








**DELAWARE INLAND BAYS**  
**COMPREHENSIVE CONSERVATION**  
**AND MANAGEMENT PLAN**  
**2021**



# TABLE OF CONTENTS

	<b>Acknowledgments</b> _____	1
	<b>About Us</b> _____	2
	<b>Introduction</b> _____	4
	The Delaware Inland Bays _____	4
	State of the Delaware Inland Bays _____	6
	Delaware Inland Bays National Estuary Program _____	12
	<b>A Guide to the 2021 Inland Bays CCMP</b> _____	23
	<b>Living with a Changing Climate</b> _____	24
	Objective 1: Increase community and local government understanding and help prepare communities for potential impacts of the changing climate through mitigation and adaptation actions. _____	26
	Objective 2: Use research, monitoring, and modeling to analyze and project climate change impacts to the Inland Bays watershed. _____	28
	<b>Clean Waters: Healthy Agricultural Landscapes</b> _____	30
	Objective 1: Broaden partnerships within the agricultural community. _____	31
	Objective 2: Reduce nutrient and sediment loads and other contaminants entering waterways from agriculture. _____	33
	Objective 3: Protect and restore natural ecosystems in the agricultural landscape. _____	36
	<b>Clean Waters: Reducing Pollution from the Developed Landscape</b> _____	37
	Objective 1: Conduct education and outreach to encourage management practices that limit pollution from nutrients, sediments, and other contaminants. _____	38
	Objective 2: Reduce the amount of nutrients, sediments, and other contaminants entering waterways from wastewater sources. _____	39
	Objective 3: Reduce the amount of nutrients, sediments, and other contaminants entering waterways from stormwater sources. _____	42
	<b>Healthy Bay Ecosystems: Protect and restore thriving habitats for abundant fish and wildlife</b> _____	44
	Objective 1: Continue to use research, monitoring, and modeling to capture trends that can provide information to help protect and restore prime habitat for fish and wildlife particularly in light of the CCVA findings. _____	44
	Objective 2: Enhance and restore fish populations and their habitats in the Inland Bays. _____	46
	Objective 3: Maximize the amount of natural Inland Bays shoreline. _____	47

Objective 4: Increase regulatory protections for wetlands and restore previously lost wetlands. _____	49
Objective 5: Enhance populations of eastern oysters and other shellfish species. _____	50
Objective 6: Control the spread of invasive species within the Bays and their watershed. _____	53

**Coordinated Land and Water Use Management \_\_\_\_\_ 54**



Objective 1: Increase and improve water access and waterway management. _____	54
Objective 2: Increase sustainable growth practices to reduce environmental impact. _____	57

**Education, Outreach, and Marketing \_\_\_\_\_ 59**



Objective 1: Enhance the James Farm Ecological Preserve and Education Program. _____	59
Objective 2: Educate residents, visitors, and tourists in the watershed about their impacts on water quality and how they can help improve the Bays. _____	61
Objective 3: Communicate environmental results and raise awareness about the importance of the Inland Bays and their watershed to promote public involvement and influence behaviors and actions to foster stewardship. _____	62
Objective 4: Encourage more stakeholder support through volunteerism. _____	64

<b>Appendix A: CCMP Implementation Agreement _____</b>	<b>65</b>
<b>Appendix B: Glossary of Terms and Acronyms _____</b>	<b>67</b>
<b>Appendix C: Index of Actions _____</b>	<b>69</b>

**TABLES**

Table 1: Comparison of CCMP Focus Areas, 1995, 2012, and 2021 _____	15
Table 2: PCS Actions within the 2021 Revised CCMP _____	21
Table 3: Cost Estimate Symbols _____	23

**FIGURES**

Figure 1: Map of the Inland Bays watershed study area _____	1
Figure 2: Map of 2012 land use with proposed development projects _____	5
Figure 3: Depiction of healthy bays versus unhealthy bays _____	6
Figure 4: Pervious vs. impervious surfaces _____	7
Figure 5: Nutrient pollution in the watershed _____	8
Figure 6: Committee Structure _____	13
Figure 7: Anatomy of CCMP Elements and Actions _____	23
Figure 8: Cover crop acres planted in the Inland Bays watershed using SCD cost share funds. _____	32

## BOARD OF DIRECTORS

Dr. Susan Ball  
Chair, Elected Director

Ms. Pat Coluzzi  
Vice Chair, Appointee of the Speaker of the Delaware House of Representatives

Mr. David Baird  
Treasurer, Sussex Conservation District

Ms. Aimee Isaac  
Secretary, Appointee of the Delaware Senate  
President *Pro Tempore*

Ms. Amie Howell  
U.S. Environmental Protection Agency Region III  
ex officio

Secretary Shawn Garvin  
Delaware Department of Natural Resources and  
Environmental Control

Mr. Gerard Esposito  
Board, Elected Director  
Chair, Development Committee

Mr. Todd Lawson  
Sussex County Administrator

Mr. Richard Mais  
Sussex County Association of Towns

Ms. Pat Ragan  
Board, Elected Director

Secretary Michael Scuse  
Delaware Department of Agriculture

Dr. Ken Sigvardson  
Board, Elected Director

Dr. Claire Simmers  
Chair, Citizens Advisory Committee

Ms. Jennifer Volk  
Chair, Scientific & Technical Advisory Committee

## CENTER STAFF

Mr. Chris Bason  
Executive Director

Mr. Mike Brough  
Oyster Gardening Program Assistant

Ms. Brittany Burslem  
Office Manager

Mr. Robert Collins  
Program Manager

Mr. Zachary Garmoe  
Science Technician

Ms. Jackie Knoll  
Head Environmental Educator

Ms. Mary Kunst  
Environmental Educator

Mr. Andrew McGowan  
Environmental Scientist

Ms. Kelli Papciak  
Administrative Assistant

Ms. Nivette Pérez-Pérez  
Project Manager

Ms. Michelle Schmidt  
Watershed Coordinator

Ms. Anna Short  
Development Coordinator

Ms. Aviah Stillman  
Watershed Assistant

Ms. Lisa Swanger  
Outreach & Education Coordinator

Dr. Marianne Walch  
Science & Restoration Coordinator

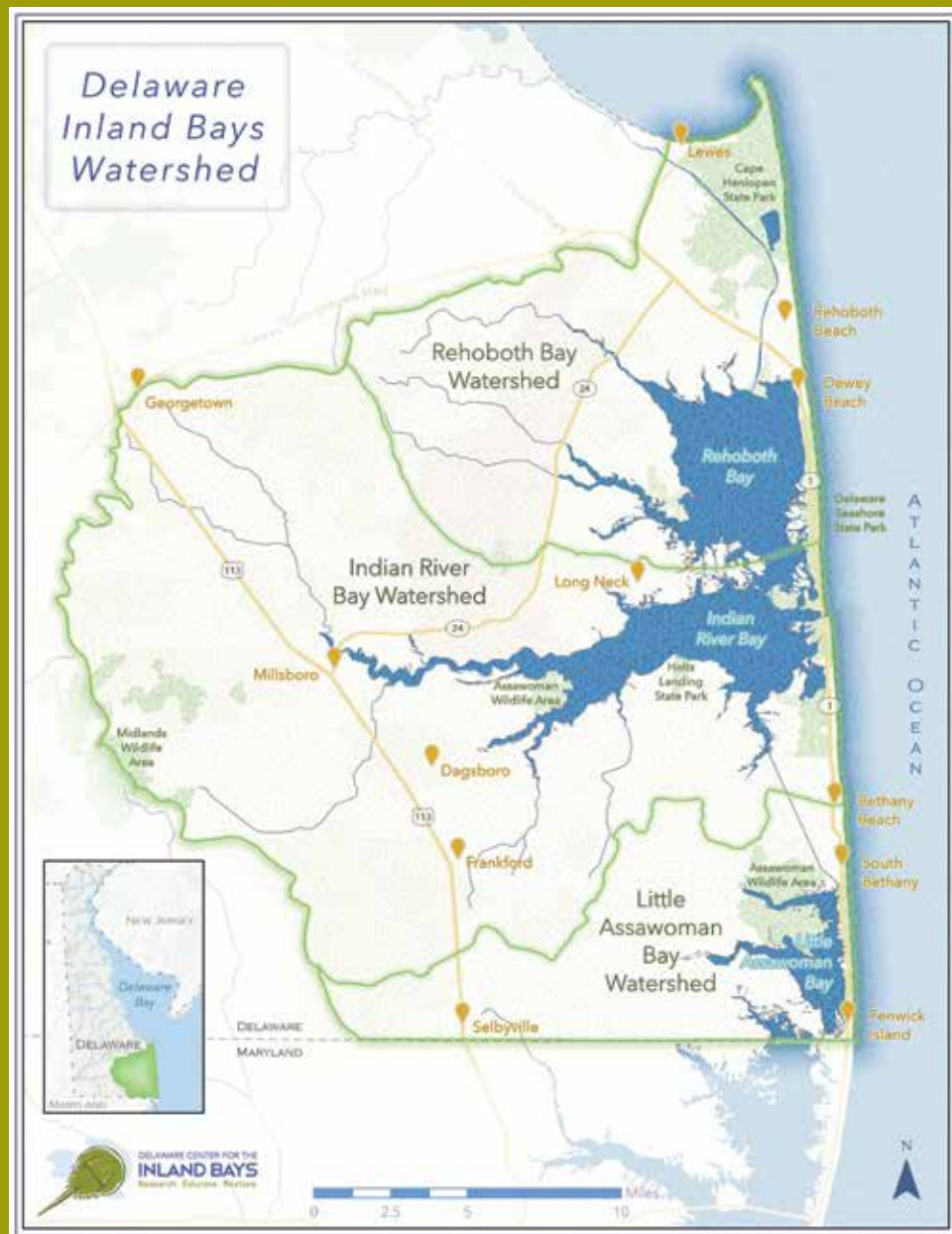


Figure 1

## Acknowledgments

The 2021 Comprehensive Conservation and Management Plan for the Inland Bays (CCMP) was prepared by Michelle Schmidt (Center's Watershed Coordinator), with research, writing, and data/graphics support from RK&K Consulting, Watershed Solutions, Center staff, and members of the Center's Scientific and Technical Advisory Committee (STAC), Community Advisory Community (CAC), and members of the CCMP Signatories. The Center's Board of Directors and the U.S. Environmental Protection Agency (EPA) approved this revision of the CCMP in 2021.

# ABOUT US



*Beach at James Farm Ecological Preserve.*

The Delaware Center for the Inland Bays (Center) was established as a nonprofit organization in 1994 under the auspices of the Inland Bays Watershed Enhancement Act (Title 7, Chapter 76). Its creation was the culmination of more than 20 years of active public participation and investigation into the decline of the Inland Bays and the remedies for the restoration and preservation of the watershed.

Delaware's Inland Bays were designated an "estuary of national significance" in 1988 by the U.S. Congress, and as such, the Center for the Inland Bays is one of the 28 National Estuary Programs (NEP).

The mission of the Center is:

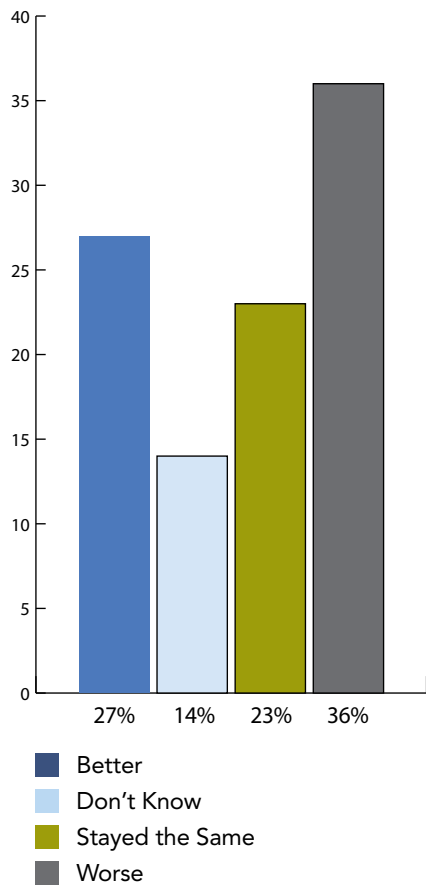
*To preserve, protect and restore Delaware's Inland Bays and their watersheds.*

And the goals of the Center are:

1. To facilitate the wise use and enhancement of the Inland Bays' Watershed through the coordinated implementation of the Inland Bays Comprehensive Conservation and Management Plan.
2. To provide a forum where science supports public education and decision making regarding the Inland Bays watershed.
3. To foster a collaborative, consensus-building culture among watershed stakeholders crucial to support research, education, protection and restoration initiatives, and to inform policy decisions.

The Center accomplishes these goals by working with its many partners to conduct public outreach and education, implement water quality and habitat restoration projects, conduct research, and support public policy.

**SURVEY: How do you believe water quality has changed in the Inland Bays over the last ten years?**



More than **500** people responded to the survey. Of those responses, **60%** identified urban/residential runoff as the biggest threat to the health of the Inland Bays today, and over half of the respondents identified urban/residential runoff and the construction of new developments as the biggest threat to the Inland Bays ten years from now.

**Public and Stakeholder Input**

The Center engaged a diverse group of stakeholders and the public during the development of the 2021 CCMP. An online survey (using non-Section 320 funding) was released in the Spring of 2018 to gather information about how people view the Bays.

Questions included:

**How do you believe water quality has changed in the Inland Bays over the last ten years?**

**What is the greatest concern for the health of the Bays?**

**What is your level of understanding of the issues surrounding clean water and healthy habitats?**

**What are the greatest threats to the health of the Bays in ten years?**

The information from the survey was used to develop actions and priorities that addressed these major concerns.

A series of workshops were held with technical and community experts from Delaware Department of Natural Resources and Environmental Control (DNREC), Delaware Department of Agriculture (DDA), Sussex Conservation District (SCD), University of Delaware, University of Delaware Cooperative Extension, United States Geological Service, U.S. EPA, and others. During these workshops, participants discussed priorities for the management of the Inland Bays over the next ten years, reviewed existing CCMP actions and discussed the status of implementation, and generated new or updated actions to address the most pressing issues for the next ten years.

Input was also solicited from STAC and CAC through meetings and discussions with STAC and CAC leads. During the four years that this document was being developed, input from partners was continuous and ongoing – through in-person meetings, emails, and conference calls.

A public forum was hosted in July 2018, where Center staff presented the draft core elements, objectives, and actions that were developed as a result of the workshops and partner input. The Center solicited public feedback on the initial elements of the draft at the forum. After the draft was completed, the Center sought public comment between September and November of 2020. A summary of the comments can be found here or on the Center’s website.

# INTRODUCTION



*Indian River Inlet.*

## The Delaware Inland Bays

The Delaware Inland Bays are three shallow interconnected coastal lagoons situated behind a narrow barrier island that separates them from the Atlantic Ocean. They are unique places where freshwater flowing from the land mixes with saltwater that flows through the Indian River and Ocean City Inlets. The Bays are dynamic, continually changing in response to human activities and the climate. Saltmarshes, tidal flats, bay grass meadows, oyster reefs, and saltwater creeks can all be experienced in this watershed and collectively provide immense value.

The Inland Bays watershed comprises approximately 292 square miles of eastern Sussex County, Delaware. Starting at Lewes and Cape Henlopen State Park at the southern edge of the entrance to Delaware Bay, the area extends southward 24 miles along the Atlantic shoreline to the Maryland state line. It includes the coastal communities of Rehoboth Beach, Dewey Beach, Bethany Beach, South Bethany, and Fenwick Island. State Route 1 (SR 1) extends parallel to the shoreline and connects the towns.

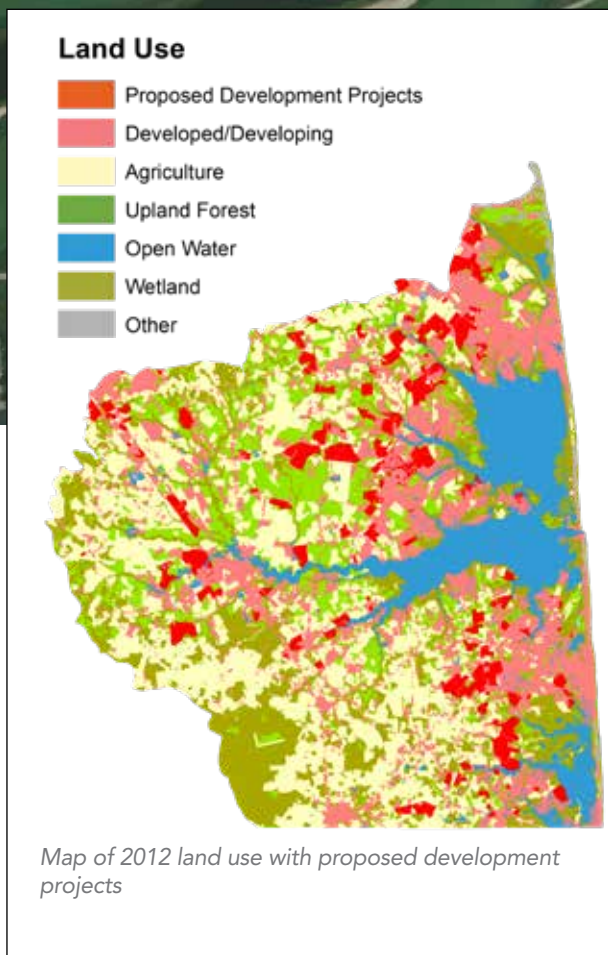
At the Maryland state line, the watershed boundary extends westward approximately

16 miles to the western edge of the Great Cypress Swamp and thence along an arcuate line extending northwestward about 19 miles to Georgetown, the county seat of Sussex. Along this boundary, starting at the Maryland State Line and proceeding northward, the towns of Selbyville, Frankford, Dagsboro, Millsboro, and Georgetown are connected by U.S. Route 113. The northern border of the Inland Bays and Delaware Bay watershed roughly parallels State Route 9 and extends from Georgetown northeastward back to Lewes and Cape Henlopen State Park. To the west is the Chesapeake Bay watershed. On the north and south side of the Inland Bays watershed are two other NEPs: Partnership for the Delaware Estuary and Maryland Coastal Bays Program, respectively. The Center works collaboratively with both the Partnership for the Delaware Estuary and Maryland Coastal Bays Program on projects and initiatives that further the mission of the National Estuary Program.

Since the first CCMP was published in 1995, the physical study area has remained much the same. The watershed area and size of the actual bays have not changed significantly. The dominant physiographic feature of the watershed is the three coastal lagoons that are located just



*Large development in the Inland Bays watershed.*



**Figure 2**

landward of the Atlantic Ocean shoreline. From north to south, these are Rehoboth Bay, Indian River Bay, and Little Assawoman Bay. Rehoboth Bay contains the Lewes-Rehoboth Canal and Rehoboth Bay watershed; the Indian River Bay contains the Indian River, Iron Branch, and Indian River Bay watersheds; and the Little Assawoman Bay contains the Little Assawoman, Assawoman, and Buntings Branch watersheds. Rehoboth Bay and Indian River Bay are tidally connected to the Atlantic Ocean by the Indian River Inlet. Little

Assawoman Bay is connected by the Ocean City Inlet 10 miles to the south in Maryland. The Bays are shallow, generally less than 7 feet, and have an average tidal range of 3 feet.

The Bays and tidal tributaries cover approximately 32 square miles. Various major and many smaller streams drain to the three Bays. The eight major tidal tributaries flowing into the bays are Love Creek, Herring Creek, and Guinea Creek (Rehoboth Bay); Indian River, Pepper Creek, and Whites Creek (Indian River Bay); and Miller Creek and Dirickson's Creek (Little Assawoman Bay).

Land use and land cover in the watershed, based on 2012 estimates, is 31% agriculture (including crops, orchard, and pasture), 17% forest (including brush), 28% water (including the Bays, wetlands, and barren areas), and 24% developed and developing lands (Figure 2).

Topography in the Inland Bays watershed is flat, typical of the Atlantic Coastal Plain Physiographic Province. The elevations in the watershed range from 0 to 22.9 meters, with an average of 6.9 meters. Slopes in the watershed are generally very gradual (less than 1 percent). Streams in the uplands may be incised, especially in the well-drained upland region.



