barnegatbay/plan-wqstandards.htm>), our understanding of the bay is improving.

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 applied actions, may require monitoring at different levels (species, natural communities, implementation activities) and across multiple scales (local, regional, statewide). Through varying styles of monitoring, we can identify challenges or impacts of management activities or landscape alterations. Finally, monitoring must be inherent in simply understanding the effects, intended or otherwise, of any management approach.

In 2017, the BBP Science and Technical Advisory Committee released its Barnegat Bay Prospectus: Monitoring, Assessment and Research Priorities for the Barnegat Bay-Little Egg Harbor Ecosystem to Support Science-Based Watershed Management. This was a revision of the STAC's 2010 Prospectus, which identified research priorities and data gaps which were funded by NJDEP as part of the NJDEP 2010 Barnegat Bay Initiative.

This 2017 document identified the 5 main categories of studies which are considered critical to advancing our understanding of the bay and monitoring the effectiveness of restoration activities:

- Comprehensive Water Quality and Biotic Monitoring
- Targeted Watershed Studies
- Water Supply/Flow Issues
- Soil Health Assessment and Restoration
- Coastal Wetlands Monitoring and Enhancement

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Over the next 2 years, the BBP Program Office staff, along with the BBP Science and Technical Advisory Committee (STAC) will work together to develop a comprehensive monitoring plan for the Barnegat Bay and Watershed, in support of CCMP implementation, and taking into account the impacts of climate change and sea level rise. To the extent possible, BBP will work to coordinate and connect its monitoring plan with the JC NERR monitoring plan.

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## Chapter 9 Organization and Financial Strategy

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 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 EPA National Estuary Program in accordance with Section 320 of the Clean Water Act, which was most recently re-authorized in 2016. This funding covers a large percentage of the BBP's operations; however, this funding, awarded via federal appropriations processes, has been dynamic over the past decade and is not guaranteed. This Section 320 CWA funding remains critical to the continuing operation of the BBP and nearly all other NEPs; nonetheless, it does not pay for all of the BBP's operations. 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 EPA, the BBP Program Office identifies and applies for other grant funding, mainly from state and local government sources, to support project implementation. However, as the BBP is a part of a public county college which is an instrument of county government, the BBP is not able to conduct direct fundraising or apply for grants that require an IRS 501(c)3 designation.

**The Barnegat Bay Watershed and Estuary Foundation was established in 200X to** provide fundraising support to the BBP. As an independent 501(c)3 nonprofit organization, this group was able to raise funding through the years through donation and special events; however, the group is currently inactive and its future is uncertain.

To maintain the level of work currently underway and meet the challenges of the future, the BBP and its partners recognize that they will need to continue to increase revenue and diversify their funding. As part of this effort, the BBP will be conducting an Organizational Needs Assessment in summer 2018 to investigate the following:

- 1) Long-term staffing needs of the Program Office;
- 2) Long-term facilities needs (including staff office space, laboratories, field facilities, storage, exhibit space, visitor center, outreach and educational space);



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- 3) Operational needs of the BBP, including a review of the conditions of the current Memorandum of Understanding; and
- 4) Organizational structure of the BBF and its relationships to the BBP Program Office, OCC, OCC Foundation, and other partner organizations.

Once completed, the Organizational Needs Assessment results will be used, along with BBP financial data for the past several years, 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 implementation. The Financial Strategy will also identify the organizational options for re-establishing the BBF to work in concert with all program partners and other bay stakeholders to support CCMP implementation.

The Financial Strategy will be included/appended here.

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## Chapter 10 - 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 Barnegat Bay watershed is fortunate to have 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 have formed successful working partnerships to carry out various projects and 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.

### 10.1 Goal and Objectives

The goal of the Communication Plan is 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 CEC has 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.

### 10.2 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).

### **10.3 Implementation**

The BBP’s CEC has 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.

### **10.4 Next Step – Revision**

After the CCMP revision is completed, the BBP will review and revise the Communication Plan with the goal of supporting the objectives and actions in the new CCMP.

## **Chapter 11 CCMP Revision Process**

### **1.0 11.1 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 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. 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. 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 possible disintegration of barrier islands.

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). 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.

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 there were considerable overlaps between these two categories, leading to a great deal of duplication. Upon further examination, it was concluded that combining the two categories into one priority area would eliminate unnecessary duplication in the document and would allow the CCMP Goals, Objectives and Actions to be more streamlined, without sacrificing detail or impacting intended ecological outcomes.

## **11.2 NEP Contributions**

### **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.

### **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.

### **Wetlands Research**

Freshwater tidal, brackish, and salt marshes are hallmark features for the coastal plain region of New Jersey and represent perhaps the most critically important habitat type for both ecosystem functioning and human health. Improved assessment and monitoring of these important habitats help us to manage water quality by understanding not only how water quality affects marshes but also how tidal wetlands

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affect water quality. A better understanding of marsh status and trends will also help us to manage key living resources and healthy tidal marshes (especially salt marshes) are imperative as we begin to address the impacts of climate change and sea level rise.

In 2009, BBP began working with the Partnership for the Delaware Estuary on an integrated wetlands monitoring and assessment network in New Jersey that would include both the Barnegat Bay and the Delaware Bay. The monitoring project utilizes the USEPA’s three-tier wetlands guidance for the development of a monitoring and assessment program. To date, the New Jersey initiative has received funding support from the USEPA (Headquarters and Region 2) and pass-through funding from the NJ Department of Environmental Protection’s 319 (h) Program and NJ Coastal Management Office.

BBP and the PDE are closely working together with the NJ Department of Environmental Protection, USEPA’s Region 2 and Headquarters Offices of Wetlands, Oceans and Watersheds, The Academy of Natural Sciences of Philadelphia, US Fish & Wildlife Service and other partners. 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. MACWA was conceived as a pilot effort by the PDE within the Delaware Estuary to be a part of the National Water Quality Monitoring Network.

**STAC Funded Research**

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
USGS	An Analytical Framework For Evaluating Present And Future Watershed Inputs To The Barnegat Bay-Little Egg Harbor Estuary	2003
OCSCD	Sub-aqueous Vegetation Sediment Classification System and Mapping Study for the Barnegat Bay	200X
Rutgers University	Establishment of a Biodiversity Index for the Barnegat Bay-Little Egg Harbor Estuary	2002
Rutgers University	Submerged Aquatic Vegetation and Benthic Habitat Mapping for the Barnegat Bay-Little Egg Harbor Estuary	2003
Rutgers University	Barnegat Bay Build-out Analysis	?
Rider University	The Effect of Artificial Shoreline on Habitat Quality and Mortality of Blue Crabs, <i>Callinectes sapidus</i> )	2004

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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
Rider University	Fecundity of BB Blue Crab: the influence of size, seasons and relative fishing efforts	2010

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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



11.3 **Map of Study Area**



## **11.4 NEP Management Conference**

The Barnegat Bay Partnership (BBP) is a partnership of federal, state, county, municipal, academic, business, non-profit, and private organizations working together to protect, restore, and enhance the natural resources of the Barnegat Bay ecosystem. Since 2003, the BBP and its staff have been administered through Ocean County College and supported with a grant award from the USEPA.

The BBP is administered as a department of Ocean County College, and currently has a 6-person staff (5 full-time, 1 part-time). The Partnership's management structure includes:

### **Policy Committee**

The Policy Committee is comprised of high-level municipal, county, state, and federal leaders, as well as a Science and Technical Advisory Committee member and a Citizen representative. The Policy Committee provides overall direction and sets priorities for the BBP, defines Advisory Committee membership, and selects the Program Director.

### **Advisory Committee (AC)**

The AC is comprised of representatives from federal, state, and county agencies, other partners, and the chairs of the Science and Technical Advisory Committee and Communication and Education Committee. The AC refines the definitions of watershed problems and develops strategies to solve them, provides oversight to the scientific characterization of the watershed, prepares action plans for the CCMP, and plans programs to implement the CCMP.