Other distinctive physiographic characteristics include human-made drainage ditches that are used to drain soils with high-water tables, which are most prevalent in the area south of Millsboro and Indian River Bay. There are many different habitats in the Inland Bays watershed, including saltmarsh, maritime forest, freshwater wetlands, underwater bay grass meadows, intertidal flats, and sandy beaches. These habitats are home to a great variety of plant and animal species and are essential for migratory birds and spawning fish. Birds such as ospreys, herons, egrets, and bald eagles take shelter in the forest and use that habitat for nesting. The freshwater tributaries are spawning habitat for striped bass, herring, American shad, and American eels. Intertidal flats, the zone from the high tide line to the low tide line, is home for semi-terrestrial crustaceans such as fiddler crabs, hermit crabs, and snails. Under the mud are worms, mollusks, shrimps, and more. And the sandy beaches are critical nesting habitats for two iconic species native to the Bays: the diamondback terrapin and the horseshoe crab.

## State of the Delaware Inland Bays

The Bays were thought to be generally healthy several decades ago. However, after years of accumulated nutrient pollution and habitat loss, driven by changes in the landscape, the conditions of the Bays have declined. There were once clear waters, plentiful bay grasses, productive oyster reefs, and oxygen levels that support diverse and abundant fish populations. Now the Bays are generally murky, dominated by algae, have very few bay grasses or oysters, and have unhealthy dissolved oxygen levels.

Every five years the Center produces a State of the Bays report which is a compilation of environmental data about the Bays and their watershed. To assess the health of the Inland Bays, a suite of environmental indicators is selected. These are specific species and conditions that are measured over time to determine how the Bays are changing and how much progress has been made toward restoration goals. Thirty-five individual environmental indicators are grouped by subject matter and presented as the six chapters of the State of the Bays report. Each group is assigned a status and a trend by assessing its indicators together.

- The indicators are based on long-term measurements of environmental parameters and management actions.
- Status and trends are assigned using best professional judgment and reviewed by scientists knowledgeable in these areas.
- For each indicator, long-term trends are addressed, as well as short-term changes that have occurred since the previous State of the Delaware Inland Bays report was published.

While the original physical geography and area of the bays and watershed have remained relatively unchanged since 1995, the watershed conditions have changed dramatically. The most recent State of the Delaware Inland Bays report, published in 2016, examined 35 individual environmental indicators to assess the health of the Inland Bays<sup>1</sup>. Although the overall watershed condition was rated fair to poor and trending negatively, both

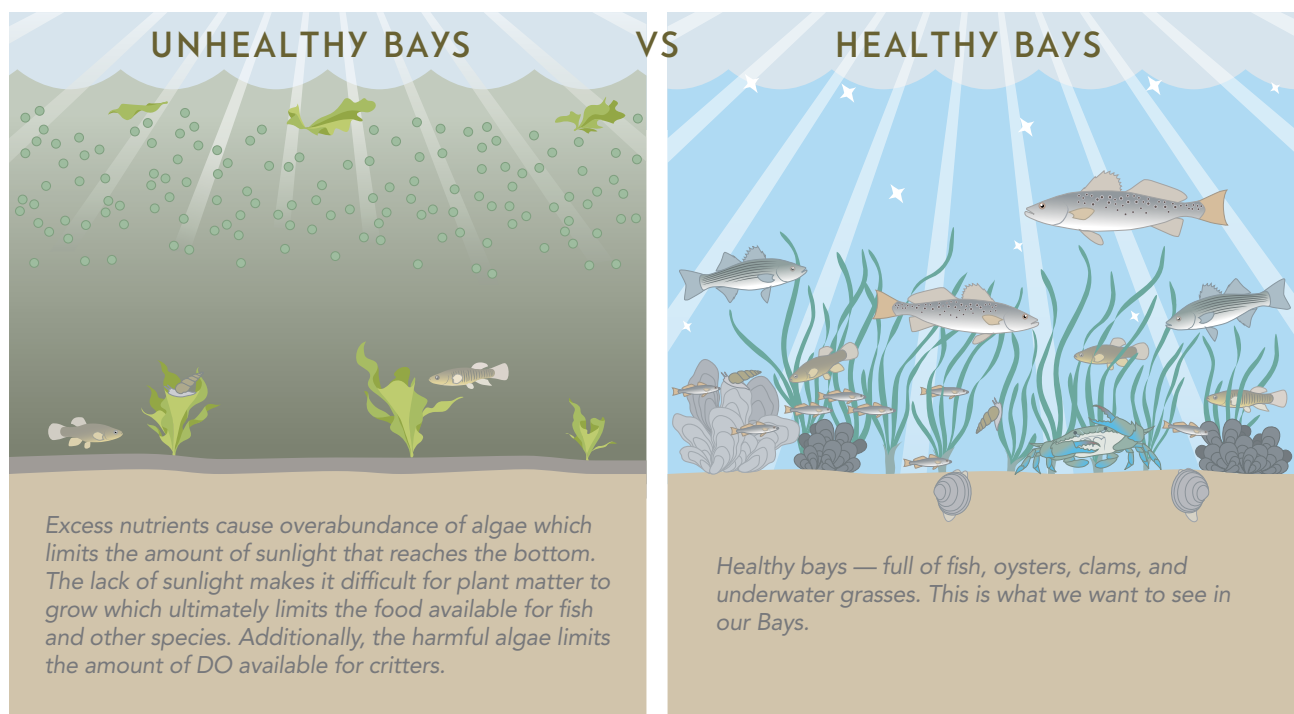


Figure 3

management of nutrient pollution and water quality were rated as trending positively which is a great sign of improvement. The following sections are summaries of the findings of the 2016 State of the Delaware Inland Bays report. The next State of the Bays report will be published in 2021 and will continue to inform watershed restoration and CCMP actions.

## WATERSHED CONDITION

- Human Population Growth
- Land Use Change
- Impervious Surface Coverage Buffers
- Salt Marsh Acreage & Condition
- Natural Habitat Protection & Restoration
- Indian River Inlet Flushing

Development driven by rapid population growth is increasing the acreage of impervious surface coverage, which is one reason why the overall watershed condition of the Inland Bays was rated as trending negatively. This land use change contributes to urban stressors such as encroachment by new developments on wetlands and tree canopy loss, which adds to urban pollution sources and stresses habitats.

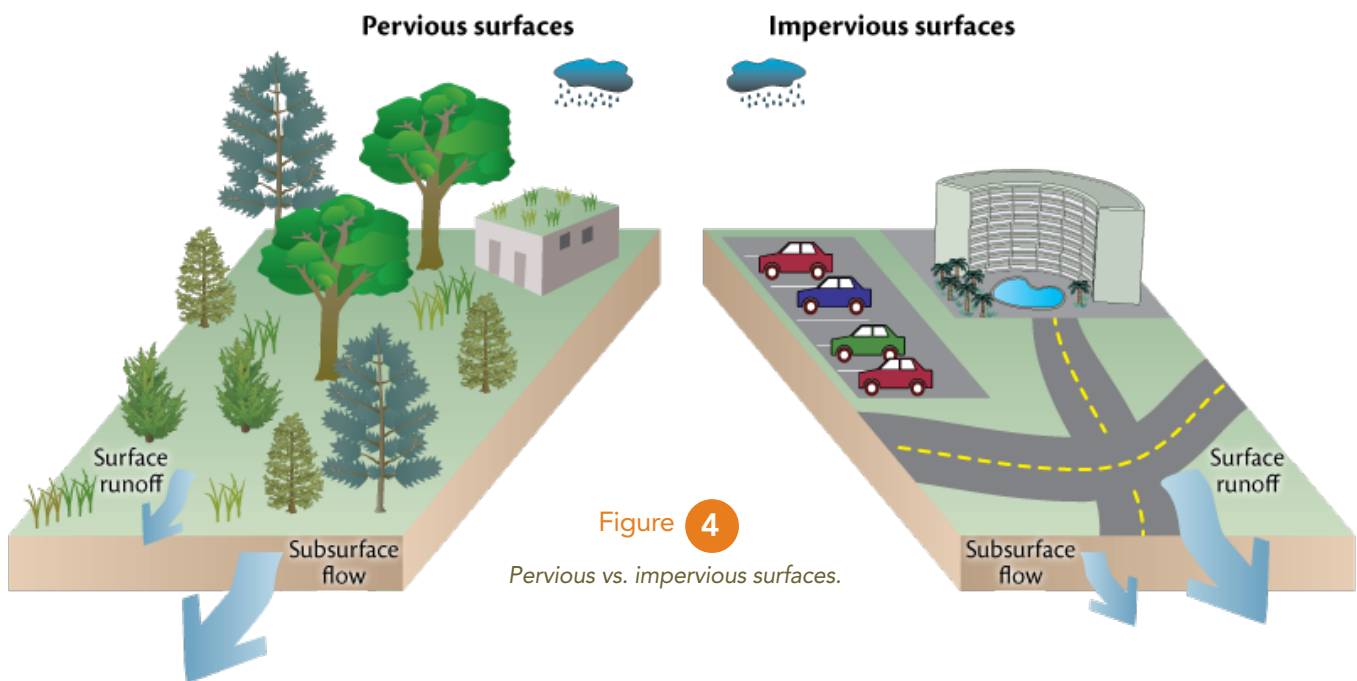
The 1995 CCMP identified an increase in Sussex County's population from 80,000+ in 1970 to

113,000 in 1990. The plan also projected the population to increase to 150,000 by 2011. The 2016 State of the Bays reports the 2010 census population at close to 198,000 residents, with 89,000 residing within the watershed.

That report projects that by 2020, over 102,685 year-round residents will reside in the Inland Bays watershed. These numbers do not include seasonal non-residents and tourists, which is important to consider given that the Inland Bays watershed is a popular destination, and can cause the population numbers to more than double in the summer months.

Watershed imperviousness now exceeds 10% and is higher in many subareas. This increase exacerbates stormwater runoff problems, flooding, and streambank erosion. As of the 2016 report, the percentage of impervious area from 1992 increased by 22%. As population trends continue, the CCMP actions related to urbanization will be increasingly important.

Other concerns for land use change in the watershed are also amplified by the increased population and development of the Bay's watershed. The watershed has seen developed lands increase by 34 square miles, agricultural lands decrease by 18 square miles, and upland forests decrease by 14 square miles from 1992 to



Pervious surfaces such as grass, soils, and 'green roofs' allow water to infiltrate the ground, slowing and reducing runoff and recharging groundwater. Impervious surfaces such as cement, asphalt, and roofing prevent infiltration, increasing the volume and velocity of surface runoff which carries nutrients and sediments with it. Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Dennison, W.C., J.E. Thomas, C.J. Cain, T.J.B. Carruthers, M.R. Hall, R.V. Jesian, C.E. Wazniak, and D.E. Wilson. 2009. *Shifting Sands: Environmental and cultural change in Maryland's Coastal Bays*. IAN Press, University of Maryland Center for Environmental Science.

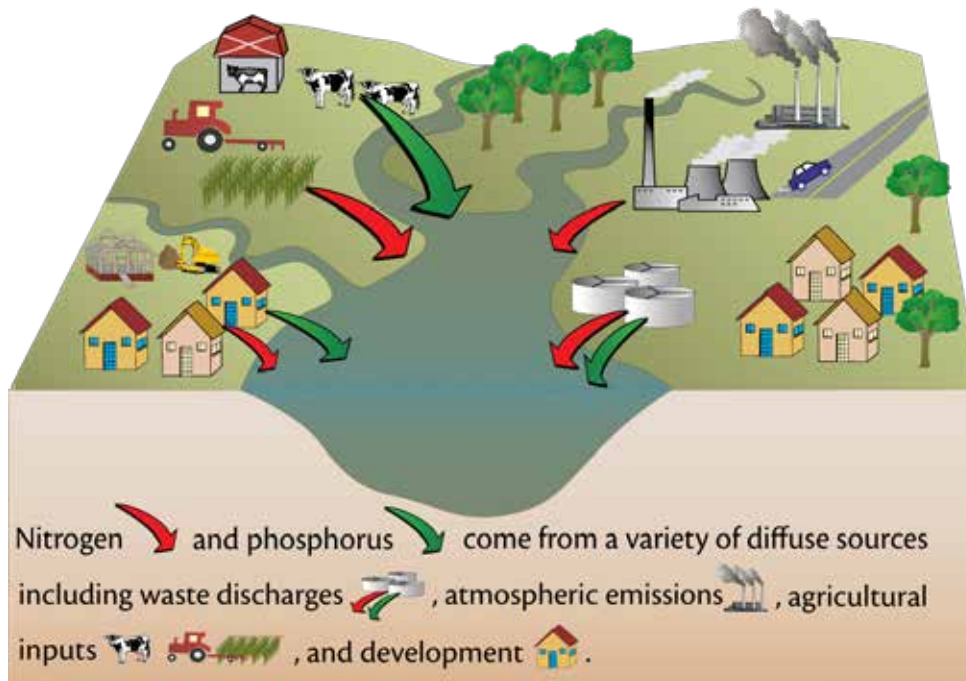


Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Lane, H., J.L. Woerner, W.C. Dennison, C. Neill, C. Wilson, M. Elliott, M. Shively, J. Graine, and R. Jeavons. 2007. Defending our National Treasure: Department of Defense Chesapeake Bay Restoration Partnership 1998-2004. Integration and Application Network, University of Maryland Center for Environmental Science, Cambridge, MD.

Figure 5 Nutrient pollution in the watershed.

2012. With the current building and development expansion occurring in the watershed, those land use changes are continuing even more rapidly. While the updated 2018 Sussex County Comprehensive Plan provides a more manageable blueprint for growth, the already-approved plans for watershed-wide development will challenge the ability of some CCMP actions to keep pace with this growth.

Other trends affecting general watershed conditions include continued loss of saltmarsh due to sea-level rise and historic drainage practices. Acres of saltmarsh has decreased from nearly 11,000 in 1940 to less than 7,000 in 2010. The loss of saltmarshes reduces the capacity of the watershed to reduce flooding and erosion from storms, filter pollutants, trap and store carbon, and provide critical habitat for fish and wildlife.

The loss of natural buffers within the Inland Bays watershed continues to be a concern since the first CCMP was adopted and the buffer provision in the PCS and Regulations was struck down by Delaware courts. Repeated efforts by the State of Delaware to adopt freshwater wetland protections have not been successful. This CCMP adopts several actions to continue to promote the local Sussex County wetlands and buffer ordinances that might prove to offer the best local protection to date and continues to be a work in progress.

## MANAGING NUTRIENT POLLUTION

- Point Sources
- Atmospheric Sources
- Nonpoint Sources
  - Agriculture Nutrient Management
  - Septic System Conversion to Central Sewer
  - Stormwater Retrofits

Excess nutrient inputs remain the most significant issue facing the Inland Bays. Point source nutrient loads continue to decline with the credit going to the removal of 12 direct discharge sources since 1990. The most recent and one of the largest, the Rehoboth Wastewater Treatment Plant Outfall, was the result of over ten years of discussion, litigation, and negotiation. There remains but one point source discharging to the Bays – the Allen Harim facility near the Indian River. While the nonpoint or diffuse sources of nitrogen are still well above healthy limits in all Bays, loads to the Little Assawoman Bay may now be decreasing. Phosphorus loads, on average, are within healthy limits for Rehoboth and Little Assawoman Bays but continue to exceed healthy limits in the Indian River Bay.

Generally, atmospheric deposition of nitrogen has seen a successful decrease since the early 1990s due to improved federal emission standards for power plants and automobiles. However, atmospheric deposition of phosphorus has increased due to unknown reasons. Between 2012

and 2016, the retirement of coal-fired generating units at the Indian River Power Plant is thought to have contributed to the decrease in atmospheric inputs of nitrogen to the Bays. Now, atmospheric nitrogen loads meet their annual pollution reduction goal on average.

The conversion of septic systems to central sewer has helped to reduce nonpoint source nitrogen entering the Bays. This conversion began in the 1970s, with over 50,000 septic systems being converted to central systems. Central sewer service allows a higher level of sewage treatment and eliminates pollution from septic systems. While new septic systems are continually permitted, the total number of septic systems in the watershed has decreased with central sewer expansion. This aggressive pursuit of septic elimination and the conversion of standard systems to more highly efficient ones is a positive trend that should continue into the next decade.

Agriculture and stormwater in the Inland Bays continue to challenge the funding and technology necessary to meet the nutrient goals of the PCS and CCMP fully. Many lands in the Inland Bays were developed before the 1990s when the first statewide stormwater programs were put into place through regulation. While those 1991 regulations and even more innovative recent changes have dealt effectively with runoff from land development, the challenge in the PCS to retrofit 4,500 acres of land with stormwater BMP's remains mostly unmet. Only 100 acres have been retrofitted since those metrics were last assessed in 2016.

**Agricultural lands, the most extensive land use in the watershed, have been credited with reaching goals of almost 100% of lands being managed with a nutrient management plan.**

While the nutrient management plans go a long way toward the successful implementation of innovative practices, cost share funding and other investments in amounts over \$5M per year are necessary for cover crops and other agriculture BMP's by many estimates.

Continued investments in BMP implementation along with funding for increased technology and science for both stormwater and agriculture in the Bay's watershed is necessary for both implementation and monitoring in these sectors. A decrease in nutrient inputs to the Bays are necessary for other factors such as dissolved oxygen and water clarity to improve. Improvements in water quality are critical for underwater species to thrive in the Bays.

---

## WATER QUALITY

Algae Concentration  
Concentration of Nutrients  
Water Clarity  
Water Quality Index  
Dissolved Oxygen Concentration  
Seaweed Abundance

---

Measures of water quality are the most basic indicators of Bay health. They are key measures of the effectiveness of actions taken to reduce pollution to the Bays. The Water Quality Index combines nitrogen and phosphorus concentrations, algae concentrations, and water clarity into an integrated measure of whether conditions are present to support the reestablishment of eelgrass. Overall, water quality in the Inland Bays remains fair to poor, but is improving.

Healthy standard levels of dissolved oxygen (DO), something all living creatures in the Bays need, is 4 milligrams of oxygen per liter of water. During the day, plants and algae release oxygen into the water through photosynthesis. At night, plants, algae, and animals continue to respire and draw oxygen out of the water. But nutrient pollution makes these cycles extreme by fueling algal blooms. When the excessive algae respire at night, they can cause oxygen to drop below this healthy limit. The 2016 State of the Bays reported that about 54% of the sites monitored had DO levels low enough to harm aquatic life. However, since 2012 DO has improved in the upper Indian River at Millsboro and in Herring Creek.

Because all plants need sunlight to grow, clear water is essential for underwater bay grasses to reestablish in the Inland Bays. Algae, sediments, and organic matter floating in the water all reduce clarity, which is measured by lowering a black and white Secchi disk into the water until its markings can no longer be seen. When all other conditions are right, bay grasses can grow in shallow waters with an average Secchi depth of at least 2.2 feet. From 2011 to 2015, 55% of water quality monitoring sites in the Bays met or exceeded this standard. Little Assawoman Bay and areas near the Indian River Inlet were clearest, while tributaries were murky and below standards.



*Female blue crab with sponge. The average sponge holds about 2 million eggs!*



**Overall, water quality in the Inland Bays remains fair to poor, but is improving.**

*Seaweed accumulation at the James Farm Beach. December 2020*

---

## **LIVING RESOURCES**

- Bay Grasses
- Eagle & Osprey Nesting
- Hard Clam Landings
- Winter Waterfowl
- Blue Crab Abundance
- Fish Abundance
- Number of Fish Kills
- Recreational Fishing

---

Living resources, such as birds, fish, and shellfish, are good indicators of shifts in water quality, habitat, and climate. Between 2011 and 2016, bald eagles and ospreys rebounded from pesticide pollution, and the number of osprey nests continues to increase. After declines in the 1980s, the number of black ducks that winter in the Inland Bays watershed has stabilized. Hard clam populations have been stable since 1976 and continue to support a fishery.

However, the numbers of wintering brant and canvasback in the Bays are declining. The blue crab population has not rebounded. Bay anchovy populations have also declined. And bay grasses remain rare in the Inland Bays, while coastal bays in Maryland and New Jersey have thousands of acres of these highly valuable habitats. Bay grasses

provide refuge, food, and nurseries for important fish and shellfish and also remove nutrients and adds oxygen back into the water. Eelgrass, one of the most highly valued bay grass, declined dramatically in the 1930s due to disease and increasing pollution. Efforts to restore bay grasses remain an important piece of this CCMP, however reducing nutrient pollution in the Inland Bays will be critical to this success.