### **Science and Technical Advisory Committee (STAC)**

The STAC is composed of scientists, engineers, environmental professionals, planners, citizen interest groups, representatives from federal, state, and local governments, and individuals from academia and industry. The STAC provides the BBP and collaborating entities with objective, expert advice and peer review for overall scientific and technical matters related to National Estuary Program activities and goals, such as those specified in the CCMP. It works with the Advisory Committee to identify and prioritize science and technical needs within the Barnegat Bay-Little Egg Harbor estuary and its watershed, and assists with the BBP's efforts to raise awareness and resources for addressing these needs. The STAC also facilitates communication among other specialized science and technical subcommittees, and recommends forming and disbanding new STAC sub-committees and technical work groups as needed.

### **Communication and Education Committee (CEC)**

The CEC provides the BBP and collaborating entities with objective, expert advice and peer review for

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overall communication, education and outreach matters related to National Estuary Program activities and goals, such as those specified in the CCMP and the BBP's Communication Plan. The CEC works with the Advisory Committee to identify and prioritize communication, education, and outreach needs within the Barnegat Bay-Little Egg Harbor Estuary and its watersheds, and assists with the BBP's efforts to raise awareness and resources for addressing these needs. The CEC also facilitates public participation and diverse stakeholder involvement in BBP-related activities and assists with the selection of the Citizen Representative to the BBP Policy Committee.

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## 11.5 Changes to Existing CCMP Action Plans

The following table shows Action Items from the previous Barnegat Bay CCMP as well as the status of those Action Items. This review of accomplishments is required periodically to ensure continual progress is being made toward program goals.

Action Item #	Action Item Title	Priority	Lead/ Partners	Status/Schedule	Cost	Comments; Reason if not completed
<b>Water Quality and Water Supply Action Plan</b>						
5.9	Identify & reduce water quality problems from livestock farms & manure piles	Low	USDA-NRCS, OCPD, OCSCD, DEP/DWM	Completed	\$ 66K	
5.11	Sample and analyze water to evaluate fertilizer and pesticide residues introduced into surface water systems.	Medium	Rutgers Cooperative Extension (RCE)	Completed	\$ 37K	Action addressed in part via statewide fertilizer law; fert. activities incorporated into revised CCMP
***5.17	Acquire a sewage pumpout boat for Barnegat Bay & its major tributaries.	High	New Jersey Clean Vessel Program (CVA), OCPD	Completed	\$ 57K	Model program continued since inception; included in revised CCMP.
***5.18	USEPA designation of Barnegat Bay as a No Discharge Zone.	High	New Jersey Marine Sciences Consortium, OCPD	Completed in 2003	\$ 15K	Action remains in place but no longer in CCMP.
5.5	Encourage native species landscaping to minimize water use and fertilizer and pesticide application.	Medium	BBP/ OCSCD; NJDEP	Ongoing	Base Programs; NJDEP grant \$?	JFY website developed; action included in revised CCMP
5.6	Develop a financial incentives mechanism,	Medium	OCSCD	No Action	\$ 75,000	Lack of funding; changing and conflicting perspectives (?)

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Action Item #	Action Item Title	Priority	Lead/ Partners	Status/Schedule	Cost	Comments; Reason if not completed
	"Water Quality Rebate," for implementing BMPs on non-federal, non-agricultural lands.					
5.8	Promote existing technical and financial assistance programs to implement soil management practices on agricultural lands.	Medium	USDA-NRCS, OCPD and OCSCD	No action	\$ 20,000	Changing priorities; ag < 1% of watershed land use. No longer a CCMP priority?
5.12	Continue publication of "Pesticides for NJ" to include site-specific recommendations for the use of pesticides on golf courses & public lands.	Medium	Rutgers Cooperative Extension (RCE)	No action as proposed; related actions completed.	\$ 1,000	Related action addressed through statewide fertilizer law; include in revised CCMP.
5.13	Promote <i>Home*A*Syst for the Barnegat Bay Watershed</i> (RCE, 1998) through widespread distribution.	Medium	Rutgers Cooperative Extension (RCE)	No Action	\$ 7,000	Lack of funding and changing priorities.
5.14	Periodically examine technical and permit data on small point source discharge permit holders in order to promote and maintain	Medium	Barnegat Bay Estuary Program (STAC)	No Action	\$ 1,500	Low priority but possible addressed through municipal compliance or other programs(?).

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Action Item #	Action Item Title	Priority	Lead/ Partners	Status/Schedule	Cost	Comments; Reason if not completed
	understanding of their relationship to the overall ecological health of the bay.					
***5.1	Development of Total Maximum Daily Loads (TMDLs) for areas listed on the 303 (d) list of impaired waterbodies.	High	NJDEP	Ongoing	\$ 300,000	Nutrient TMDL a high priority included in revised CCMP.
***5.2	Complete a high-intensity Natural Resources Inventory to identify pollution sources from land use information and site conditions.	High	OCSCD, NRCS, OCPD, municipalities	Completed in some municipalities; ongoing in others.	\$ 375,000	Being addressed in revised CCMP through WMPs.
5.3	Retrofit retention or detention basins, and retrofit stormwater basins to increase infiltration and recharge of rainfall runoff.	Medium	NJDEP, OCPD and OCSCD	Ongoing	\$ 200,000	Ongoing; long-term action included in revised CCMP.
***5.4	Implement Phase II Municipal Stormwater Rules in the Barnegat Bay Watershed.	High	NJDEP, OCPD, BBNEP, Envir. Joint Ins. Fund	Ongoing	Base Programs	Ongoing; long-term action included in revised CCMP.
5.7	Institute the Nonpoint Education for	Medium	Rutgers Cooperative	Completed	\$ 65,000	Completed; included in CEC Comm. Plan of revised CCMP (?).

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Action Item #	Action Item Title	Priority	Lead/ Partners	Status/Schedule	Cost	Comments; Reason if not completed
	Municipal Officials (NEMO) program within the Barnegat Bay watershed.		Extension (RCE), OCPD			
5.10	Develop a management strategy to reduce the congregation of Canada Geese populations in urban areas.	Medium	Ocean County Health Department (OCHD)	Ongoing		Related action included in revised CCMP.
5.15	Periodically examine technical and permit data on the Oyster Creek Nuclear Generating Station in order to promote and maintain an understanding of its relationship to the overall ecological health of the bay.	Medium	NJDEP, BBP STAC	Ongoing	\$ 2,500	OCNGS closure assessment to be Included in revised CCMP.
***5.16	Eliminate the discharge of boat sewage into the bay by promoting the use of sewage pumpout facilities.	High	NJDEP CVA/CMP; NJMSC; OCPD; MTA	Ongoing	Base Programs	To be included in revised CCMP; critical to replace pumpout capacity lost due to Sandy
***5.19	Develop Clean Marinas Program	High	MTA; OCPD	Completed; ongoing	\$ 10,000	Program developed but needs funding; critical to replace pumpout capacity lost due to Sandy