---

## **HUMAN HEALTH RISKS**

- Bacteria Pollution
- Approved Shellfish Growing Waters
- Fish Consumption Advisories

---

Two of the main attractions of the Delaware Inland Bays are the fresh seafood and opportunities for water recreation. The open waters of the Inland Bays are generally safe for recreational contact, however, poorly flushed tributaries and canals regularly fail to meet safe swimming standards. Pathogens enter the water from many sources, including waste from wildlife, humans, and domestic animals, while some bacteria occur naturally in the Bays. Exposure to these pathogens through water contact or by eating contaminated shellfish could cause acute illness.



*Bethany Beach during the 2019 Nor'easter.*

Currently 61% of the Inland Bays are approved for shellfishing year-round, which is a change from the 2011 State of the Inland Bays report. The Center will focus efforts over the next ten years to reduce contaminants in the Bays so that eventually more areas can be opened for shellfishing. The removal of one of the last point source discharges to the Inland Bays, the Rehoboth Beach Wastewater Treatment Plant which was removed in 2018, may allow for some reopening of waters closed to shellfishing near the Lewes-Rehoboth Canal.

---

## **CLIMATE**

Carbon Dioxide Concentration & Air Temperature  
Sea-Level Rise  
Growing Season Length  
Precipitation  
Ocean Acidification

---

Global emissions of greenhouse gases are bringing about higher temperatures, longer growing seasons, and rising sea-levels. These changes influence everything from the chemistry of bay water to the location and distribution of ecosystems like saltmarshes and bay grass meadows. The timing and degree to which

migratory fish and birds use the estuary may change; species of plants and animals may shift in favor of those that prefer or tolerate warmer weather. Increasing heat is a significant concern. The growing season will continue to lengthen, and heat waves are expected to become more extreme. As a result, the Bays will likely be warmer for a longer period each year. While no changes in average annual precipitation have been observed, increasing frequency of droughts and floods may be occurring and are projected. This could increase the transport of nutrients to the Bays, which can lead to conditions that create oxygen-depleting algal blooms.

However, the State of Delaware has taken action to address climate change through the signing of Executive Order 41 in 2013. This order directs state agencies to address both the causes and consequences of climate change by developing actionable recommendations to reduce greenhouse gas emissions that contribute to climate change, increase resilience to climate impacts, and avoid and minimize flood risks due to sea-level rise. The Center and its partners have also agreed, through this CCMP, to actions that address both mitigation and adaptation of climate change impacts over the next 10 years.

---

<sup>2</sup>Scotto, Susan L., et. al. Decisions for Delaware: Sea Grant looks at the Inland Bays. 1983.

## Delaware Inland Bays National Estuary Program

In a 1983 report, “Decisions for Delaware<sup>2</sup>,” Delaware Sea Grant called for a task force to be established to recommend a strategic plan for managing the Inland Bays. Under the recommendation, Governor Pete du Pont formed an Inland Bays Task Force, which published its findings the following year. The resulting plan, “Protecting Delaware’s Inland Bays: Charting a Course for Change,” included a recommendation to establish an Inland Bays Monitoring Committee to oversee implementation of the plan’s strategies. The Monitoring Committee was established that same year and worked from 1984 to 1989 to carry out the strategic plan. More than 60 percent of the task force recommendations had been implemented during this time, but much work remained to be done. The population in the watershed was growing, and there was a lack of comprehensive planning for sewage treatment and shoreline preservation. Additionally, the growth of the agricultural industry presented new challenges for the continued reduction of nutrient pollution from these operations.

Five years after the original Delaware Sea Grant report, the Inland Bays watershed was declared an estuary of national significance by the United States Congress and became one of 28 National Estuary Programs (NEPs). The NEP is a non-regulatory program established by Congress and was authorized by section 320 of the Clean Water Act (CWA) in 1987. In 1994, the Delaware General Assembly passed the “Inland Bays Watershed Enhancement Act,” which established the

Delaware Center for the Inland Bays as the entity to oversee and facilitate the implementation of the CCMP and a long-term approach to the use and enhancement of the watershed. The following year, the Center submitted the first CCMP for the Inland Bays to Delaware Governor Thomas Carper and the EPA for approval.

---

### DELAWARE INLAND BAYS MANAGEMENT CONFERENCE

---

Two key elements of the Center are its Management Conference and committees. “Management Conference” is a term under Section 320 of the CWA used across all NEPs. It refers to the collective body of all agencies or groups responsible for collaboratively developing and implementing the CCMP and the committees in which they do that work. For the Inland Bays, the original Management Conference included:

- Citizens Advisory Committee (CAC),
- The Delaware Department of Agriculture (DDA),
- The Delaware Department of Health and Social Services (DHSS),
- The Delaware Department of Natural Resources and Environmental Control (DNREC),
- Scientific and Technical Advisory Committee (STAC),
- Sussex Conservation District (SCD),
- Sussex County Association of Towns (SCAT), and
- Sussex County Council.



Widgeon grass harvest in South Bethany. From left to right: M Bott, M Walch, N Keller, E Milton, C Bason.

The Delaware Department of Health and Social Services, which managed Delaware’s marine, shellfish, and drinking water programs, left the Management Conference in 1993 when those programs became part of DNREC. All of the remaining members of the Management Conference are signatory to the CCMP and hold a seat on the Center’s Board of Directors. From 1994 to 2015, the Board also included appointees of the Speaker of the House and the Pro tem of the Senate of the Delaware Legislature and an ex officio EPA representative.

The Inland Bays Watershed Enhancement Act, which established the Center, was amended in 2015 by Delaware House Bill No. 162 of the 148th General Assembly. The bill added to the Center’s Board five citizens of Sussex County Delaware to be elected by the voting membership of the Board itself. The amendment was made for two reasons: first, to include more local community representation on the Board; and second, to improve the Center’s capacity to solicit private donations to help fulfill its mission.

All Management Conference members, committees and organizations were partners in the development of CCMP goals and actions in both the 1995 document and the 2021 Revision. The Conference committee structure is depicted in Figure 6.

A new committee of the Board, the Development Committee, was created in 2018 to augment the Center’s efforts to solicit support from private donors. The chair of the Development Committee is selected from among the committee appointees. Center staff supports committee efforts. In 2019, the CCMP Implementation Committee was reinvigorated to oversee the tracking and implementation of the CCMP. This Committee is made up of members from the Signatory and other partner organizations. Center staff also supports committee efforts.

The committee structure and membership ensure that the CCMP actions and goals are developed in a consensus-driven manner based on scientifically sound information with local input and meets the purpose of the NEP.

The Board of Directors, including all members of the Management Conference, meets at least quarterly to conduct and oversee the business of the Center. Meetings of the Board are preceded each quarter by meetings of its standing Committees, including the STAC, CAC, Finance, Executive, Development, and CCMP Implementation. The Committees regularly make recommendations to the Board, including the Management Conference, on issues of potential relevance to the CCMP. Throughout the history of the Center, the CAC has been

Figure 6 Committee Structure.



\*While this committee structure has been in place since the first Inland Bays CCMP was signed in 1995, the Implementation Committee was not formalized until March 2019 when a new chair was appointed and new members were invited. Prior to this time, Center staff were the agents and trackers of CCMP implementation.



particularly important in this regard through its role of considering issues of public concern. Such issues have included permitting decisions that have had extraordinary or precedent-setting environmental impacts, and specific governmental policy decisions related to CCMP objectives. The CAC also has directed matters of scientific concern to the STAC for consideration and potential recommendation for action to the Board. The Board itself may direct work or issues for consideration to the STAC or Executive Director, and thence the staff of the Center. The process of identifying, studying, and considering for action issues potentially related to the CCMP is an ongoing one.

The Board of Directors, including the Management Conference, approves an annual workplan to implement the CCMP that is submitted to the EPA for approval. The workplan is focused on CCMP objectives and actions involving the Center staff independently and in collaboration with its many partners. Workplans include those projects funded with Section 320 of the CWA as well as those projects using other funds. Workplans are developed by assessing the CCMP and its components (Environmental Monitoring Plan, Finance Plan, Habitat Restoration Plan, Education and Engagement Plan), the Center's

Strategic Plans, and any priorities of the STAC, CAC, and CCMP Implementation Committee. Implementation of CCMP actions that are led by Management Conference members and have little or no involvement of Center staff are planned and carried out by those members. These actions and associated resources expended to implement the CCMP are tracked and reported through the Center's participation in the EPA's National Estuary Program Reporting Tool.

## The Evolution of the Delaware Inland Bays CCMP

The first CCMP for the Inland Bays was published in 1995 and identified two categories of priority problems: eutrophication and habitat loss. The 1995 CCMP planned to address these issues with a series of objectives included in five focus areas, which were intended to guide the work of the agencies and committees of the Management Conference. While the 1995 CCMP shepherded many successes, new challenges like climate change and sea-level rise, and rapid changes in land use required an update to the CCMP. In 2012, the Center published an Addendum to the CCMP which reorganized the goals from the 1995 CCMP and added new, discrete actions to address identified issues.

*James Farm at sunset.*



At the time of the 2012 Addendum, it was decided that the CCMP would be revisited every five years to assess changes within the watershed and shifts in NEP priorities. During this time, the Center would determine whether an update (minor changes) to the CCMP was necessary or a revision (major changes). As a result, in 2017 the Center undertook a process to review the 1995 CCMP and 2012 Addendum and initiated an update. Halfway through the process, the Management Conference decided to complete the process as

a CCMP Revision. This decision was driven by an EPA requirement to revise the 1995 CCMP by the year 2023. The 2021 CCMP reflects new science and information gathered since 2012, as well as new understandings of the shifting landscape. Table 1 below shows the evolution of CCMP focus areas from the 1995 CCMP, the 2012 Addendum, and the 2021 Revision by analogous focus areas. Appendix C shows an in-depth view of how the actions and objectives have changed between the 1995 and 2021 CCMP.

**Table 1** Comparison of CCMP Focus Areas, 1995, 2012, and 2021.

FOCUS AREAS 1995	FOCUS AREAS 2012	CORE ELEMENT* 2021
—	Planning for Climate Change	Living with a Changing Climate
Agricultural Source Action Plan	Nutrient Management	Clean Waters: Healthy Agricultural Landscapes
Industrial, Municipal, and Septic System Action Plan	Water Quality Management; Wastewater Management; Stormwater Management	Clean Waters: Reducing Pollution from the Developed Landscape
Habitat Action Plan	Managing Living Resources and their Habitat	Healthy Bay Ecosystems: Protect and restore thriving habitats for abundant fish and wildlife
Land Use Action Plan	Coordinating Land and Water Use Decisions	Coordinated Land and Water Use Management
Public Participation and Education Action Plan	Outreach and Education	Education, Outreach, and Marketing
<b>5 Focus Areas; 16 Objectives, 64 Actions</b>	<b>8 Focus Areas; 25 Objectives, 122 Actions</b>	<b>6 Core Elements; 20 Objectives, 93 Actions</b>
<i>*Note that the 2021 Revised CCMP uses the term "Core Element" instead of "Focus Area."</i>		

The most substantial shift between the 2012 Addendum and the 2021 Revision was the reconceptualization of water quality impacts. Where, in 2012, the Center found it most useful to consider water quality impacts from four fronts (nutrient management, water quality, wastewater, and stormwater), in 2021 there was a determination to separate water quality issues by landscape (agricultural and developed lands). This shift reflects the increased importance of addressing impacts associated with these two defining landscape types. Sussex County is developing rapidly, trading farm fields and forests for housing and shops. Both agricultural practices and development of formerly rural places can take a toll on the watershed, and there are clear strategies with accompanying policies

and funding sources to mitigate land use-specific impacts on the waters of the Inland Bays. With this reorganization, the Center acknowledges the importance of focusing on specific audiences for more direct messaging and implementation.

Beyond the consolidation and reorganization, small changes to wording in the focus area descriptions are also important. The shift from "Planning for Climate Change" to "Living with a Changing Climate" better reflects the conditions under which we live, and simultaneously represents the urgency and pragmatism with which climate change must be addressed.

On the action level, there are many changes to text between the 2012 Addendum and the 2021 Revision; however, there are few actions in this

Revision that are not directly analogous to existing actions. New actions were driven by reports and studies completed since 2012 that influenced new goals, objectives, and actions.

Two major trends detailed in the 2016 State of the Bays report that has influenced the CCMP revision are reductions in nutrient loading and increases in carbon dioxide concentrations. In regards to nutrient loading, the near elimination of direct discharges of nutrients to the Bays (point sources) in 2018 combined with the achievement of the goal to reduce atmospherically-derived nitrogen to the Bays has shifted focus directly to the control of diffuse sources of pollution from the watershed (nonpoint sources). Actions of the 2008 Inland Bays Pollution Control Strategy (PCS) to address nonpoint sources are specifically included in the CCMP revision to encompass a range of best management practices focused on the agricultural landscape. A body of information developed since the original CCMP was published has demonstrated that the agricultural landscape contributes both the greatest amounts of nutrients and allows the greatest cost-efficiencies to prevent those nutrients from reaching the Bays. Actions to develop the necessary funding at the state level were added to the CCMP and its accompanying plans to help attain the ambitious goals set for voluntary best management practices for nutrients. Actions to produce detailed project implementation plans found to be essential for strategy implementation were also added to the revision.

Many point sources of nutrients were converted to land-based discharges, essentially becoming managed as nonpoint sources of nutrients. Thus, actions to understand land-based wastewater nutrient loads and to facilitate the coordination of partners to reduce the loads have been maintained and enhanced in the CCMP revision. The sustained improvements in many of the biological indicators of eutrophication included in the 2016 State of the Inland Bays report, such as reductions in the level of seaweed and planktonic algae, have provided compelling evidence that pollution control strategies are working, albeit slowly.

In regards to climate change, a steady and remarkably-rapid increase in the levels of atmospheric carbon dioxide first indicated in the 2011 State of the Inland Bays report has continued. This change in atmospheric carbon dioxide has driven increases in sea-level, increases in average annual air temperature (and assumed increases in water temperature), and lengthened the agricultural growing season. In turn, increases in sea-level have driven tidal wetland migration and increased flooding while higher temperatures

have contributed to conditions that facilitate the growth of harmful algae blooms, low dissolved oxygen, and degradation of fish and shellfish habitat. A tremendous increase in understanding of the climate system and the inter related effects on ecosystem processes has occurred since the original CCMP was published. This knowledge has been utilized by increasingly powerful predictive models that point to extreme changes in the physical, chemical, and biological aspects of terrestrial and aquatic ecosystems if carbon dioxide concentrations continue to increase.

### Despite over 40 years of calls to action from the scientific community to reduce greenhouse gas emissions, increases continue.

This has led to an increased focus on the climate-related actions of the CCMP and an elevated importance of the carbon capture functions of those actions with other primary purposes such as nutrient management. For example, efforts to address mitigation of climate impacts through increased education and promotion of renewable energy sources have been added to the revision.

According to the 2016 State of the Inland Bays report, improved coordination between partners responsible for implementing actions outlined in the Inland Bays PCS is necessary, and this is reflected in numerous actions in the revised CCMP. The report also states that the rapid urbanization of the watershed and loss of wetlands and natural shorelines is impacting both migrating and resident animal populations, including certain

species of fish. The 2021 Revised CCMP includes actions aimed at restoring lost habitat and natural shorelines to help mitigate these trends. In 2018, the Center completed a risk-based Climate Change Vulnerability Assessment, a requirement of all NEPs by the EPA. The purpose of completing the Vulnerability Assessment was to identify risks associated with climate change that may affect the successful implementation of the CCMP. The results of this assessment show which CCMP objectives were susceptible to risk and were used to review existing draft actions. This step ensured that those risks were minimized, and goals could be achieved in the face of a changing climate.



*Great Blue Heron at Ingram Pond.*

**New CCMP actions are summarized below:**

- Nutrient and wastewater management actions have been added related to public outreach on the benefits of centralized sewerage, improving treatment levels at wastewater facilities, and continuing septic system conversion to central sewerage where appropriate.
- Habitat-related actions “new” to the CCMP include advocating for ecosystem-based management of fisheries and annual reporting on metrics like number and acreage of shellfish aquaculture leases, species harvested, and value paid by species.
- Climate change actions that have been added are education, advocacy, outreach and adaptation oriented. Educating the public about renewable energy and developing a publicly-accessible, real-time Coastal Flood Monitoring System are actions that have been added to the CCMP.
- New land and water coordination actions include exploring transfer of development rights, discussing habitat protection priorities with the conservation community, and revising the Sussex County code related to buffers.
- Education and outreach-related efforts new to the CCMP include implementing the James Farm Master Plan, working on anti-littering campaigns and sustainable funding for water quality improvements, conducting field visits with decision makers, and advocating for the enforcement of existing environmental regulations.

Despite the newness of these actions, their goals are still thematically similar to objectives from the 2012 Addendum. This is not surprising given the

long-term nature of the impacts to the estuary and the multi-faceted decadal response to restore its quality. Changes in the 2021 Revision reflect changing conditions and new strategies aimed at achieving a very similar goal: protecting and restoring the Delaware Inland Bays.

**Below are priorities identified by the Center and partners and that are reflected in the actions of the CCMP:**

1. Improve coordination between partners responsible for implementing CCMP actions
2. Increase state and federal funding available for CCMP implementation
3. Incorporate the Pollution Control Strategy actions into the CCMP to further elevate importance of achieving those actions
4. Continue improving habitat for key species by using the results of monitoring programs to inform restoration activities
5. Continue to improve water quality by using the results of monitoring programs to inform activities
6. Understand the hydrodynamics of the Bays and their tributaries and how activities on the land influence water quality to inform restoration and management activities
7. Continue to educate on the importance of the Bays and their watersheds and issues impacting their health
8. Understand how development is impacting the Inland Bays watershed, and coordinate with partners to ensure the best management of the valuable resources given the changes occurring

*A group of birders gather.*



## Supporting Documents to the CCMP

Since 1995, two other documents have been produced which support the implementation of the CCMP: the Inland Bays Environmental Monitoring Plan (IBEMP) and the 2018 Finance Plan. The original IBEMP was first developed in 1995 along with the original CCMP and was later updated in 1996 and 2017. The purpose of the IBEMP is to track the status and trends of key environmental indicators used to assess the chemical, physical, and biological integrity of the estuary and surrounding study area, and to evaluate whether the goals of the CCMP are being met. It is a comprehensive inventory of existing, new, and proposed monitoring activities to achieve these objectives and is intended to guide future research and monitoring efforts. The plan is also designed to lead to increased integration of work and consolidation of resources. Of primary importance are recommendations made for new monitoring programs, or enhancement of existing programs. These recommendations are made based upon critical data gaps (including emerging issues), the availability of new methods or technologies, and or changes needed to make programs sustainable over the long term. Many of the recommendations of the IBEMP are also actions within the Revised CCMP, as noted with an asterisk (\*).

### Highest priority recommendations are:

- Development of a new hydrodynamic/watershed model for the Inland Bays\*;
- Upgrade of the University of Delaware's Citizen Monitoring Program database to a format that is sustainable long-term and can serve data to the public through STORET and or the state's Water Quality Portal;
- Long-term, continuous monitoring of dissolved oxygen and chlorophyll at key stations;
- Monitoring of submerged aquatic vegetation in tidal regions of the Inland Bays\*; and
- Monitoring of local indicators of sea-level rise\*.

### Other recommendations, judged to be important but of slightly lower priority, include:

- Continued monitoring of the tidal prism at the Indian River Inlet\*;
- Long-term monitoring of oyster recruitment and growth in the Bays, particularly as aquaculture begins, and shellfish restoration and enhancement projects are undertaken\*;
- Shoreline condition and modification monitoring to evaluate the effectiveness of living shoreline initiatives\*;

- Continued analyses of tidal marsh acreage and condition using GIS methodology established in a 2014 study conducted by the University of Delaware\*;
- Monitoring of estuary acidification;
- Monitoring of recreational blue crab and hard clam harvests from the Inland Bays\*; and
- Build and maintain a list of research and monitoring activities focused on emerging contaminants in the Inland Bays.

The purpose of the Center's 2018 Finance Plan is to identify priority CCMP programs and actions for funding and evaluate existing and potential new funding options, then strategically prioritize the pursuit of those short and long term funding options. Financial needs exist for both the Center as an organization and the full implementation of the CCMP and associated monitoring. Though the Center as an organization is critical in developing resources to implement the CCMP, its partner organizations must be equally or more so involved. Financing is a political process, and the Center must be closely involved in developing funding mechanisms that may be regional or statewide through coordination and advocacy. Building political coalitions in this regard will be essential for success. The Finance Plan details current funding approaches, status and trends, internal financial priorities, and external financial priorities. The Finance Plan also identifies and evaluates new or expanded funding opportunities for CCMP implementation.