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Action Item #	Action Item Title	Priority	Lead/ Partners	Status/Schedule	Cost	Comments; Reason if not completed
***5.20	Establish a comprehensive water supply plan for the Barnegat Bay watershed that will guide water supply development, use, and reuse through the year 2040 and, to the maximum extent possible, maintain the natural hydrology of the watershed.	High	NJDEP, OCPD and OCSCD	Ongoing	\$ 500,000	Statewide Water Supply Master Plan released, but key BB issues (e.g., determination of minimum ecological flows) to be included in revised CCMP
***5.21	Develop a workplan and institute controls for management of water demand/water conservation.	High	NJDEP, OCPD and OCSCD	Status unknown	\$ 125,000	To be included in revised CCMP; Convene all responsible agencies to discuss and carry out the following detailed steps that are summarized as follows: 1) Evaluate the Opportunities for Water Supply Interconnections between Adjacent Public Supply Systems; 2) Assessment of Irrigation Systems in the Barnegat Bay Watershed; 3) Develop Public Service Announcements (PSAs) for Water Conservation, Water Demand Management, and Drought Awareness; and, 4) Evaluate the Potential to Reinstate Conjunctive Use of the Potomac-Raritan-Magothy Aquifer System in the Barnegat Bay Watershed During Periods of Drought. NJDEP/DWM has initiated workplan development and is coordinating with the BBP.
***5.22	Integrate existing shallow groundwater protection programs.	High	NJDEP	Status unknown		Specific steps for integrating groundwater programs will be developed by cooperating parties, and a plan to protect groundwater supplies developed by linking the following efforts. The data collected will



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Action Item #	Action Item Title	Priority	Lead/ Partners	Status/Schedule	Cost	Comments; Reason if not completed
						be entered into the NJDEP GIS. Additional steps may be identified in conjunction with results of ongoing groundwater protection efforts. The three major efforts are summarized as follows: 1. Integrate Results of Ongoing Studies; 2. Integrate Results of the Source Water Assessment Program; and, 3. Coordinate Protection Programs. Toms River, Metedeconk studies and Southeast New Jersey Water Supply studies and projects are ongoing. NEDS more internal DEP/DWM discussion.
5.23	Establish a network of three weather stations in the watershed tied to the South Jersey Resource Conservation & Development RISE network.	Low	South Jersey Resource Conservation & Development (SJRCDD), OCPD	Completed.	\$ 6,750	Network of local weather stations in place; no longer a priority.
5.24	Establish a demonstration project for wastewater reuse, which will be discharged back to the watershed, and which alleviates the need for potable water for irrigation of lawns, golf courses, or other public areas.	Medium	OCUA, OCPD	Status unknown		To be included in revised CCMP. In 2001, the OCUA began a feasibility study to determine positive and negative aspects of diverting a portion of the OCUA Central Wastewater Treatment Plant effluent through a tertiary new treatment process. Pump the final treated effluent for use in irrigating existing and future golf courses near the facility. Final decision has not been made. In 2002, discussions began with the OCUA to examine other wastewater re-use opportunities. Prior to the initiation of a "Demonstration project", OCUA is currently using an outside consultant to perform a feasibility study (at a cost of \$90,000) to assess the demand for reclaimed water and the economics of same. This study was started in 2003

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						and should be complete in June/July 2004. The next logical step after the feasibility study would be the demonstration project. An Initial Proposal was sent to EPA for a Grant to conduct the demonstration project. The Demonstration Project would be dependent upon sufficient demand for reclaimed water as well as support from the governing bodies and the environmental community within Ocean County.
***5.25	Assist municipalities in their involvement in the NJDEP Shellfish Waters & Bathing Beaches protection strategies for the Barnegat Bay watershed.	High	Toms River, Seaside Heights, NJDEP, BBP STAC	Ongoing	\$ 500,000	To be included in revised CCMP The objective of this action plan is to ensure that the existing shellfish and recreational bathing water quality planning and management strategy is fully comprehensive. The Implementation of point and/or nonpoint source pollution controls is being funded and coordinated by the NJDEP through its watershed management program. Integral components of this shellfish and recreational bathing beach water quality management plan include: 1. Point Sources Controls; 2. Malfunctioning Septic Systems; and, 3. Urban/Suburban Stormwater Runoff. In 2004, OCUA completed a proposal for a demonstration project. Completed the Long Swamp Creek 319(h) feasibility study and an initial implementation project in the lower portion of the watershed and also designated Long Swamp Creek the priority stream segment in the watershed. The intent is to fund additional implementation projects using CBT or 319(h) funds to improve water quality. In addition, the Department also plans to undertake additional source trackdown sampling in the lower

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						reaches of the segment as recommended in the plan.
<b>Habitat and Living Resources Action Plan</b>						
6.6	Implement more effective LE of regulations regarding sensitive coastal habitats.	Medium	State & federal LE	Completed	\$ 50,000	Follow-up actions to be included in revised CCMP
6.7	Coordinate and integrate management of federal lands for natural habitat values.	Medium	USDOD/ MAFPE	Related state-county LE ongoing	\$ 50,000	Related follow-up actions to be included in revised CCMP.
6.10	Assess the effectiveness of CAFRA II regulations within the Barnegat Bay Coastal Zone Boundary	Low	NJDEP	Completed; CAFRA reviewed and revised in 2014		Follow-up action to be included in revised CCMP.
***6.1	Protect & improve vegetated buffer zones adjacent to coastal wetlands & freshwater tributaries to maintain continuous riparian corridors, for habitat protection & low-impact recreational pursuits.	High	NJDEP OCPD	Ongoing	\$ 37,500	Coastal resilience projects to be included in revised CCMP.
***6.2	Conduct a Barnegat Bay ecosystem	High	USACE, NJDEP	Portions Completed	\$ 2,500,000	Two fish ladders were installed and 2 dredged holes were restored. They have also done a draft report, as well as plans and specifications, for fish ladders at

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	restoration feasibility study.					Lake Pohatcong and Manahawkin Lake. In 2003-2004 approximately \$534,000 spend by USACE and NJDEP on Barnegat Bay restoration projects and \$100,000 by USACE on Mordecai Island restoration.
6.3	Control erosion in threatened shoreline areas.	Low	NJDEP, OCPD	Ongoing	\$ 75,000	Follow up actions (post-Sandy coastal resilience) to be included in revised CCMP.
6.4	Manage tidal wetlands to preserve unditched wetlands & to rehabilitate wetlands that have been ditched or otherwise altered.	Low	USFWS, OCPD	Ongoing	\$ 15,000	Follow up actions (post-Sandy coastal resilience) to be included in revised CCMP.
6.5	Maintain intact large blocks of Pinelands habitat within state parks & forests & other publicly owned lands.	Medium	NJDEP, OCPD	Ongoing	\$ 25,000	To be included in revised CCMP
<b>***6.8</b>	Facilitate partnerships for habitat protection & restoration projects	High	NJDEP, OCNLT, NRCS, ONLM, TPL, OCPD	Ongoing		To be included in revised CCMP
<b>***6.9</b>	Revise municipal master plans to encourage subwatershed planning to minimize impervious coverage & maintain natural	High	NJDEP, OCPD, municipalities	Ongoing	\$ 100,000	To be included in revised CCMP

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	habitat & landscape values					
6.11	Identify and manage impaired sub-watersheds through local government cooperation to address water resource issues that cross municipal boundaries.	Medium	US Environmental Protection Agency (USEPA), OCPD	Ongoing	\$ 50,000	To be included in revised CCMP
6.12	Develop a cooperative approach among the Pinelands Commission, state parks, state wildlife management areas, state forests, and other state agencies to coordinate watershed protection on state lands.	Medium	NJDERP, PC, OCPD	Ongoing	\$ 50,000	To be included in revised CCMP
<b>Human Activities and Competing Uses Action Plan</b>						
***7.1	Draft a Barnegat Bay personal watercraft (PWC) management strategy, thereby setting an example for statewide policy.	High	PWC Task Force	Completed (?)	\$ 10,000	Alternative approach to managing sensitive habitats in consideration; to be included in revised CCMP (?)
7.2	Promote the use of the "Boater's Guide to Barnegat Bay and Little	Medium	RCEOC, MTANJ, OCPD	Completed	\$ 20,000	Related/follow-up actions to be included in CEC Comm. Plan of revised CCMP (?)