### Below is the list of prioritized objectives intended to secure the Center's most promising funding opportunities and an indication of the planned timeframe.

1. Maintain and increase state and federal operating grants that support the base operations and leveraging capacity of the Center through a continued political process supported by the Board and the Association of National Estuary Programs (ANEP). (Short-term).
2. Increase revenue from private individuals and organizations to achieve organizational reserve and endowment goals through an accelerated program of solicitation supported by the Board's Development Committee and increased marketing and outreach. (Short & Long-term).
3. Support the Clean Water for Delaware Act legislation in the Delaware General Assembly to develop a sustainable new funding source for CCMP implementation. (Short-term).

4. Incorporate medium to large private foundation grants as an important funding component for internal projects. (Short-term).
5. Further explore and develop fee-based revenue sources. (Short-term).
6. Improve coordination and solicitation for CCMP funding options. (Short-term).

Currently, the Center is working to produce a five-year Public Education and Engagement Plan (PEEP). Through this process, a collaborative of multiple organizations will be developed to meet mutual outreach and education goals set in this CCMP. The PEEP will outline strategic actions to target the CCMP goals and will also include timelines and partner goals. This project is slated to be completed in 2022.

**Habitat loss was one of the primary issues of concern when the 1995 CCMP was written, and continues to be a primary issue of concern today.**

The 2021 CCMP addresses many habitats that are important for key species such as wintering brant and canvasback to thrive, including underwater bay grasses, forested land, and natural shorelines. Additionally, the 2021 CCMP addresses many primary reasons why these habitats are degrading, such as nutrient pollution, sea-level rise, and development pressure. After the completion of the revised CCMP, the Center will work to produce a Habitat Plan which contains restoration actions to increase the adaptability of those important habitats and species to climate change impacts and other pressures. The Center will work with its partners to implement those Habitat Plan actions to ensure a healthy Inland Bays ecosystem. The anticipated completion date for this document is 2025.

The Habitat Plan will also contain components from other studies and plans such as the Shellfish Enhancement Plan, Living Shoreline Initiative, Watershed Reforestation Plan, Rapid Assessment Project Plan (to be developed) and the Natural Lands and Habitat Strategy (to be developed). Without healthy habitats, the Inland Bays watershed cannot support a vibrant community of aquatic species, mammals, birds, and reptiles. Many species are also found in neighboring estuaries, the Delaware Estuary and Maryland Coastal Bays. Identifying the key habitats and species and actions to restore those areas are critical to ensuring a healthy ecosystem.

## Inland Bays Watershed Restoration Progress

These most recent updates and revisions to the CCMP reflect a continuum of progress from the inception of the Inland Bays Recovery Initiative that began in March of 1990 until the present day CCMP Revision. The first 1995 CCMP broadly identified two categories of priority problems: eutrophication and habitat loss. The original CCMP also contained 64 goals and objectives that were included in 5 focus areas (see Table 1). Some CCMP actions, like conservation planning efforts through the Center and its partners (such as the Sussex Conservation District), have continued from 1995 through today almost uninterrupted. Additionally, since the publication of the 1995 CCMP, there have been several key successes in the Inland Bays that grew from initiatives identified in the 1995 document. These successful initiatives include the development of the Total Maximum Daily Loads (TMDLs) for the Delaware Inland Bays; the establishment of the Delaware Nutrient Management Program; the revised Statewide Stormwater Management and Sediment Control regulations for new development; and progress on codifying preservation of riparian buffers.

The development of the TMDL regulations for the Inland Bays is central to the history of the water quality improvement initiatives and environmental regulation in the region. Initial goals for TMDLs were established in the early nineties, even before the publication of the 1995 CCMP. At that time, a computer model was developed to assess nutrient loads and determine TMDLs for point and nonpoint sources in the watershed. Following the completion of the 1995 CCMP, TMDLs for nitrogen and phosphorus were established for Indian River, Indian River Bay, and Rehoboth Bay in 1998; and for Little Assawoman Bay and the major tributaries of the Inland Bays in 2005.

The TMDL's called for the systematic elimination of all point sources of nutrient loading to those water bodies along with a 40-65% reduction of nonpoint phosphorus loading and a 40-85% reduction in nonpoint nitrogen loading. The TMDL's also called for a 20% reduction in atmospheric deposition. To

### *Did You Know?*

In 1990, there were 13 point sources of pollution discharged to the Inland Bays. Since then, **12 out of the 13 point sources have been removed!**

## WHAT IS A TMDL?

A TMDL is the maximum amount of nutrient pollution that a waterbody can receive and still support healthy conditions.

aid in achieving these targets, the TMDL required the development of an implementation plan or a Pollution Control Strategy (PCS).

The PCS was developed by DNREC through a collaborative public process involving multiple interests in the watershed. Inland Bays Tributary Action Teams, comprised of local government representatives, business owners, environmentalists, farmers, and residents, were developed and coordinated by the Center to gather public stakeholder input to inform PCS development over several years. The PCS was completed in 2008, amid concerns that portions of the PCS and the ensuing Regulation would be challenged in regards to its sections related to buffers. The PCS contains both regulatory and voluntary components centered around the nutrient reduction areas of Point Sources, Agricultural Nonpoint Sources, and Urban/ Residential Nonpoint Sources - the latter includes provisions for the Development, Onsite Wastewater, and Stormwater Sectors. It was envisioned that the combination of actions would lead to the achievement of the TMDL.

The relationship between the strategies contained in the PCS and the CCMPs developed over

the years is complex and needs to be given perspective on several levels. Broad overarching goals in the PCS that were adopted in the state regulations, such as the systematic elimination of point sources of nitrogen and phosphorus, have been accomplished because of combined elements in the CCMPs, local municipal plans, DNREC regulatory efforts, EPA support, and years of public advocacy. Similar strategy actions were supported in both the 1995 CCMP and 2012 Addendum related to regulatory support for DNREC on-site wastewater regulations and the recently-revised stormwater regulations.

The PCS contained general actions and specific action items for all sectors previously identified. Certain actions, such as all agricultural acres having a nutrient management plan, have been echoed in all CCMPs with progress toward that action being identified with lead responsible agencies and performance measures. Actions for other sectors, such as constructing stormwater BMPs on those lands developed before stormwater regulations, remain in the CCMP and should be examined periodically as policies regarding stormwater management requirements during redevelopment may adjust the milestones.

Actions regarding the preservation, establishment, and management of vegetated buffers were included in the Agricultural Source Action Plan, the Land Use Action Plan, and the Habitat Protection Plan of the 1995 CCMP. The Land Use Action Plan explained the importance of riparian buffers and their benefits. The CCMP

contained actions requiring the use of environmentally-sensitive development practices, including providing for buffer areas.

Progress on the goals was to be measured in acres of stream, wetland, and subaqueous lands buffered. This was also an action in the PCS. However, in 2011, the Delaware Supreme Court upheld a Superior Court ruling that Section 4 of the PCS Regulations, which establishes the water quality buffer, and the related stormwater control provisions of Section 5, constituted "zoning," and thus directly conflicted with the Sussex County Zoning Ordinance. Those sections of the Regulations were removed, significantly weakening the PCS.

Progress toward the establishment and protection of buffers remains a local action and

*Children enjoying the beach at James Farm. Photo by Ken Sigvardson*



is a centerpiece of the current CCMP. Members of the Management Conference continue to work toward additional protections and flexible ordinances for local jurisdictions within the Inland Bays watershed for buffers that better safeguard important resources. These efforts continued through a Sussex County Wetland and Buffers Working Group (2019-2020) that worked toward an updated Sussex County wetlands and streams buffer ordinance. This working group stalled during the COVID-19 pandemic. This action carries over from the 2012 CCMP Addendum.

TMDL goals identified in the 2008 PCS were analyzed in the 2016 document Assessment of

the Implementation of the Inland Bays Pollution Control Strategy to assess the progress of implementation. Implementation of voluntary best management practices as tracked through cost-share or technical assistance programs and compliance with regulatory programs were highlighted in the report. However, implementation of many of the voluntary actions has seen little progress relative to its goals due to a lack of dedicated funding. As a result of the assessment, specific goals were carried forward and streamlined in the revised CCMP so that progress may continue.

The importance of the PCS and continued reference in the CCMP is underscored by the creation of the CCMP Implementation Committee. This Committee will aid in the implementation and tracking of actions that are included in both the PCS and the CCMP. Sustainable sources of funding for clean water projects will ensure full PCS and CCMP implementation, which is highlighted throughout the CCMP through education and advocacy actions.

Another important success from the original CCMP was the establishment of the Delaware Nutrient Management Program. The Nutrient Management Program resulted from the passing of the Delaware Nutrient Management Law in 1999, which was a response to degrading water quality conditions and the over application of fertilizers, including poultry litter, to farm fields. The law created the Delaware Nutrient Management Commission, which developed regulations for nutrient management, waste management for animal feeding operations, and National Pollutant Discharge Elimination System (NPDES) permits for concentrated animal feeding operations. The requirement of nutrient management plans for farming operations over 10 acres and animal feeding operations limited applications of phosphorus to high phosphorus soils to a three-year crop removal rate and nitrogen applications to no more than necessary to meet an expected crop yield. Nearly all farms now have nutrient management plans. The Inland Bays watershed directly benefited from these statewide initiatives led by many of the Center's partners and stakeholders. These regulations and plans, along with a myriad of advancements to agricultural science and management practices, remain vital to achieving water quality improvements in the Inland Bays.

As the 1995 CCMP was being developed, the concept of impacts to water quality from

Table 2

PCS Actions within the 2021 Revised CCMP.

### HEALTHY AGRICULTURAL LANDSCAPES

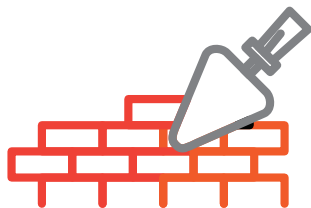


Increase the amount of cover crops planted annually in the Inland Bays watershed.

Continue to use and support the construction of poultry manure storage sheds, composters, and animal mortality freezers.

Relocate manure from the watershed and put into alternative use and encourage participation by integrators.

### REDUCING POLLUTION FROM THE DEVELOPED LANDSCAPE



Develop a plan to create stormwater retrofits to work toward a goal of treating 4,500 acres of urban and residential lands developed pre-1990.

<sup>3</sup>U.S. EPA. <https://www.epa.gov/npdes/stormwater-discharges-municipal-sources>





*Egret in the marsh at Pasture Point Cove. Photo by Chris Bason*

unmanaged stormwater was gaining traction among regulatory groups, land use planners, and environmental organizations. Since that time, the Center has been integral to the development and evolution of programs aimed at eliminating and remediating stormwater impacts from new development. Over the years, the Center and its stakeholders and partners have worked to develop statewide regulations to manage stormwater from new development. They have also worked with communities to adopt ordinances supporting water quality management in development plans.

Another significant program that has evolved since 1995 is the Municipal Separate Storm Sewer System (MS4) program for stormwater. A separate storm sewer system is a collection of structures, including retention basins, ditches, roadside inlets, and underground pipes, designed to gather stormwater from built-up areas and discharge it, without treatment, into local streams and rivers. It's called a separate system because it's not connected to the sanitary sewer system. Only communities that are classified as "urbanized areas" under the United States Census Bureau are required to have an MS4 permit. The 1990 Phase 1 regulation requires medium and large municipalities to obtain an NPDES permit for their stormwater discharge under the MS4 program. According to EPA, a "large" municipality is considered as having a population of 250,000

or more. A "medium" municipality has between 100,000 and 250,000 people<sup>3</sup>. At the time this document was written, there are no communities within the Inland Bays watershed under an MS4 permit. However, over the next several years this will likely change as new census data becomes available. As communities are phased into the program, the Center could work with stakeholders and partners to develop solutions, implement demonstration projects, and conduct outreach.

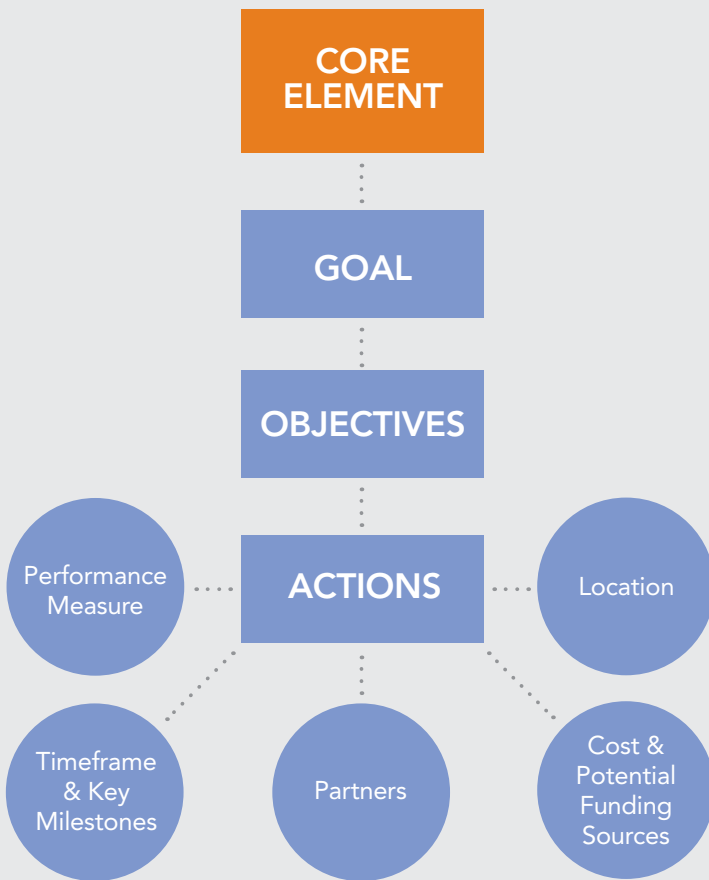
Increasing the efforts within the Bays for protection and restoration have been and will continue to be primarily a result of the availability of funding from federal and state opportunities. Those funding efforts have been inconsistent over the years, but recently state funding has been delivered for both agricultural land and open space preservation. Local governments have also stepped up efforts to deliver funds for open space preservation in the recent years.

**The Inland Bays CCMP will highlight actions that afford the Bay partners' opportunities to maximize these and other funding streams. There will need to be more creative and innovative approaches to financing land conservation and restoration in the future to protect those watershed areas that are still healthy and restore those that have been negatively impacted.**

# A GUIDE TO THE 2021 INLAND BAYS CCMP

Figure 7

Anatomy of CCMP Elements and Actions.



Cost estimates for implementing each action are categorized in the following way:

\$	less than \$25K
\$\$	\$25–\$100K
\$\$\$	\$100–\$500K
\$\$\$\$	\$500–\$1M
\$\$\$\$\$	over \$1M

Table 3 Cost Estimate Symbols.

The heart of the 2021 CCMP is the actions that will be implemented over the course of the next decade. These are separated into six Core Elements: Living with a Changing Climate; Clean Waters: Healthy Agricultural Landscapes; Clean Waters: Reducing Pollution from the Developed Landscape; Healthy Bay Ecosystems: Protect and Restore Thriving Habitats for Abundant Fish and Wildlife; Coordinated Land and Water Use Decisions; and Education, Outreach, and Marketing. The Core Elements and actions are not in a prioritized list.

**Lead & Supporting Implementor:** Each action has designated Lead and/or Supporting implementer(s). The lead implementer(s) have primary responsibility for ensuring successful implementation of the action and may be provided support in various forms (funds, time, resources) by the supporting implementer. Only entities who are signatory to the CCMP were assigned to these roles; however, the Center recognizes that other partners play critical roles in the successful implementation of the CCMP. Listing in the partners section does not commit any organization to any specific activity; rather, it is recognition of that entity’s previous work and engagement relevant to the action plan in the watershed and an expectation of continued interest and involvement.

**Timeframe & Key Milestones:** This refers to when important milestones are expected to be reached. Many of the actions have already been initiated, and implementation is simply ongoing. In most cases, the timing of specific projects is contingent on a number of factors, particularly funding availability.

**Location:** This refers to where in the watershed the action will occur. Oftentimes, “watershed wide” is used to indicate that the action will take place throughout the entire Inland Bays watershed.

**Cost & Potential Funding Sources:** This refers to the estimated funding needed to implement each action and potential funding sources that can be used for implementation. See Table 3 for the estimated cost symbols.

**Implementation Tracking:** The CCMP Implementation Committee will track the CCMP annually and report out on progress to the Management Conference and other partners.

# LIVING WITH A CHANGING CLIMATE



## GOAL:

**Help communities in the Inland Bays watershed understand, mitigate, and adapt to the impacts of climate change.**

As a low-lying coastal state, Delaware (and in particular Sussex County – home of the Inland Bays) is susceptible to climate change-related stressors, including increasing temperatures, sea-level rise, and more intense storms. These risks are made more pronounced by the rapid population growth along Delaware’s coastline - an area that makes up the eastern portion of the Inland Bays watershed. The changing climate will have far reaching effects, all of which play a role in the successful implementation of the CCMP.

Delaware is already experiencing changes related to climate change. According to the *2014 Delaware Climate Change Impact Assessment*, annual and seasonal temperatures in Delaware have increased by two degrees Fahrenheit since 1900 and are expected to increase another 2.5 – 4.5 degrees by 2050. Heat waves and the number of days above 100 degrees are projected to increase by mid-century. Sea-levels at the Lewes

*A living shoreline was constructed at the Delaware Botanic Gardens at Pepper Creek during a partnership project with the Center.*

tide gate have risen more than a foot over the last century and are expected to rise an additional 9-23 inches by 2050. The growing season, as defined by the number of days between the last frost in spring and first frost in fall, has increased by at least 45 days (25%) since 1945. Precipitation varies widely from year to year, but as the climate warms, precipitation in Delaware is projected to increase annually. Other climate variability, including increased flooding and storminess, are expected to be closely associated with changes to our local climate.

These changes trickle down and impact other areas such as energy demands, agriculture, water resources, ecosystems and wildlife, and infrastructure. Increasing temperatures will cause greater heat stress for humans as well as poultry and other livestock, alter timing and availability of food sources for wildlife and increase the number of pests and diseases and could cause an increase in the number of harmful algal blooms. More frequent and heavier rainfall could cause an increase in nutrient inputs to the bays from croplands. Flooding of farmlands could wash away

<sup>4</sup>Delaware Department of Natural Resources and Environmental Control, Division of Energy and Climate. Delaware Climate Change Impact Assessment. 2014.

<sup>5</sup>Delaware Cabinet Committee on Climate and Resiliency. Climate Framework for Delaware. 2014.

fertilizers and require additional applications to the field. Flooding may also impact other areas by damaging infrastructure and overwhelming stormwater and wastewater systems, which could increase the risk of contaminated floodwaters and disrupt outdoor recreation and shellfish harvest. Sea-level rise is changing the shoreline as we know it and is causing increased flooding of homes, businesses, and infrastructure along the coast. It will also increase saltwater intrusion in agricultural fields which can reduce agricultural productivity<sup>4</sup>.

Statewide, Delaware has been developing the assessment and planning tools necessary to adapt to a changing climate for close to ten years. In 2013, Governor Jack Markell signed Executive Order 41, *Preparing Delaware for Emerging Climate Impacts and Seizing Opportunities from Reducing Emissions*. The Order directed state agencies to address both the causes and consequences of climate change. Technical teams were developed statewide, and the *Climate Framework for Delaware*<sup>5</sup> was completed in 2014, highlighting 155 recommendations from state agencies for adaptation actions.

**These actions centered on three areas for implementation:**

1. Mitigation—Reducing greenhouse gas emissions to lessen human contributions to climate change.
2. Adaptation—Protecting Delaware residents and resources from the effects of climate change.
3. Flood Avoidance—Reducing the risk of flood damage to infrastructure by building to a higher standard and avoiding areas with high flood risk.

Currently, Delaware is preparing the updated *Climate Action Plan* building on earlier efforts to identify strategies for adaptation. It is anticipated that this *Climate Action Plan* will focus more on mitigation, such as greenhouse gas reduction



Bethany Beach flooding during Nor'easter in March 2018.

strategies. The current goal is to reduce emissions by 26% by 2025 from the 2005 baseline. A Natural and Working Lands Section, which includes working Agricultural lands, will develop priorities for carbon storage and sequestration. This area will intersect with CCMP objectives related to water quality and buffer protection.

Building on the national, regional, and statewide climate change assessment data was important while developing this CCMP and actions that reduce risks in order to meet specific watershed goals and objectives. The CCMP associated Environmental Monitoring Plan and other statewide assessment and modeling processes help to show the trends in climate change over time and will assist in identifying watershed impacts and course-altering actions. In addition, the Center will develop a follow-up Habitat Plan that will further address protection and restoration of critical habitat and species and reflect the findings in the Center's Climate Change Vulnerability Assessment discussed below.

Since estuaries are particularly susceptible to climate change related impacts, the EPA provides targeted assistance to NEPs to assess climate change vulnerabilities as they impact the ability to accomplish the goals in their CCMP. Some NEPs, including the Center, have received supplemental grant funding to complete a Climate Change Vulnerability Assessment (CCVA) using the 2014 EPA guidance *Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Strategies*. This guidance approaches the development of risks by analyzing the impact of climate-related stressors such as rising sea-levels but also includes increased storminess, warmer temperatures, and warmer waters as additional factors that drive risk-based vulnerability assessments.

In the CCVA, the risks to successfully implementing a CCMP in the Inland Bays were identified across all sectors, assuring the Center's most up to date CCMP is "climate ready."

**Of the nearly 200 identified, some of the highest risks are described below.**

- Warmer winters may exacerbate the spread of invasive insects and pests that kill trees, shrubs and grass.
- Sea-level rise will cause higher water tables and septic system drain fields may become inundated.
- Sea-level rise may negatively impact the effectiveness and lifespan of BMPs for nutrient reduction and retrofits.

- Stormwater infiltration practices may become less viable due to sea-level rise.
- Tidal flooding, added to sea-level rise, will exacerbate storm flooding causing higher volumes of untreated stormwater entering the bays.
- Warmer water increases/lengthens season for micro- and macroalgae blooms, resulting in changes to dissolved oxygen and increased fish kills.
- Higher concentrations of bacteria might also occur with warming water, further limiting the shellfish harvesting areas.
- Sea-level rise may cause higher salinities further inland, which would impact the agricultural cropping practices dramatically.

The CCVA results were used to ensure that the CCMP actions were crafted such that the objectives could still be achieved given the risks identified. Because of anticipated climate change impacts, the Center and its partners agreed that it is important to address both the causes and consequences of climate change through mitigation and adaptation measures, respectively.

While the Living with a Changing Climate core element includes actions directly related to climate change, many actions housed under different Core Elements also address climate mitigation and adaptation. For example, successful implementation of Action AG 3-2 in Clean Waters: Healthy Agricultural Landscapes will result in increased forest cover in the Inland Bays watershed, which will remove CO<sub>2</sub> from the atmosphere. Since CO<sub>2</sub> is the most important greenhouse gas, by removing CO<sub>2</sub> from the atmosphere through reforestation we are not only improving habitat and water quality but also mitigating climate change.

**Other examples of CCMP actions to mitigate risks and adapt to climate change include the following:**

- Implementing living shoreline projects which will reduce wetland and/or shoreline erosion (action HB 3-2).
- Increasing the beneficial reuse of sediment to enhance shorelines and tidal wetlands (action CM 1-2b).
- Restoration of wetlands to prevent further loss (action HB 4-2).
- Controlling the spread of invasive species (action HB 6-1).

- Long term saltmarsh monitoring which will study how well the saltmarshes in the Inland Bays watershed are keeping pace with sea-level rise (in the Inland Bays Environmental Monitoring Plan).
- Reducing the amount of impervious pavement throughout the watershed which will reduce the occurrence of flooding (action DL 3-2).
- Develop a separate Habitat Strategy that will contain critical habitat and species protection, restoration, and climate change adaptation actions to be implemented by the Center and its partners (action HB 1-5).

*From Left to Right: Rep. Pete Schwartzkopf, Senator Carper, Dr. Marianne Walch.*




---

## OBJECTIVE 1:

Increase community and local government understanding and help prepare communities for potential impacts of the changing climate through mitigation and adaptation actions.

---

Public perception of climate change and the associated impacts is changing. Delaware Coastal Programs conducted surveys in 2009, 2014, and 2020 on the general public's knowledge of and belief in climate change as well as actions the government should take in response. The 2014 survey results showed that of those who took the survey, 79% are either completely or mostly convinced climate change is happening, and likewise 79% said that climate change is a threat. The survey also showed that 37% of respondents knew little or nothing about climate change<sup>6</sup>. The 2020 report shows some differences. According to the summary, 77% of respondents are either completely or mostly convinced climate change is happening. However, 70% of respondents also said that we should take immediate action to reduce the impacts of climate change. Still, 29% of respondents still reported knowing little to nothing about climate change, only a small improvement from 2014<sup>7</sup>.

<sup>6</sup> DNREC Coastal Programs, Delaware Sea Grant, and DNREC Division of Energy and Climate. *Delaware Residents' Opinions on Climate Change and Sea Level Rise 2014 Survey*. 2014.

<sup>7</sup> Brewer, Paul. DNREC Division of Climate, Coastal, and Energy. *Delaware Residents' Opinions on Climate Change and Sea Level Rise 2019 Survey*. 2019.

Though people over the years seem to be more knowledgeable on climate change and sea-level rise, continuing to educate about the impacts of climate change and actions to mitigate and adapt is an important goal of the Center and its partners.

**Many agencies and organizations are already providing this type of outreach and education, especially to local governments and planners:**

- Delaware’s Coastal Training Program offers technical assistance, seminars, workshops, and technology demonstrations for local governments and planners.
- The Coastal Training Program, in partnership with the University of Delaware’s Institute for Public Administration (IPA) and Delaware Sea Grant, leads a training course that reviews the multiple sources of flood risks (including sea-level rise) to Delaware communities that can be mitigated through planning, codes, and ordinances. The course covers floodplain requirements for municipalities and tools for adapting to flood risk and building community resiliency.
- Delaware Resilient and Sustainable Communities League (RASCL) is a group of 14 government, academic, and non-governmental partners (including the Center and many Inland Bays CCMP Signatories) that assist Delaware communities as they adapt to climate change and work toward a more resilient and sustainable future. RASCL’s efforts include an annual educational summit, informational “coffee hours,” and participation in public outreach events.

Promoting sustainable practices, such as the use of renewable energy sources, that mitigate the effects of climate change by reducing greenhouse gas emissions is beneficial to the health of the watershed. Warming air temperatures as a result of climate change will cause water temperatures to rise as well. The Inland Bays are more susceptible



*Living Shoreline on Read Avenue in Dewey Beach.*

to warming waters as a result of warming temperatures because they are shallow, with an average depth ranging from three to eight feet. Warmer water temperatures can cause several impacts, as described above.

By working with local governments and the entities mentioned above, the Center can bring about more sustainable practices and help to mitigate and adapt to the effects of climate change. In doing so, the Center can help communities make decisions that will benefit themselves and the Inland Bays watershed in the long run.

**ACTIONS**

**CC 1-1:** Develop and implement projects, programs, and policies that encourage and support communities and governments to mitigate and adapt to the high climate change risks identified in the Climate Change Vulnerability Assessment.

**Responsible Parties:** DNREC, Center (Lead); SCAT, CAC (Supporting)

**Performance Measure:** Number of projects and programs developed and implemented. Number of policy initiatives introduced on mitigation and adaptation. Demonstrate quantifiable risk reductions within the time period of this CCMP.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ CWA Section 320, local partners, federal, state, and local grants

**CC 1-2:** Educate the public about the benefits of and promote the use of renewable energy including wind, solar, and other sources.

**Responsible Parties:** DNREC (Lead); Center, CAC (Supporting)

**Performance Measure:** Number of publications and educational materials produced on the benefits of renewable energy annually.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ CWA Section 320, local partners, state grants, foundation support

<sup>8</sup> DNREC Coastal Programs. *Preparing for Tomorrow’s High Tide: Sea Level Rise Vulnerability Assessment for the State of Delaware*. 2012.

Environmental Scientist, Andrew McGowan, measures sea level rise.



---

## OBJECTIVE 2:

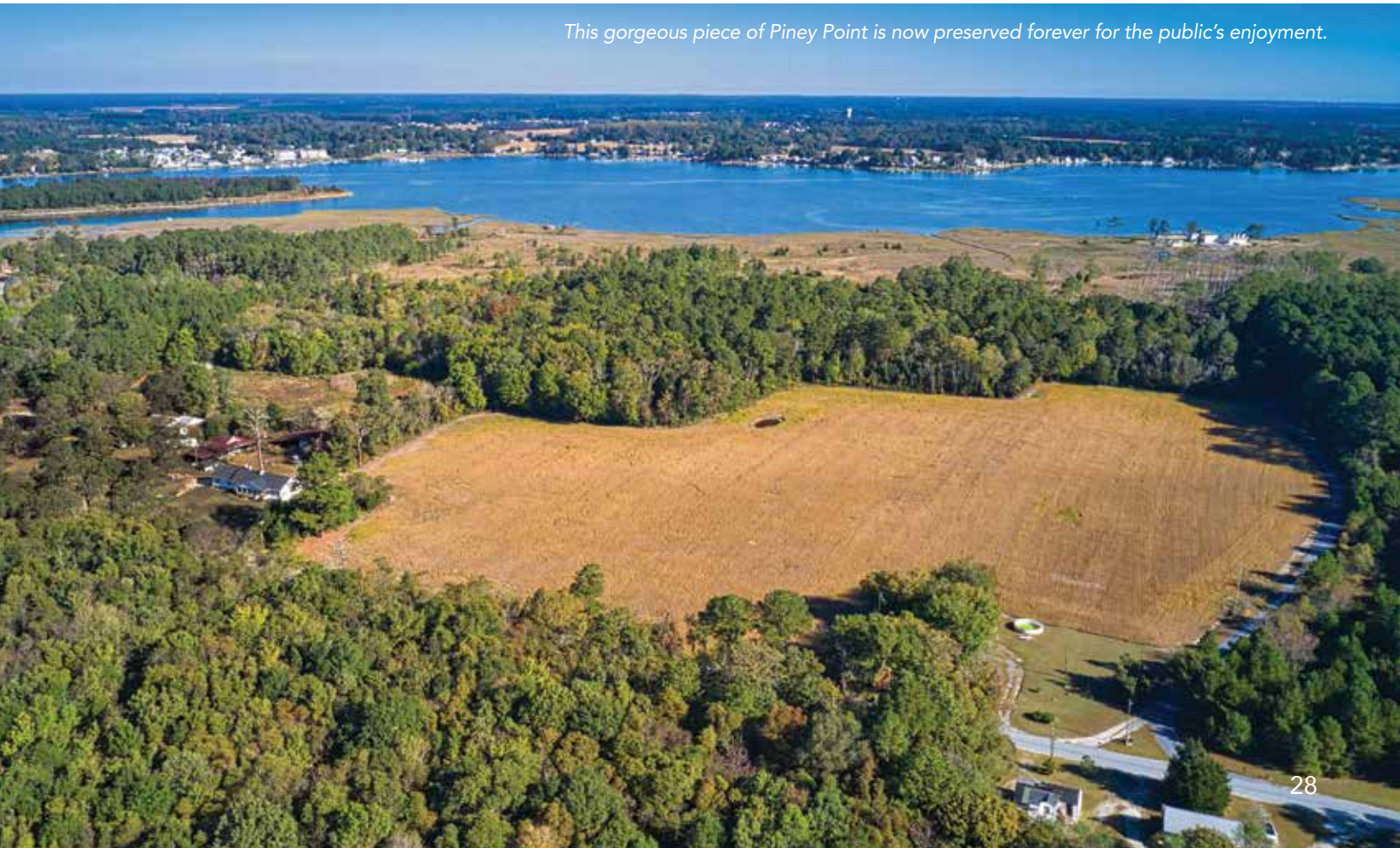
Use research, monitoring, and modeling to analyze and project climate change impacts to the Inland Bays watershed.

---

Understanding localized climate change impacts from the past and present can help prepare for impacts now and in the future. The State of Delaware, among others, has already conducted research to project the magnitude of sea-level rise and the potential impacts of other climate change stressors. These reports, Delaware Sea Level Rise Vulnerability Report<sup>8</sup> and Delaware Climate Impact Assessment, can be found on the DNREC website. Continuing to research how climate change may impact the Inland Bays watershed and local communities is imperative. Ultimately, the better we understand the repercussions of various environmental changes, the better position we are in to proactively address the future needs of local communities and our natural systems.

Flooding in the Inland Bays watershed, especially along the coastline, is a primary issue of concern. Sea-level rise paired with increasing intensity of storms has caused more frequent flooding. The Coastal Flood Monitoring System (CFMS) is a web-based tool and alert system designed to provide emergency managers and planners with important information about upcoming coastal flood events.

*This gorgeous piece of Piney Point is now preserved forever for the public's enjoyment.*



The CFMS serves three primary functions: 1) to send out warning alerts up to 48 hours in advance of potential flood conditions, 2) to provide access to current meteorological and hydrologic conditions, and 3) to provide local tidal predictions and map their areas of impact. The CFMS was initially developed for the Delaware Bay coast, but the Center and its partners recognize the need to bring the CFMS to the Inland Bays region and have prioritized this need by including it as an action in the CCMP.

Before the Inland Bays communities can effectively plan for climate change, they need to understand their vulnerabilities and the potential risks. The best way for municipalities within the Inland Bays watershed and the county to achieve this understanding is to complete comprehensive climate change vulnerability assessments. The type and extent of the vulnerability assessments should be determined by each municipality and the county individually and will depend on the specific priorities, interests, and funding. The vulnerability assessments may analyze climate change impacts to critical infrastructure such as wastewater treatment plants, and community facilities such as firehouses and hospitals. Municipalities and the county may also include an analysis of key environmental resources such as marshes and riparian buffers. These types of assessments could help with future land use planning and conservation efforts to protect the most vulnerable areas.

## ACTIONS

**CC 2-1:** Expand the Coastal Flood Monitoring System to the Inland Bays to provide a publicly-accessible, real-time tool to create flood inundation potential maps and time series of forecasted tidal predictions.

**Responsible Parties:** DNREC (Lead); STAC, Center (Supporting)

**Performance Measure:** Online tool developed and active.

**Timeframe & Key Milestones:** Tool developed by 2022 and maintained.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$ DNREC Coastal Programs through NOAA grant to develop CFMS. Tool will be maintained by University of Delaware

**CC 2-2:** Monitor the chemical, physical, and biological characteristics in the Bay to determine climate change impacts such as ocean acidification and take action to help mitigate those impacts and communicate results to the public.

**Responsible Parties:** DNREC, Center (Lead); STAC (Supporting)

**Performance Measure:** Results from monitoring efforts are shared with the public through various media including, but not limited to, press releases, social media posts, journal articles.

**Timeframe & Key Milestones:** Results shared when they become available.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$ CWA Section 320, local partners, federal and state grants

**CC 2-3:** Encourage municipalities within the Inland Bays watershed and Sussex County to complete a comprehensive climate change vulnerability assessment which identifies mitigation and adaptation strategies.

**Responsible Parties:** SCAT, Sussex County (Lead); DNREC (Supporting)

**Performance Measure:** Percent of municipalities in the Inland Bays that complete a comprehensive vulnerability assessment. Number of strategies implemented once municipality completes assessment.

**Timeframe & Key Milestones:** By 2030, 75% of municipalities in the Inland Bays watershed will have completed a vulnerability assessment.

**Location:** Watershed-wide

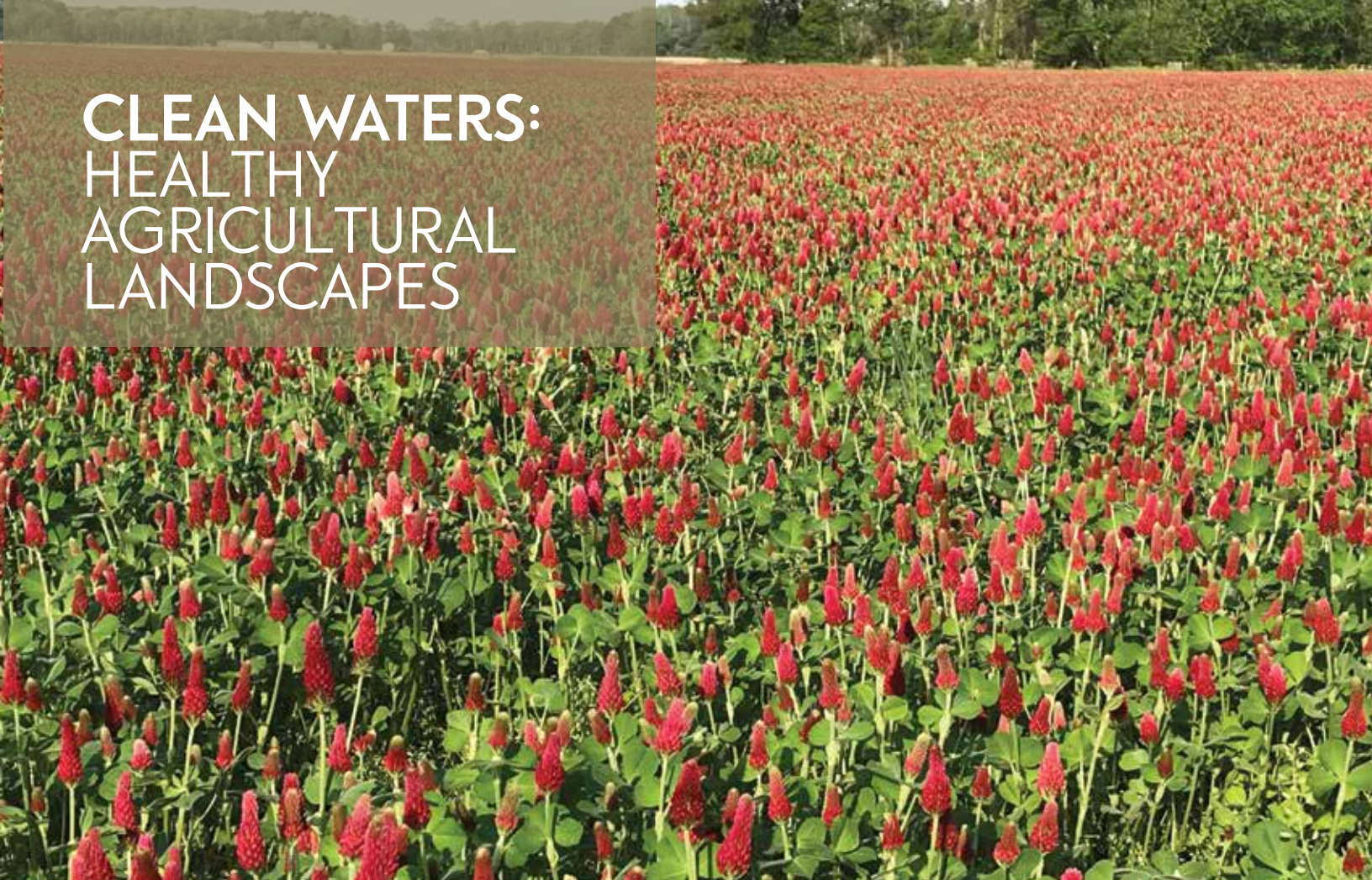
**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ FEMA grants, DNREC grants, County and Municipal funds



*Recycled oyster shells are used to stabilize a shoreline.*



# CLEAN WATERS: HEALTHY AGRICULTURAL LANDSCAPES



*Clover cover crop. Photo from Sussex Conservation District*

## GOAL:

**Work with the agricultural community to implement TMDLs of pollution to improve water quality and to protect and restore fish and wildlife habitat.**

Land use in the Inland Bays watershed is dominated by agriculture, which contributes to pollution through the unintentional loss of fertilizers and sediments to surface waters and wetlands. Best management practices for nutrients and sediments can significantly reduce pollution and improve soil fertility and are usually the most cost-effective solutions for reducing nutrient and sediment pollution.

The 2008 PCS is comprised of a set of recommendations to reduce nutrients entering streams, ponds, and the Inland Bays. Implementation of the PCS is intended to help achieve the TMDLs established for the Inland Bays.

**The agricultural chapter is comprised of ten actions that aim to reduce nonpoint sources of nutrients:**

- Full compliance with the Delaware Nutrient Management Act

- Planting cover crops
- Planting forested riparian buffers
- Restoring wetlands in areas previously converted to croplands
- Maintaining existing acres of wildlife habitat, grassed waterways and grassed filter strips
- Planting grassed buffers
- Using poultry manure storage sheds and composters and building additional structures
- Increase the annual quantity of manure relocated or put into alternative use
- Continuing the use of feed amendments and minimize calcium di-phosphate in poultry feed
- Implementing additional water control structures

In 2005, the Center and its partners began tracking these practices to determine from time to time the progress towards nutrient management goals. Of the ten practices, only Nutrient Management Planning (a regulatory requirement) had met its goal as of 2016 when progress was last determined. This requirement was made

in 1999 when the Nutrient Management Law was passed by the Delaware General Assembly. Provisions of this legislation also created a certification program for individuals involved in the generation or application of nutrients, promoted the development and implementation of BMPs to improve water quality and optimize nutrient use, and established educational programs.