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	Egg Harbor" to protect sensitive areas by mitigating boater impacts to water quality and natural resources.					
7.9	Construct an environmentally sensitive demonstration lawn for homeowners to use as a model for landscaping plans.	Medium/	RCEOC, OCSCD, NJDEP, BBP	Completed but ongoing	\$ 6,500	JFY to be included in revised CCMP
7.6	Establish a Barnegat Bay Blue Card certification program on soil health, low-input landscapes, and balancing the water cycle.	Low	OCSCD OCPD	Completed; ALS Bay Scape program	\$ 75,000	JFY follow-up actions to be included in revised CCMP
7.7	Use data & information from the Natural Resources Inventory (NRI) to promote the use of Best Management Practices (BMPs).	Low	OCSCD	Related actions completed; ongoing	\$ 75,000	JFY follow-up actions to be included in revised CCMP
7.3	Follow-up the Municipal Outreach Project with continued production of	Medium	BBWEF	Discontinued	\$ 10,000	Low priority; discontinued (?)

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	"Community Connection" newsletter & with a community awards program.					
7.4	Use environmental commissions to foster the watershed approach	Medium	BBEP, Ocean County Environmental Agency	Ongoing	Base Programs	Environmental commissions are currently included in the local and county government planning processes; does regular outreach to ECs. The BBEP has created a stronger linkage to CCMP goals and objectives to assist environmental commissions and helping local governments better pursue sustainable development policies through membership on the OCEA.
***7.5	Support the Barnegat Bay Watershed and Estuary Foundation (BBWEF) to protect Barnegat Bay and its watershed resources	High	Municipal and county governments, OCPD	In review as part of CCMP	\$ 55,000	Follow-up actions to be included in revised CCMP.
7.8	Design and construct environmentally sensitive demonstration gardens in all municipalities.	Low	Rutgers Cooperative Extension (RCE), OCPD	Ongoing	\$ 35,000	JFY follow-up actions to be included in revised CCMP.
7.10	Conduct shellfish resource survey of the bay to examine potential causes of stock decline and meat discoloration in hard	Medium	NJDEP	Completed	\$ 190,000	Completed; related actions ongoing; to be included in revised CCMP

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	shell clams and explore resource enhancement strategies so than an adequate supply of shellfish exists to reap the benefits of improved water quality resulting from Action Item 5.24 in the Water Quality/Water Supply Action Plan.					
<b>Public Participation &amp; Education Action Plan</b>						
8.1	Post the Pinelands Curriculum Guide Lessons for Grades 4-6 & 7-8 on the World Wide Web.	Low	Pinelands Commission	Complete	\$ 20,000	To be included in CEC Comm Plan as part of revised CCMP. Posted at <a href="http://www.state.nj.us/pinelands/pinecur/index.htm">www.state.nj.us/pinelands/pinecur/index.htm</a> . Link can be found on the BBNEP website.
8.4	Conduct an annual Environmental Educators Roundtable.	Medium	OCSCD	Completed; Ongoing	\$ 2,500	To be included in CEC Comm Plan as part of revised CCMP.
8.6	Develop the Forest Resource Education Center (FREC) as a resource and interpretive center that promotes an understanding of the human & resource connections & a stewardship ethic among students,	Medium	NJDEP, OCPD	Completed;	\$ 20,000	FREC programs to be included in CEC Comm Plan as part of revised CCMP.



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	scouts, & the general public.					
***8.8	Develop a Barnegat Bay watershed-specific activity guide.	High	OCSCD OCPD	Completed; ongoing	\$ 60,000	Ongoing implementation workshops to be included in CEC Comm Plan as part of revised CCMP.
8.12	Create a Barnegat Bay-specific Educational Guide outlining the natural and cultural ecotourism opportunities in Central New Jersey, with an emphasis on the Barnegat Bay watershed region.	Low	NJMSC	Completed	\$ 20,000	To be included in CEC Comm Plan as part of revised CCMP.
***8.14	Provide interpretive exhibits, programs, & activities focusing on the historical human uses of the environmental resources within the Barnegat Bay watershed.	High	Barnegat Bay Decoy & Baymen's Museum	Completed; ongoing	\$ 1,290,000	Partner(s) to be included in CEC Comm Plan as part of revised CCMP.
8.16	Revise and reprint the "Low-Maintenance Landscaping Homeowners' Guide."	Medium	OCSCD, RCEOC, OCPD	Completed; ongoing	\$ 35,000	To be included in CEC Comm Plan as part of revised CCMP.
8.11	Establish a Bay Keeper Program as a public	Low	Water Keeper Program	Completed (ALS); ongoing	\$ 60,000	To be included in CEC Comm Plan as part of revised CCMP (?).