Two other practices, the construction of poultry manure sheds or composters and the relocation and alternative use of manure, have achieved over 50% of their goals. The remaining practices (establishing cover crops, forested buffers, and grassed buffers; restoring wetlands; and treating cropland with additional water control structures) have had little progress. Maintaining existing acres of wildlife habitat, grassed waterways, and grassed filter strips have not been tracked. It is believed that this lack of progress is due to the voluntary nature of the recommendations, and the fact that implementation is driven by government investment in subsidies, which have a large shortfall in funding.

Agricultural practices from the PCS have been included in the CCMP to further elevate them for funding and implementation. The Center and its partners have had great success in developing operational project plans to implement PCS and other conservation actions to protect water quality and restore habitat. One example of this is the Watershed Reforestation Plan for the Inland Bays. This operational plan contains concept designs, estimated costs, estimated nutrient reductions, and potential funding sources for reforestation projects throughout the watershed. This type of operational plan ensures that projects are ready when funding becomes available and makes the grant writing process more efficient. The Center and its partners plan to create similar operational plans for additional practices for the entire watershed.

### *Did You Know?*

The cover crop program provides cost-share assistance to farmers who plant grasses, legumes, or forbs after an annual crop to replenish soils with nutrients and to prevent soil erosion.

*Producers learning about soil health. Photo by Edwin Remsburg and USDA-SARE*



## **OBJECTIVE 1:**

**Broaden partnerships within the agricultural community.**

Building upon existing partnerships in the agricultural sector is a priority for the Center. Collaboration among local, state, federal, private, and nonprofit groups to share costs and leverage funding will be key for success. The Center has been engaged with the agricultural sector since its inception. Partnerships built since the 1990s have led to the implementation of numerous policies and BMPs that have reduced nutrient pollution and sediments in the Inland Bays. Through the CCMP Implementation Committee, the Center intends to continue working with existing partners and to engage with new ones to better implement and track BMPs. Additionally, the Center and its partners intend to use the Implementation Committee to share new technology and information that can better meet water quality goals for the watershed.

Though agriculture is the leading source of nutrient pollution in the Inland Bays watershed, farmers are adhering to policies and implementing the best practices to limit the amount of nutrient pollution generated from farming operations. Agricultural landowners also maintain significant woodlands and wetlands that provide clean water to the estuary and maintain wildlife habitat in its watershed. It is important to help communicate to the public that these efforts are taking place to create support for good management tactics and hardworking partners. Agriculture is important to the economy and heritage of the Inland Bays and can be practiced in a way that helps to achieve water quality and habitat goals in the region.

**ACTIONS**

**AG 1-1:** Utilize the CCMP Implementation Committee to engage new and existing partners and improve implementation and tracking of agricultural best management practices and technology transfer.

**Responsible Parties:** Center (Lead); DNREC, DDA, SCD (Supporting)

**Performance Measure:** Improved comprehensive tracking and implementation of agricultural BMP implementation.

**Timeframe & Key Milestones:** Tracking system identified by 2021 and in use by 2022. Committee works to enter BMP information into tracking system annually. Complete an update of the PCS Assessment by 2024.

**Location:** Agricultural landscape of Inland Bays watershed.

**Cost & Potential Funding Sources:** \$ Local partners in-kind, CWA Section 320 funds

**AG 1-2:** Promote and celebrate those in the agriculture sector who are good stewards of the environment.

**Responsible Parties:** DDA, SCD (Lead)

**Performance Measure:** Members of the agricultural sector are recognized publicly for their innovation and BMP implementation.

**Timeframe & Key Milestones:** Annual recognition of three farmers.

**Location:** Agricultural landscape of the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$ Local partner operating budgets. EPA Section 320 funds and match will not be used.

**AG 1-3:** Conduct educational programs for the general public on best management practices employed by the agricultural sector to protect clean water and habitat.

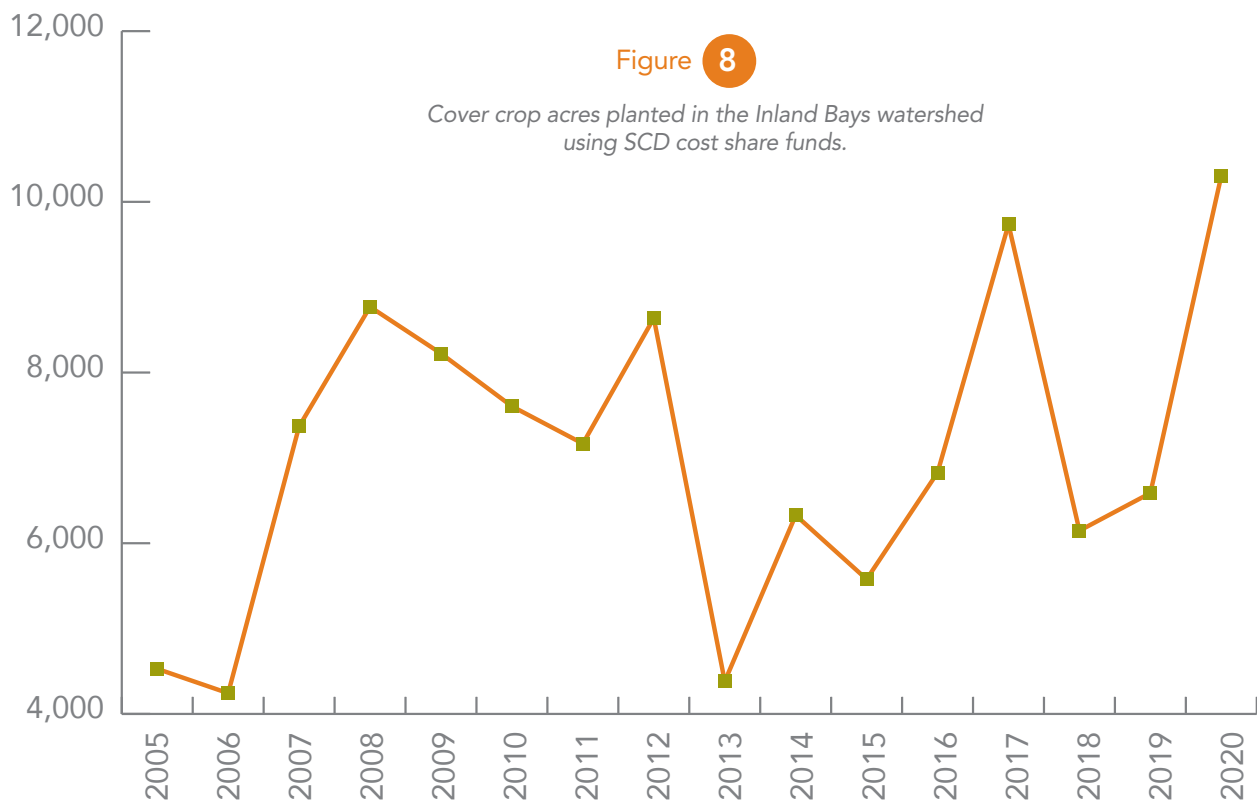
**Responsible Parties:** DDA, SCD (Lead)

**Performance Measure:** Number of individuals that attend programming.

**Timeframe & Key Milestones:** Two programs hosted annually. Goal of 50 people reached.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ Local partner operating budgets, state grants, foundation support



Cover crop. Photo by Allen Messick



## OBJECTIVE 2:

Reduce nutrient and sediment loads and other contaminants entering waterways from agriculture.

Over the past twenty years, the Center and its partners have made significant progress on phosphorus load reductions to the Bays, and in 2018 the phosphorus reduction goal of the Inland Bays PCS was achieved. However, nonpoint nitrogen loads remain far in excess of healthy limits in the watershed. Since implementing agricultural BMPs is the most cost-effective way of addressing nutrient pollution from agricultural sources, certain agricultural actions from the PCS have been included in this CCMP (see table 2). Cover crop implementation has fluctuated since 2005 due to funding availability and weather conditions affecting planting (see Figure 8). A sustainable and dedicated source of funding for the cover crop program is critical to ensure the goals set in the CCMP can be achieved, which is a primary goal of the Center's 2018 Finance Plan. Other practices, including water control structures, should be implemented and maintained to help achieve water quality goals. Water control structures, such as weirs, improve water quality by slowing or holding water back with the installation of flash boards, which allows the sediments and nutrients to settle out before moving down stream. Landowners hold the water in the ditch in the summer to help with improved water availability to crops in the fields.

Additionally, an operational project plan to help implement the strategies is proposed to aid in the fulfillment of the PCS goals. These operational project plan(s) identify areas for BMP implementation and include preliminary design, estimated cost, estimated nutrient reduction, and more to aid in project implementation. This plan(s) will help to more precisely determine milestones for attaining actions reflecting the PCS goals. Research and development of new, cost-effective

BMPs will need to be undertaken to ensure that the best solutions to reducing nutrient pollution are being employed. Outcomes of this research would be shared with the agricultural community, and creative methods for funding these efforts will be explored.

## ACTIONS

**AG 2-1:** Advance innovative technologies and agricultural practices that reduce nonpoint pollution from farming operations.

**AG 2-1a:** Encourage agricultural utilization of treated wastewater where practicable.

**Responsible Parties:** SCD, DDA (Lead); STAC (Supporting)

**Performance Measure:** Number of acres utilizing treated wastewater effluent on an "on demand" basis for optimum crop growth.

**Timeframe & Key Milestones:** Ongoing

**Location:** Agricultural lands in Inland Bays watershed.

**Cost & Potential Funding Sources:** \$ County funds, state partner funds, local partner funds

**AG 2-1b:** Encourage on-farm research on nutrient best management practices with farmers.

**Responsible Parties:** SCD (Lead); STAC (Supporting)

**Performance Measure:** Number of on-farm research opportunities annually.

**Timeframe & Key Milestones:** Goal of 3 research opportunities by 2029.

**Location:** Agricultural lands in Inland Bays watershed.

**Cost & Potential Funding Sources:** \$-\$\$ Local and state partner grants

**AG 2-1c:** Encourage the use of the 4R nutrient stewardship approach (right time, right place, right rate, right source) to reduce nutrient losses from cropland.

**Responsible Parties:** DDA (Lead)

**Performance Measure:** Number of farms utilizing 4R nutrient stewardship approach.



*Staff and volunteers planting trees.*

**Timeframe & Key Milestones:** 60% of available cropland treated using 4R nutrient stewardship approach annually.

**Location:** Agricultural lands in Inland Bays watershed.

**Cost & Potential Funding Sources:** \$ Local and state partner grants

**AG 2-1d:** Support the development of and promote diversification of cropping systems that result in improved water quality as opportunities arise.

**Responsible Parties:** Center (Lead), DDA, SCD (Supporting)

**Performance measure:** Percentage of cropland with non-traditional crop rotations resulting in water quality improvement.

**Timeframe & Key Milestones:** Ongoing. Assess opportunities for support every two years.

**Location:** Agricultural parcels in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$ CWA Section 320, local partners

**AG 2-2:** Develop and implement a project plan to achieve the Agricultural Actions of the Inland Bays Pollution Control Strategy.

**Responsible Parties:** Center (Lead); SCD, DDA, DNREC (Supporting)

**Performance Measure:** A detailed project plan with location, description, and estimated cost is completed. Number of projects completed annually from the Project Plan once completed.

**Timeframe & Key Milestones:** Project plan completed by 2022. Implementation completed 5-7 years after plan is completed.

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$ CWA Section 320, local partners, state grants or loans

**AG 2-2a:** Increase the amount of cover crops planted annually in the Inland Bays watershed.

**Responsible Parties:** SCD (Lead)

**Performance Measure:** Number of acres of cover crops planted annually.

**Timeframe & Key Milestones:** Ongoing - goal of 60% of available acres planted annually.

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ State and federal funding

**AG 2-2b:** Continue to use and support the construction of poultry manure storage sheds, composters, and animal mortality freezers.

**Responsible Parties:** SCD (Lead)

**Performance Measure:** Number of new poultry manure storage sheds and composters constructed and used annually.

**Timeframe & Key Milestones:** Ongoing - goal of 50 additional structures built. As of 2016 PCS Assessment, 28 structures have already been constructed.

**Location:** Poultry operations in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ State, federal, and local funding

**AG 2-2c:** Relocate poultry manure from the watershed and put into alternative use and encourage participation by integrators.

**Responsible Parties:** DDA (Lead)

**Performance Measure:** Number of pounds of manure relocated and put into alternative uses annually.

**Timeframe & Key Milestones:** Ongoing—goal of 20,909 tons of manure relocated annually or put into alternative use.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ State, federal, and local funds

**AG 2-2d:** Implement additional water control structures to treat cropland and maintain the 1,530 acres currently treated by these structures.

**Responsible Parties:** SCD (Lead)

**Performance Measure:** Number of acres treated by water control structures.

**Timeframe & Key Milestones:** Ongoing

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ State (319) and federal implementation grants, partner matching funds

**AG 2-3:** Encourage cost share providers to prioritize assistance for the highest priority BMPs.

**Responsible Parties:** Center (Lead); DNREC, SCD, DDA (Supporting)

**Performance Measure:** Provide expertise that encourages how cost share dollars are spent when opportunities arise. Track cost share dollars spent annually.

**Timeframe & Key Milestones:** Ongoing

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$ Local partner operating budgets, CWA Section 320 funds

**AG 2-4:** Continue County-level cost sharing for voluntary nutrient management practices.

**Responsible Parties:** Sussex County (Lead)

**Performance Measure:** Dollars appropriated by the County for cost-share for voluntary nutrient management practices.

**Timeframe & Key Milestones:** Reported annually

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$ County funds



### OBJECTIVE 3:

Protect and restore natural ecosystems in the agricultural landscape.

Historically, agriculture in the Inland Bays watershed altered the landscape by clearing forests, ditching and channelizing streams, and draining and filling wetlands in the quest for productive cropland. These changes altered the natural hydrology of the land. Restoring the natural hydrology and functions of the landscape will aid in nutrient removal and sediment retention and ultimately help reduce the amount of pollution entering the Inland Bays from agricultural areas. To date, there have been several federal and state programs created to encourage the protection or restoration of wetlands, streams, and forests on agricultural lands. It is important to help find ways to encourage or incentivize agricultural interests to use these funds, as well as identify creative funding mechanisms for these programs.

#### ACTIONS

**AG 3-1:** Plant riparian forested and grassed buffers.

**Responsible Parties:** Center, SCD (Lead); DNREC (Supporting)

**Performance Measure:** Total number of acres of forested and grassed buffers planted.

**Timeframe & Key Milestones:** Goal of 3,246 acres of riparian forest buffer and 1,772 acres of grassed buffers.

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$ Section 319 grants, Arbor Day Foundation grants, other state and federal grants

**AG 3-2:** Implement the Watershed Reforestation Plan for the Inland Bays.

**Responsible Parties:** Center, SCD (Lead); DNREC (Supporting)

**Performance Measure:** Number of acres of trees planted on cropland included in the Plan.

**Timeframe & Key Milestones:** Watershed Reforestation Plan fully implemented by 2025.

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$ Section 319 grants, Arbor Day Foundation grants, DNREC Surface Water Matching Planning Grant, other local grants

**AG 3-3:** Restore wetlands in areas that were previously converted to cropland.

**Responsible Parties:** SCD (Lead); Center (Support)

**Performance Measure:** Number of acres of wetlands restored that were previously converted to cropland.

**Timeframe & Key Milestones:** Ongoing - goal of 4,175 acres restored. Restoration opportunities identified through planning exercise by 2025.

**Location:** Agricultural lands in the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$-\$\$\$ Section 319 grants, CWA Section 320, other state grants or loans, federal programs (NRCS, FSA), County funds

**AG 3-4:** Restore streams in the Inland Bays watershed.

**Responsible Parties:** Center, SCD (Lead)

**Performance Measure:** Linear feet of streams restored.

**Timeframe & Key Milestones:** Identify areas for restoration by 2026. Restoration ongoing once identified.

**Location:** Streams throughout the Inland Bays watershed.

**Cost & Potential Funding Sources:** \$\$\$ Section 319 grants, CWA Section 320, other state grants or loans, federal programs (NRCS, FSA), County funds

# CLEAN WATERS: REDUCING POLLUTION FROM THE DEVELOPED LANDSCAPE



Anchorage Canal Wetpond. Photo Credit: Chris Bason

## GOAL:

Reduce the impacts of the developed landscape on water quality and wildlife habitat.

Pollution from the developed landscape comes from one of three places: point sources (pollution that comes from a pipe, such as discharge from a wastewater treatment plant), nonpoint sources (pollution coming from many different sources and dispersing into groundwaters and surface waters), and atmospheric sources (pollution in the air from power plants, cars, and agricultural practices that is deposited onto the surface of the Bays). Since the publication of the original CCMP, substantial progress has been made on reducing atmospheric pollution and major point sources (as reported in the 2016 State of the Inland Bays report). Point source nutrient pollution, in particular, has decreased by over 80% since the 1990s, and there is now only one minor point source remaining in the Bays. Substantial progress has also been made on conversions of septic systems to central sewer.

Despite the encouraging trends, there are still high levels of nutrients and sediment pollutants in the Bays. Much of the pollution identified in

the developed landscape can be attributed to nutrients from landscaping practices, land-based wastewater application, and stormwater runoff (including erosion of conveyance channels due to increased hydrologic energy from runoff). While nutrients may sound like a good thing, too much of them are harmful to the Bays and the plants, animals, and systems that they support.

Additionally, since the completion of the 1995 CCMP, development has accelerated in the Inland Bays watershed. Development creates more impervious or hardened surfaces, which prevent water from filtering naturally into the ground and contribute to pollutants in stormwater. The impervious surface generated with new development creates more stormwater runoff. More stormwater runoff creates higher velocities in streams and rivers. This stresses natural systems by disturbing and eroding channels and wetlands and also deposits pollutants into the system. While there were some protections to water quality from developments built in the 1990s, that protection focused largely on stormwater quantity. More recent state regulations and municipal ordinances focus on both stormwater quantity and quality. As a result, there are a great number of opportunities to improve water quality in older developments using retrofits.





### OBJECTIVE 1:

Conduct education and outreach to encourage management practices that limit pollution from nutrients, sediments, and other contaminants.

Providing Inland Bays’ residents, businesses, and visitors (including second homeowners) with clear science and best management practice options allows them to make informed decisions about their actions concerning nutrients in the developed landscape. The actions below focus on two sources of nutrients: landscaping and septic systems. Over application of fertilizers and pesticides on lawns is a source of nonpoint nutrient pollution in the Bays. Certifying commercial nutrient managers for lawns bolsters practitioners’ credentials and creates an opportunity to educate an audience responsible for managing multiple properties or large areas—helping to address nutrients on a large scale.

This certification is for people who apply nutrients on land 10 acres or larger, including but not limited to agricultural land, lawns and landscapes, golf courses, and athletic fields. This certification is to ensure both environmental and public health safety. Public outreach about the financial and ecological benefits of central sewerage will help to capitalize on the momentum gained from the over 50,000 conversions from septic that have occurred in Sussex County since the 1970s. For those without the opportunity or means to convert from septic systems to central sewerage, outreach about proper maintenance and replacement would be provided to help navigate best practices.

#### ACTIONS

**DL 1-1:** Continue certification and education of commercial nutrient managers for lawns.

**Responsible Parties:** DDA (Lead)

**Performance Measure:** Number of commercial nutrient managers certified annually.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ DDA operating funds

**DL 1-2:** Educate homeowners and HOAs on the wise use of fertilizer to reduce nutrient runoff from lawns.

**Responsible Parties:** Center (Lead); DDA (Supporting)

**Performance Measure:** Number of people reached through educational programming/materials.

**Timeframe & Key Milestones:** Educational materials (presentation, flyers, targeted social media, journal articles, etc.) produced annually.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ CWA Section 320 funds, state grants, foundation support

**DL 1-3:** Continue public education on the economic and environmental benefits of central sewerage.

**Responsible Parties:** Center (Lead); Sussex County (Supporting)

**Performance Measure:** Number of individuals educated on the economic and environmental benefits of central sewerage.

**Timeframe & Key Milestones:** Educational materials (presentation, flyers, targeted social media, journal articles, etc.) produced annually.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ CWA Section 320 funds, Sussex County

**DL 1-4:** Conduct an education campaign on the proper maintenance and replacement of septic systems.

**Responsible Parties:** DNREC (Lead); Center (Supporting)

**Performance Measure:** Number of individuals educated on septic system maintenance and replacement.

**Timeframe & Key Milestones:**

Campaign initiated by 2027

**Location:** Watershed-wide.

**Cost & Potential Funding Sources:** \$-\$\$  
State grants, CWA Section 320 funds

**DL 1-5:** Regularly report on the implementation of regulations for small on-site wastewater systems to the CCMP Implementation Committee.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** A report is updated and presented to the CCMP Implementation Committee.

**Timeframe & Key Milestones:** Annual report

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$  
Partner operating budgets

*Golf course on the Indian River being sprayed with fertilizer.*




---

## OBJECTIVE 2:

Reduce the amount of nutrients, sediments, and other contaminants entering waterways from wastewater sources.

---

Increased population and associated development also increase the amount of wastewater to be treated and disposed of. Many point source discharges of nutrients once removed from the Bays were converted to land-based disposal where they became classified as nonpoint source discharges.

Land-based disposal is considered a more desirable disposal alternative than through a direct discharge to a waterbody because it provides the opportunity for the trapping and removal of nutrients from the wastewater effluent within the

first few feet of soil to which it is applied. Here, both nitrogen and phosphorus can be removed through plant uptake during the growing season and subsequent harvest, while phosphorus has the capacity to bind to soil particles to a limited extent. Relatively limited removal of nitrogen to the atmosphere through volatilization and microbially-mediated conversion of nitrate to nitrogen gas can also occur in this zone of the soil. However, once nutrients in groundwater flow through this zone into the surficial aquifer, very little removal of nutrients occurs, particularly for nitrogen. This water eventually discharges to surface waters and remaining nutrients contribute to pollution.

Utilization of rapid infiltration basins to dispose of wastewater results in higher hydraulic loading rates relative to application on fields. This largely bypasses the nutrient removal and retention capacity of the upper layer of soil and has demonstrated potentially higher mobility of phosphorus in some systems. While land-based application of wastewater is an improvement over direct discharge, it has contributed to the widespread contamination of the surficial aquifers of the watershed and continues to pose challenges for achieving water quality goals for the Bays.

As wastewater facilities have improved treatment and removed their direct discharges, pollution to the Inland Bays from direct discharges has decreased dramatically. Between 1990 and 2009, pollution loads from point sources decreased by over 400 pounds per day of nitrogen and over 40 pounds per day of phosphorus. There is now only one remaining point source left in the Inland Bays watershed, as others have been replaced by disposal methods such as the spraying of treated wastewater onto land. A better system of accounting for and tracking land-based wastewater loads of nutrients and their transport through the surficial aquifer to surface waters is needed to understand the overall changes in loads from wastewater discharges over time.

There has also been considerable progress converting septic systems to central sewer in Sussex County. A properly maintained traditional septic system leaches approximately 10.6 pounds of nitrogen and 0.7 pounds of phosphorus to groundwater each year. When multiplied by the estimated 8,292 systems (2016 estimate) in the watershed, the total pollution contribution of septic systems is nearly 89,000 pounds of nitrogen annually and more than 5,800 pounds of phosphorus. Central sewer service allows a higher level of sewage treatment and eliminates pollution from septic systems. While impacts from point sources are expected to continue decreasing

(as required by the TMDL regulation), and while central sewer expansion continues, new septic systems are continually permitted. Population growth is projected to continue in the Inland Bays watershed, which will create greater stress on wastewater systems. Because of this, there is a need to ensure that system capacity is sufficient to meet the growing demand and that regulations and permits are enforced. Sussex County has continued to allocate County funds for wastewater facility improvements.

However, at the time this document was written, no regulations specifically limit the amount of nutrients in wastewater that can be discharged to the land relative to the TMDLs of their receiving waters. Thus, increased coordination among the multiple public and private entities responsible for managing decisions involving land use (and subsequent population levels) as well as permitting of wastewater nutrient concentrations and loads to the land is needed. The coordination is intended to ensure that present and future land-based wastewater contributions will allow TMDLs to be achieved. Thoughtful planning, research, remediation projects, and regulatory enforcement will help to reduce pollutants entering the waterways from wastewater and enhance the wildlife habitat and recreational uses of disposal areas. Wastewater operators will need to continue applying innovative practices, as well as tried and true practices such as spray irrigation and biosolids, to treat wastewater to targeted levels.

## ACTIONS

**DL 2-1:** Develop a wastewater planning committee comprised of DNREC, Sussex County, utility industry representatives, and other stakeholders to coordinate the treatment and disposal of wastewater from new and existing developments based on the TMDLs of receiving waters.

**Responsible Parties:** Center (Lead); DNREC, Sussex County (Supporting)

**Performance Measure:** A Wastewater Planning Committee is formed with key partners and meets regularly.

**Timeframe & Key Milestones:** Committee formed by 2022. Once formed, the Committee will decide how to handle the issue of wastewater planning, whether through the creation of a plan or other method.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ Local partner operating budgets

**DL 2-2:** Enforce the waters of Exceptional Recreational and Ecological Significance (ERES) provisions of the State Water Quality Standards requiring the least environmentally damaging disposal alternatives for wastewater.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** ERES provisions are enforced through inclusion in wastewater disposal permitting.

**Timeframe & Key Milestones:** ERES provisions included in permitting process by 2030.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ State funding

**DL 2-3:** Develop a nutrient budget for wastewater to determine existing and projected loads to receiving waters and report biannually; Explore the need for annual updates.

**Responsible Parties:** DNREC, STAC (Lead); Sussex County, Center (Supporting)

**Performance Measure:** Nutrient budget for wastewater is developed and reporting is completed biannually, or annually if determined necessary.

**Timeframe & Key Milestones:** Nutrient budget developed by 2027.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$ Federal, state, Sussex County funding, grants, Section 320 funds

**DL 2-4:** Improve treatment levels at two Sussex County wastewater treatment facilities managing for improved nutrient retention, wildlife habitat, and recreation where practicable.

**Responsible Parties:** Sussex County (Lead); Center (Supporting)

**Performance Measure:** Improve nutrient removal percentage at the Inland Bays Regional Wastewater Facility by 10% over the next permit cycle.

**Timeframe & Key Milestones:** Reforestation of 360 acres of agricultural lands where treated wastewater is applied at the Wolfe Neck Regional Wastewater Facility completed by 2026.

Reforestation of 60 acres of cropland at the Inland Bays Regional Wastewater Facility completed by 2026. Upgrades to both treatment plants ongoing.

**Location:** Wolfe Neck & Inland Bays Regional Wastewater Treatment Facilities

**Cost & Potential Funding Sources:** \$\$\$\$\$ County funds, CWA Section 320 funds

**DL 2-5:** Continue septic system remediation and conversion projects in the Inland Bays' 10-digit hydrologic unit codes with emphasis on projects within 1,000 feet of the mean high-water line of any tidal waterbody, tidal stream, or tidal marsh.

**Responsible Parties:** Sussex County (Lead)

**Performance Measure:** Number of equivalent dwelling units transferred to central sewerage annually.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$\$\$ County funds

**DL 2-6:** Research the attenuation of nutrients and contaminants released from County-owned wastewater systems along flow paths to receiving waters.

**Responsible Parties:** Sussex County, STAC (Lead)

**Performance Measure:** Research is coalesced and used to refine loading estimates to receiving waters and influence management activities.

**Timeframe & Key Milestones:** Research completed by 2028

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$ County funds, local partners

**DL 2-7:** DNREC requires that applications for new or renewed groundwater discharge permits for wastewater clearly demonstrate how discharges affect nutrient loading and contribute to meeting TMDL reductions for the ultimate receiving waterbodies.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** Permit application requirement added.

**Timeframe & Key Milestones:** Requirement added by 2025

**Location:** Watershed wide

**Cost & Potential Funding Sources:** \$-\$\$ State operating funds

**DL 2-8:** Explore the development of a nutrient trading or offset districts for wastewater.

**Responsible Parties:** Center, Sussex County, DNREC (Lead)

**Performance Measure:** Stakeholders meet and discuss developing nutrient trading or offset districts for wastewater and make determination.

**Timeframe & Key Milestones:** Stakeholders begin discussions by 2022. Determination on whether to develop a nutrient trading or offset district for wastewater made within two years of beginning discussions.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ EPA Section 320 funds, local operating budgets

*Canals in South Bethany.*



<sup>9</sup>DeLiberty, Tracy. *Delaware Coastal Communities Impervious Surface Coverage*. 2019.

Floating oyster cages are used for oyster gardening. The oysters are held at the surface in the summer and then sunk to the bottom in the winter.



### OBJECTIVE 3:

Reduce the amount of nutrients, sediments, and other contaminants entering waterways from stormwater sources.

Stormwater is runoff that flows from impervious surfaces such as streets and roofs to surface waterbodies during and after precipitation. The runoff picks up pollutants like trash, chemicals, oils, and dirt/sediment that can harm our rivers, streams, bays, and coastal waters. The amount of impervious surfaces has increased in the Inland Bays watershed as more and more development occurs. Between 1992 and 2016, the percentage of land in the watershed covered with impervious surface increased by 22%. The largest increase occurred between 2001 and 2006.

Studies have shown that noticeable degradation to the water quality of estuaries begins when their watershed exceeds 10% imperviousness. As of 2016, the Inland Bays watershed as a whole has reached 10.4% impervious cover. This number is higher in localized areas. A study completed in 2019 found that seven coastal towns in the watershed had approximately 32% impervious cover in 2007 and 35% in 2016, a 3% increase<sup>9</sup>. Developments in Delaware constructed before 1990 were not required to control stormwater. This means that when it rains, polluted runoff from these places runs into the Bays untreated and can sometimes create flooding issues. The PCS included goals to reduce stormwater pollution, including the installation of stormwater retrofits to treat lands developed prior to 1990. As of 2016, roughly 100 acres (just over 2% of the goal) have been retrofitted.

More public and private investments are needed to help reach the goal, which is an action in the Center's 2018 Finance Plan. Without a coordinated approach, the TMDL for the Inland Bays will not be achieved. Climate change, which is anticipated to increase the frequency and intensity of rain

events in the region, will only exacerbate existing stormwater challenges. While stormwater regulations promulgated within the last several years will help to reduce impacts from new developments, there remain many developments constructed before the regulations went into effect. Retrofits will be necessary to help mitigate the impacts from these older developments. Overall, additional policies, planning, and improvement projects are necessary to reduce pollution from stormwater sources in the Inland Bays watershed.

### ACTIONS

**DL 3-1:** Establish stormwater management offset districts to improve water quality and stormwater permit compliance efficiency.

**Responsible Parties:** Sussex County (Lead); SCD, Center (Supporting)

**Performance Measure:** Stormwater management offset districts and associated bank are established.

**Timeframe & Key Milestones:** Stormwater management offset districts established by 2021.

**Location:** Watershed wide

**Cost & Potential Funding Sources:** \$\$ County funds

**DL 3-2:** Achieve actions that reduce the amount of effective impervious surface within the Inland Bays watershed.

**DL 3-2a:** County and municipalities consider ordinances that minimize new and reduce existing impervious surfaces.

**Responsible Parties:** SCAT (Lead); Center, Sussex County, DNREC (Supporting)

**Performance Measure:** Number of ordinances considered and/or adopted.

**Timeframe & Key Milestones:** Ongoing

**Location:** County and municipal areas

**Cost & Potential Funding Sources:** \$-\$\$ Federal, state, County, and municipal funding

**DL 3-2b:** Develop a plan to create stormwater retrofits to work toward a goal of treating 4,500 acres of urban and residential lands developed pre-1990.

**Responsible Parties:** DNREC, SCAT, Sussex County, Center (Lead)

**Performance Measure:** Plan is developed. Number of acres developed pre-1990 treated by stormwater retrofits.

**Timeframe & Key Milestones:** Plan is developed by 2024. Implementation of plan is ongoing - goal to treat 4,500 acres.

**Location:** Developed landscape

**Cost & Potential Funding Sources:** \$\$\$\$\$ State and local funding, Surface Water Matching Planning grant

**DL 3-3:** Explore new ordinances to address the sale and use of fertilizers to reduce nutrient pollution from lawn application.

**Responsible Parties:** Center, DDA (Lead)

**Performance Measure:** Number of policy changes explored that would reduce nutrient pollution from lawn fertilizer.



Center volunteer oyster gardener cleans oysters in his floating cages.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$ State funding, CWA Section 320 funds

**DL 3-4:** Develop a nutrient budget for stormwater to determine existing and projected loads to receiving waters and report biannually; Explore the need for annual updates.

**Responsible Parties:** Center, STAC (Lead); Sussex County, DNREC (Supporting)

**Performance Measure:** Nutrient budget for stormwater is developed and reporting is completed biannually, or annually if determined necessary.

**Timeframe & Key Milestones:** Nutrient budget developed by 2027

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$ Federal, state, local funding, federal and state grants

**DL 3-5:** Hold MS4 roundtables to explore cost effective and coordinated approaches to meeting permit requirement should the 2020 Census indicate an MS4 permit designation is possible.

**Responsible Parties:** Center (Lead); Sussex County, SCAT, DNREC (Supporting)

**Performance Measure:** Partners convene a discussion on cost-effective and coordinated approaches to meeting MS4 permit requirements, should it be deemed necessary.

**Timeframe & Key Milestones:** Roundtable discussion convened by 2024, should it be deemed necessary.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ EPA Section 320 funds

# HEALTHY BAY ECOSYSTEMS: PROTECT AND RESTORE THRIVING HABITATS FOR ABUNDANT FISH AND WILDLIFE



The Center has tagged thousands of horseshoe crabs as part of an effort to better understand their movements. Photo by Joe Whalen

## GOAL:

Restore, enhance, and protect ecosystems of the Inland Bays estuary taking climate change adaptation into consideration so that they are healthy, productive, and resilient for the benefit of both people and the natural environment.

The health of the ecosystems of the Inland Bays watershed is directly linked to clean water and hydrology. Both water quality and the way water flows impacts habitats such as wetlands and streams, which create hospitable or inhospitable environments for plants and animals. Water quality also directly impacts the abundance of birds, fish, and shellfish in an estuary. When water quality and quantity are good, there is a healthy habitat to support an abundance and diversity of plants and wildlife in the ecosystem upon which people depend. When the system is functioning well, some species, like shellfish, will help to further clean water by filter feeding. Healthy wetlands also help by filtering pollutants before they can reach the water, and by supporting populations of juvenile fish and crabs important to recreational and commercial fishing industries.

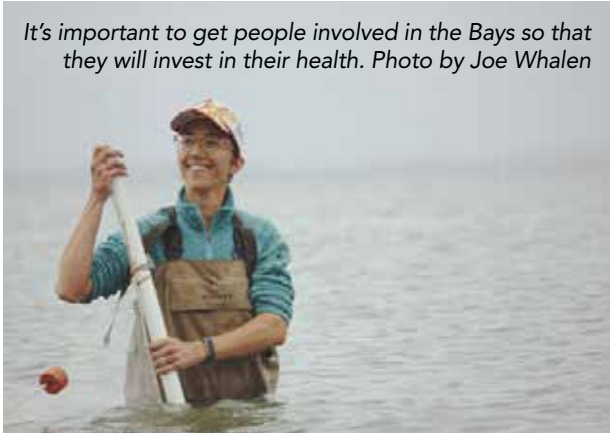
The Inland Bays watershed is fortunate to have numerous partners collaborating to support healthy ecosystems through research, monitoring, and restoration projects. According to the 2016 State of the Bays report, living resource indicators show somewhat mixed results, with positive trends for bald eagles, ospreys, black ducks, and hard clams, and negative trends for brant, canvasback, blue crabs, bay anchovy, and bay grasses. In the future, restoration projects to support various species, such as the study and successful restoration of the menhaden population, will be important. Water quality improvements are crucial to improvements in the ecosystem, and the success of the Healthy Bay actions will be closely linked to the success of Clean Water actions.

## OBJECTIVE 1:

Continue to use research, monitoring, and modeling to capture trends that can provide information to help protect and restore prime habitat for fish and wildlife particularly in light of the CCVA findings.

There have been many changes to the Bays since TMDLs were developed. Some of these changes have altered the way that the watershed functions. As a result, the TMDL developed over

*It's important to get people involved in the Bays so that they will invest in their health. Photo by Joe Whalen*



20 years ago may no longer be the right target for the Inland Bays. For example, the tidal flushing (amount of water that the tides carry from the ocean to the Bay) in the Indian River Inlet has increased since previous measurements were taken in 19881. This change resulted in a long-term increase in the salinity of the Bays and likely contributed to marsh degradation. It also resulted in the flushing out of nutrient pollution from the Bays to the ocean, contributing to improved water quality in tidally-influenced waters. It is important to understand the hydrodynamics of the Bays to protect and restore the Bays and their ecosystems. As a result, the actions below focus on updating models and conducting further research on key habitats such as baygrass meadows and oyster reefs.

## ACTIONS

**HB 1-1:** Update the Inland Bays estuarine water quality and hydrodynamic model.

**Responsible Parties:** STAC (Lead); Center, DNREC (Supporting)

**Performance Measure:** Updated model(s) populated with best available data are functional.

**Timeframe & Key Milestones:** Implementation plan developed in 2020. All plan components implemented by 2025.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** Development of implementation plan: \$; Development of model: \$\$\$\$ Federal and state funding, grants, Section 320 funds

**HB 1-2:** Update the Inland Bays watershed nutrient loading model.

**Responsible Parties:** STAC (Lead); Center, DNREC (Supporting)

**Performance Measure:** Updated model populated with best available data is functional.

**Timeframe & Key Milestones:** Model developed by 2023

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$-\$\$\$\$ Federal and state funding, grants, Section 320 funds

**HB 1-3:** Utilize updated estuarine and watershed models to evaluate if existing TMDLs are adequate to achieve water quality standards for nitrogen and phosphorus.

**Responsible Parties:** DNREC (Lead); Center, STAC (Supporting)

**Performance Measure:** Report produced

**Timeframe & Key Milestones:** Report produced by 2030

**Location:** Indian River, Little Assawoman, and Rehoboth Bays, including tributaries

**Cost & Potential Funding Sources:** \$\$\$ State funds, Section 320 funds

**HB 1-4:** Monitor the distribution of bay grasses to inform potential restoration projects, and if monitoring shows insufficient or decreasing bay grass coverage, take action to increase the acreage.

**Responsible Parties:** Center, STAC, DNREC (Lead)

**Performance Measure:** Bay grass monitoring plan developed; Report including data/maps of areas of Bays with habitat characteristics supportive of reestablishment of SAV species produced.

**Timeframe & Key Milestones:** Monitoring plan within two years; Water Quality Index for eelgrass updated with 2021 State of the Bays report; restoration suitability GIS model and report completed by 2022. Bay grass monitoring completed annually

**Location:** Indian River, Little Assawoman, and Rehoboth Bays, including tributaries

**Cost & Potential Funding Sources:** \$\$\$ Section 320 funds, federal and state funding, grants



**HB 1-5:** Develop and implement an Inland Bays Habitat Plan to protect and restore critical habitats in the Inland Bays watershed.

**Responsible Parties:** Center (Lead); DNREC, STAC, SCD, DDA (Supporting)

**Performance Measure:** Habitat Plan produced. Number of acres or linear feet of habitat restored or protected.

**Timeframe & Key Milestones:** Plan produced by 2024. Implementation of plan ongoing once complete.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$\$ Section 320 funds, federal and state funding, planning grants

*A small oyster toadfish is found during a fish survey.*



---

## OBJECTIVE 2:

Enhance and restore fish populations and their habitats in the Inland Bays.

---

Over one hundred species of fish live, feed, and grow in the Inland Bays. The Inland Bays' shallow waters and wetlands offer protection and serve as nurseries for species valued by recreational anglers and commercial fisheries. Large year-to-year differences in the abundance of many species are common. However, bay anchovy has declined significantly over the past 30 years, and once-abundant adult weakfish are now rarely observed. Other species show little change. To adequately manage fish populations and important habitats, as well as manage other species and habitats throughout the watershed, we need to be using an ecosystem-based management approach.