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	watchdog for the protection of Barnegat Bay.					
8.17	Educate professional landscapers, municipal grounds personnel, and facility managers on more efficient and environmentally sensitive use of pesticides.	Medium	Rutgers Cooperative Extension (RCE)	Completed in part via NJ Fertilizer law; ongoing	\$ 25,000	To be included as part of revised CCMP.
8.19	Incorporate Barnegat Bay Estuary Program outreach & education displays & programs at the Environmental Learning Center (ELC) of Ocean County.	Low	OCVTS; OC Environmental Learning Center (ELC)	Completed; ongoing	\$ 40,000	MATES to be included as partner in CEC Comm Plan as part of revised CCMP.
8.2	Conduct two, two-day summer teacher workshops through the Ocean County Vocational-Technical School (OCVTS) that focus on the Barnegat Bay Estuary and watershed.	Medium	OCVTS	Ongoing	\$ 5,100	Ongoing via partner efforts; To be included in CEC Comm Plan as part of revised CCMP.
8.3	Revise & reprint the Barnegat Bay Watershed	Medium	Barnegat Bay Environmental Education Roundtable	Completed (?)	\$ 5,000	Revised; to be included in CEC Comm Plan as part of revised CCMP (?)

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	Educational Resource Guide.					
<b>***8.5</b>	Support the <i>Sea Grasses for Classes</i> Project-Institute of Marine & Coastal Sciences (IMCS), Rutgers University.	High	RU/ JC NERR	Ongoing	\$ 55,000	Revised (MARE); to be included in CEC Comm Plan as part of revised CCMP (?)
8.7	Develop a Barnegat Bay Watershed Education Campaign, to be implemented in elementary schools via a mascot, "Barnie the Crab."	Medium/	Barnegat Bay Watershed & Estuary Foundation (BBWEF)	Completed; discontinued (?)	\$ 60,000	Related programming to be included in CEC Comm Plan as part of revised CCMP (?)
8.9	Continue the Alliance for a Living Ocean (ALO) Ecotour of a Barrier Island for schoolchildren and the general public.	Medium	Alliance for a Living Ocean (ALO)	Ongoing (?)	\$ 5,000	Related programming included in CEC Comm Plan as part of revised CCMP (?)
8.10	Promote the development & use of outdoor classrooms.	Medium	OCSCD, OCPD	Ongoing	\$ 5,000	Included in CEC Comm Plan as part of revised CCMP.
8.13	Establish one waterway cleanup per year within the Barnegat Bay watershed.	Medium	MTANJ, BBWEF, COA	Ongoing	\$ 10,000	Included in CEC Comm Plan as part of revised CCMP.

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***8.15	Provide education & technical training to local government officials & other coastal decision makers in the Barnegat Bay watershed.	High	JC NERR	Ongoing	\$ 893,000	CTP and related efforts to be included in CEC Comm Plan as part of revised CCMP.
8.18	Promote the use of IPM methods.	Medium	RCEOC; OCSCD	Ongoing	\$ 26,500	Related programs linked by JFY, to be included in CEC Comm Plan as part of revised CCMP.
8.20	Experience Barnegat Bay, a project of YES	Medium	NREF;	Ongoing	\$ 150,000	NREF (Lighthouse Camp) to be included in CEC Comm Plan as part of revised CCMP.