The National Oceanic and Atmospheric Administration (NOAA) defines ecosystem-

based management (EBM) as an integrated management approach that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation<sup>10</sup>. The current and future environmental challenges facing coastal ecosystems benefit from this by utilizing a broad management approach that considers cumulative impacts on marine environments, an approach that works across sectors to manage species and habitats, economic activities, conflicting uses, and the sustainability of resources. EBM allows for consideration of resource tradeoffs that help protect and sustain diverse and productive ecosystems and the services they provide.

Working toward ecosystem-based management of fisheries will help to restore fish populations. Protecting wetlands and shore-zone habitat will help to protect adult spawning habitat and juvenile nursing grounds, and long-term reductions in nutrient-pollution-fueled algal blooms will lead to improved oxygen levels that will benefit the survival and growth of young fish, especially in tributaries. Supporting fish passage in waterways with dams will also increase fish abundance by removing obstructions to spawning areas important to migratory species like the alewife, blueback herring, hickory shad, American eel, and striped bass. There are eight dams within the Inland Bays watershed that present obstacles to these fish and interventions like fish and eel ladders and dam breaches would encourage fish passage.

In 2014, an Inland Bays migratory fish passage study determined through a priority ranking model that the Millsboro Pond dam on the Indian River and the Burton Pond dam on Herring Creek were the highest priorities of the eight dams in the watershed for fish passage device installation<sup>11</sup>. The migratory fish passage study also ranked dams in the watershed according to their suitability for the installation of eel passageways. Because these devices are cheaper and easier to install, the focus was redirected to reestablishing passage of larval eels at priority dams in the watershed. The dams selected for rehabilitation and/or construction of eelways in 2017 were Millsboro Pond, Lower Betts Pond, and Burton Pond. The Burton Pond eelway is now successfully passing an estimated 1,000 eels per night during peak ingress, and opening up almost 7 miles of new habitat in the headwaters of Herring Creek. This eelway will continue to be maintained and monitored, and results will be reported annually.

---

<sup>10</sup> National Oceanic and Atmospheric Administration. <https://ecosystems.noaa.gov/EBM101/WhatisEcosystem-BasedManagement.aspx>

<sup>11</sup> Miller, Roy. Delaware Center for the Inland Bays. Inland Bays Migratory Fish Passage Restoration Feasibility and Planning Study. 2014.

## ACTIONS

**HB 2-1:** Provide access for native migratory fish to upstream areas for use as spawning and/or nursery sites.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Number of fish passage projects completed. Number of miles of fish habitat restored.

**Timeframe & Key Milestones:** Burton Pond dam project completed by 2024. Additional sites explored for more fish passage projects.

**Location:** Creeks and tributaries in the Inland Bays watershed

**Cost & Potential Funding Sources:** \$\$\$  
Funding through DelDOT, USFWS, other grants

**HB 2-2:** Conduct education and outreach efforts on the importance of migratory fish and the benefits of fish passage restoration.

**Responsible Parties:** Center, DNREC (Lead)

**Performance Measure:** Number of publications and/or educational materials produced, including brochures, social media campaigns, videos, infographs, etc. specifically targeting migratory fish and fish passage restoration.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$  
State funding, grants, Section 320 funds

**HB 2-3:** Advocate for ecosystem-based management of fisheries.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Number of comments on management plans submitted.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$  
Section 320 funds, state operating funds.

*This image shows the beauty of a saltmarsh at Bottom Hills Drain on Indian River Bay. Photo by Chris Bason*



---

## OBJECTIVE 3:

Maximize the amount of natural Inland Bays shoreline.

---

Natural shorelines along the Inland Bays can include wetlands, beaches and dunes, and reefs. In 2006 and 2012, the Center conducted a study to assess the distribution of shoreline types in the Indian River Bay and Rehoboth Bay, respectively, and found that significant waterfront has been converted to hard structures such as bulkheads. The functions of natural shoreline, which include attenuating wave energy, providing spawning habitat, filtering pollutants from water, and creating safe havens for juvenile fish, have been significantly reduced. The Center and its partners have had success restoring shorelines and need to continue working toward this goal.

In addition to this goal, it is also important to break down barriers to implementing shoreline restoration projects. One barrier to implementation is the requirement of a subaqueous land lease for shoreline stabilization projects, which includes shoreline restoration. The land lease has an annual fee that must be paid by the landowner. The lease fee can often be expensive and can limit the ability of some landowners to implement shoreline restoration projects. The Center and its partners agree on the importance of making the implementation of shoreline restoration projects easier and will review financial means to encourage their installation.

Desired marine and coastal construction practices include living shorelines and other shoreline stabilization practices.

Wetlands are critical to the health of the Bays. Wetlands provide a filtering function for the system, removing pollutants from water before they reach the Bays. Wetlands also help protect the shoreline against storm surge and can act as a sponge to mitigate flooding. They also act as a nursery for young fish and crabs, which is important for both recreational and commercial fisheries. When shorelines are “hardened” with bulkheads or riprap, wetlands to the bayside of these structures erode or are unable to migrate inland with rising sea-levels. The benefits of these eroded or drowned wetlands—the filtering capacity, storm surge protection, and fish nursery function- are lost. These functions need to be clearly communicated to the public, and alternatives to “hardened” structures need to be developed and promoted.

While low salinities made stable wild oyster populations impossible until the stabilization of the Indian River Inlet, oysters are part of the history of the Inland Bays. A healthy privatized commercial oyster industry, in which oysters were transplanted from other waterbodies, existed for several decades in the Inland Bays but had declined by the 1950s due to the introduction of oyster diseases and other factors. Today, wild oysters remain rare, but studies have shown that they are reproducing in some areas of the Bays.

Beaches are another important shoreline type to the Inland Bays watershed. Several characteristic species, including horseshoe crabs and migratory birds, depend upon the beaches of the Inland Bays for spawning and feeding habitat.

## ACTIONS

**HB 3-1:** Conduct an education and outreach program on shoreline function and management alternatives for shoreline property owners.

**Responsible Parties:** Center (Lead); DNREC (Supporting)

**Performance Measure:** Number of education and outreach materials produced, including guidebooks, social media posts, blog posts, brochures, etc., targeting shoreline function and management alternatives.

**Timeframe & Key Milestones:** Ongoing, waterfront property owner’s manual produced by 2021.

**Location:** Homeowners along the shoreline.

**Cost & Potential Funding Sources:** \$ Section 320 funds, state funding

**HB 3-2:** Continue conducting living shoreline demonstration projects to encourage widespread use of this practice.

**Responsible Parties:** Center (Lead); DNREC (Supporting)

**Performance Measure:** Create a minimum of six demonstration living shorelines in study area.

**Timeframe & Key Milestones:** Demonstration living shoreline projects completed by 2025.

**Location:** Shorelines in the Inland Bays watershed

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$. Funding through grants, state, municipalities, private communities, CWA 320 funds

**HB 3-3:** Convene a stakeholder group to explore policy changes needed to require that living shoreline techniques be employed where feasible for shoreline stabilization.

**Responsible Parties:** Center (Lead), DNREC (Supporting)

**Performance Measure:** Report developed by stakeholder group.

**Timeframe & Key Milestones:** Stakeholder group convened by 2025. Report completed by 2026.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ State funding, local partner operating funds

**HB 3-4:** Consider and review ways to reduce the burden for implementing living shorelines for home/landowners as opposed to installing hard structures.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** Review is completed.

**Timeframe & Key Milestones:** Review completed within by 2026.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ State funds. Section 320 funds and match will not be used.

Keenan Kramer, a restoration staff member with Environmental Concern, plants switchgrass along the edge of the wetland pond at the project site.



#### OBJECTIVE 4:

Increase regulatory protections for wetlands and restore previously lost wetlands.

The watershed's wetlands provide extensive environmental benefits that have afforded them various levels of regulatory protection. Wetlands harbor high plant and animal diversity, including a large proportion of the watershed's rare species. They also are critical for nitrogen removal from the watershed. They protect properties by storing floodwaters and buffering coastal storms. And saltmarshes, in particular, have a tremendous capacity to sequester and store carbon to mitigate climate change. Statewide, wetlands provide over \$1 billion in economic value.

Before the widespread societal understanding of these values, wetlands were extensively drained, ditched, and filled as land was farmed and developed. Over 3,000 acres, or roughly 30%, of the estuary's saltmarshes disappeared from 1938 to 2007, and over half of the watershed's freshwater wetlands are thought to have been lost since European settlement. Recent losses of saltmarshes have continued due to sea-level rise, and freshwater wetlands continue to decline, with over 1,000 acres converted to other land uses from 1992 to 2007. Protections for Delaware wetlands began in earnest through the passage of the 1973 Wetlands Act that led to regulations for saltmarshes. The federal Clean Water Act

also afforded protections for saltmarshes and additionally for freshwater wetlands. However, protections under the Act have varied over time based upon interpretation, most recently leaving once-protected freshwater wetlands vulnerable.

Continued loss of wetlands and related problems with water quality and flooding has led to multiple initiatives seeking protection for freshwater wetlands at the state level, but none have had successful outcomes. Healthy and abundant wetland resources are essential to achieving many water quality and habitat-related goals of the CCMP. Not only should remaining freshwater wetlands in the Inland Bays be protected, but both freshwater and saltwater marshes should be restored or bolstered where possible.

#### ACTIONS

**HB 4-1:** Educate on the benefits of regulating freshwater wetlands, including isolated wetlands, under state jurisdiction and permitting.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Technical expertise provided when needed to support the regulation of freshwater wetlands under state jurisdiction and permitting.

**Timeframe & Key Milestones:** Ongoing. Technical expertise provided as opportunities arise.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ State operating budget

**HB 4-2:** Work to reduce the continued loss of wetlands and reverse these loss trends by implementing projects to mitigate for previously lost wetlands and adapt to future rising sea-levels.

**Responsible Parties:** Center, DNREC (Lead); SCAT (Supporting)

**Performance Measure:** Number of acres of restored wetlands.

**Timeframe & Key Milestones:** Identify areas for restoration by 2027. Restoration ongoing as sites are identified and funding secured.

**Location:** Wetlands and previously converted wetlands in the Inland Bays watershed

**Cost & Potential Funding Sources:** \$\$\$ federal, state, local funding, grants



*Oyster aquaculture is ramping up in Rehoboth Bay.*

---

## **OBJECTIVE 5:**

*Enhance populations of eastern oysters and other shellfish species.*

---

Shellfish are a vital part of a healthy Inland Bays ecosystem. They provide habitat, filter suspended particles from water, and are important to regional heritage and economics. Shellfish of particular importance in the Inland Bays are hard clams and eastern oysters. Not only do both species improve water clarity by filtering water, but both have a rich history as part of a healthy commercial fishery before the 1920s when disease devastated the oyster population. After efforts in recent years to show that the Bays can support oyster gardens, a bill was passed in 2013 that allowed for oyster and clam farming to return to the Inland Bays.

Despite the environmental success represented by the passing of the bill, there are still significant water quality and public safety concerns associated with harvesting shellfish for consumption. Since clams and oysters are filter feeders, they can accumulate bacteria, viruses, and other pollutants as they feed. The risk of illness from consuming contaminated shellfish is much higher than from other seafood because shellfish are frequently eaten raw. As a result, DNREC determines approved shellfishing areas based on their proximity to potential pollution sources such as wastewater discharges and marinas. In 2016,

the harvest of shellfish was prohibited in roughly a third of the Inland Bays.

With an expanded interest in the commercial facets of shellfish come new allies in the work to support clean water in the Inland Bays. The nascent shellfish aquaculture industry uniquely provides significant water filtration, nutrient removal, and aquatic habitat provision services while generating jobs and tax revenue. Technical assistance from governments and university programs such as Seagrant and Cooperative Extension can help growers to understand the unique and dynamic environmental conditions of the Bays to ensure seafood safety and maximize production, and to understand the permitting process for their operations. For the shellfish industry, there is a clear incentive to partner on other programs that support clean water in the Bays.

## **WHAT IS AN OYSTER GARDEN?**

An oyster garden is used to grow oysters in floating cages, seen here. The oysters are then used in restoration projects throughout the Inland Bays watershed!



To help support healthy Bay habitat and clean water, the Center is engaged in a multi-faceted initiative to restore wild populations of oysters to the Inland Bays. The initiative is composed of three major programs: Don't Chuck Your Shucks shell recycling program, Oyster Gardening program, and Shellfish Enhancement Planning and Implementation. The Don't Chuck Your Shucks (DCYS) program partners with local businesses to divert oyster shells from landfills for use in shellfish enhancement projects. Natural oyster shell is the best material with which to create oyster reefs but is currently a scarce natural resource. Through the DCYS program, the Center collects at least 4,000 bushels of shell each year. The program also serves to educate a broad audience of local and visiting restaurant patrons and staff about the mission of the Center and the benefits of shellfish enhancement to the Bays.

The outreach goals of the program are two-fold. The first is to maximize restaurant patron awareness of these topics through a variety of promotional materials tailored to the specific interests of the participating restaurants. Patrons also become program participants through their purchase of oysters and their potential decision to patronize participating restaurants in the future. The second goal is to further engage restaurant staff through volunteer "bagging events" where they help to prepare the shell for use in restoration projects. This high level of engagement also increases the potential that restaurants will begin or continue to support the overall enhancement program through financial support.

The Oyster Gardening program engages volunteer gardeners to care for oyster spat set on recycled shells (collected through the DCYS program), growing them at their waterfront property using basic husbandry techniques. The primary goals of the program are to educate residents about oysters and their importance to Inland Bays water quality and ecology, produce oysters for restoration projects in the Bays, and to cultivate program support. Approximately 100 adult oysters are collected annually through this program, and in 2020 the program had 120 oyster gardeners.

The Inland Bays Shellfish Enhancement Plan identifies areas most suitable for habitat creation and specifies the methods and approaches for implementation projects. The first phase of the plan completed in 2019 includes: (1) a synthesis of information and research on the current distribution of oysters in the Bays, habitat preferences/requirements, previous restoration efforts and outcomes, permitting concerns, and regulatory considerations; (2) a geospatial oyster habitat suitability model for the Inland Bays that identifies the best available locations for the establishment of oyster reefs; and (3) concept design and monitoring plans for three pilot reefs. In Phase 2 of the Plan, monitoring data from the pilot reef projects will be reported, and this information will be used to develop concept designs and quantifiable outcomes for additional, larger, or more numerous oyster implementation projects in the Inland Bays. Implementation partners (including DNREC, Delaware Sea Grant, STAC, and water user groups) will be engaged in the development of the Phase 2 plan and funding strategy.



*Volunteers are critical to the Center's oyster reef restoration efforts.*

## ACTIONS

### HB 5-1: Implement the Shellfish Enhancement Plan.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Number of acres of oyster reefs established.

**Timeframe & Key Milestones:** Phase 2 of Plan implementation completed by 2027.

**Location:** Rehoboth, Indian River, and Little Assawoman Bays

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ Local grant funding, state funds, Section 320 funds

### HB 5-2: Educate about the environmental benefits of wild shellfish populations and shellfish farming.

**Responsible Parties:** Center, DNREC (Lead)

**Performance Measure:** Number of education and outreach materials, including workshops, brochures, booklets, social media posts, blog posts, etc. produced on the benefits of wild shellfish populations and shellfish farming.

**Timeframe & Key Milestones:** Ongoing. One publication biennially.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ Local partner operating funds

### HB 5-3: Provide technical assistance for shellfish aquaculture.

**Responsible Parties:** DNREC (Lead); STAC (Supporting)

**Performance Measure:** Technical guidance specific to the Inland Bays is published and available to shellfish farmers.

**Timeframe & Key Milestones:** Ongoing. At least one meeting/forum or publication annually.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ State funds, grants, local partners

*Moving tons of recycled shell for restoration projects would be virtually impossible without the help of volunteers.*



### HB 5-4: Increase acreage of Bay bottom approved for shellfish harvest when microbial water quality, potential pollution, and conflicts with other natural resources allow.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** Number of acres reclassified from closed to approved or seasonally approved.

**Timeframe & Key Milestones:** Ongoing

**Location:** Rehoboth, Indian River, and Little Assawoman Bays and their tributaries

**Cost & Potential Funding Sources:** \$-\$\$\$ State funding, local and federal grants

### HB 5-5: Report the number and acreage of shellfish aquaculture leases, the number of each species harvested, and the value paid for the product at harvest by species annually.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** Report produced as Personally Identifiable Information rules allow.

**Timeframe & Key Milestones:** Annually

**Location:** Rehoboth, Indian River, and Little Assawoman Bays and their tributaries

**Cost & Potential Funding Sources:** \$ State operating budget

The Center works with area restaurants, businesses, and volunteers to collect oyster shells and bag them for use in restoration projects.



## OBJECTIVE 6:

Control the spread of invasive species within the Bays and their watershed.

Invasive species are plant and animal species that are non-native and whose introduction causes or is likely to cause harm, either economically, environmentally, or to human health.<sup>12</sup> Invasive species exhibit rapid growth and maturity and can reduce native diversity by competing for resources, such as space, sunlight, water, and minerals. The State of Delaware has a series of laws and regulations designed to prevent the import and establishment of invasive species. In the Inland Bays, one of the common invasive species is *Phragmites australis*, which is present in many locations.

Many entities in Delaware, including DNREC and the Center, are working to eradicate *Phragmites australis* by employing different techniques including spraying with herbicide and cutting and removing the invasive plant. Other invasive plant species in Delaware include Japanese maple (*Acer palmatum*), Japanese honeysuckle (*Lonicera japonica*), and multiflora rose (*Rosa multiflora*).

## ACTIONS

**HB 6-1:** Manage terrestrial and aquatic ecosystems to remove invasive species and prevent their establishment.

**Responsible Parties:** Center, DNREC, SCD (Lead)

**Performance Measure:** Acres of invasive species removed annually.

**Timeframe & Key Milestones:** Treat a minimum of 100 acres of invasive species each year.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$ State funding, EPA Section 319 funding

**HB 6-2:** Educate property owners and bay users about the impacts of invasive species and how to control them.

**Responsible Parties:** Center (Lead); CAC (Supporting)

**Performance Measure:** Number of educational materials produced.

**Timeframe & Key Milestones:** Ongoing; Educational information produced when an invasive control project is completed.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$ Environmental education grants, EPA Section 320 funds, operating budgets, foundation support

**HB 6-3:** Support policies that prohibit the sale of invasive species.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Invasive species are prohibited from being sold for private and public use.

**Timeframe & Key Milestones:** Produce a policy brief of the status and impacts of invasive species in the watershed by 2022. Provide expertise on best management practices as opportunities arise as it relates to invasive species.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$ State funding. EPA Section 320 funds will not be used.

<sup>12</sup> Delaware Invasive Species Council. [www.delawareinvasives.net](http://www.delawareinvasives.net)



# COORDINATED LAND AND WATER USE MANAGEMENT



Boaters enjoying Rehoboth Bay. Photo by Driscoll Drones

## GOAL:

**Use science and cross-jurisdictional governance to sustainably manage the effects of population growth while maintaining and improving water quality and access in the Inland Bays.**

The residential population of the Inland Bays watershed is growing rapidly – more than doubling between 1990 and 2010. According to the 2019 Sussex County Comprehensive Plan, the current population in Sussex County is estimated to be 336,634 people. Since the 2010 Census, an additional 47,705 people are projected to have moved to Sussex County. An additional 48,457 to 159,167 people are expected to be living here within 25 years. The population doubles again every summer when visitors come from all over to enjoy the Bays and the beaches. It is the natural resources of the Inland Bays that provide beautiful views and recreational opportunities, attracting residents and visitors. The impacts of population growth need to be managed in such a way that the resources and activities attracting growth are not destroyed as a result of it.

Public access to and uses of the Inland Bays waterways continues to be a goal of the Center and its partners. Planning for public access and use that does not diminish the quality of the resources is needed. Green and sustainable practices, such as limiting impervious surfaces and protecting open space, will be increasingly necessary as additional land within the watershed is developed, and the waterways become more heavily traveled.

## OBJECTIVE 1:

**Increase and improve water access and waterway management.**

Providing access to the waters of the Inland Bays serves multiple purposes. It ensures that people can interact with the environment that attracted them in the first place, encouraging continued economic investment in their protection and restoration. Access also serves to support affinity to and knowledge of the Inland Bays, and people who experience and find value in the Bays are more apt to support resource preservation and restoration. Providing access in specific locations can also limit impacts to resources, directing people away from sensitive habitats or organisms and toward areas where passive or active recreation is less likely to be detrimental

to the environment. Supporting access goals also supports the intent of the Clean Water Act to make US waters fishable and swimmable.

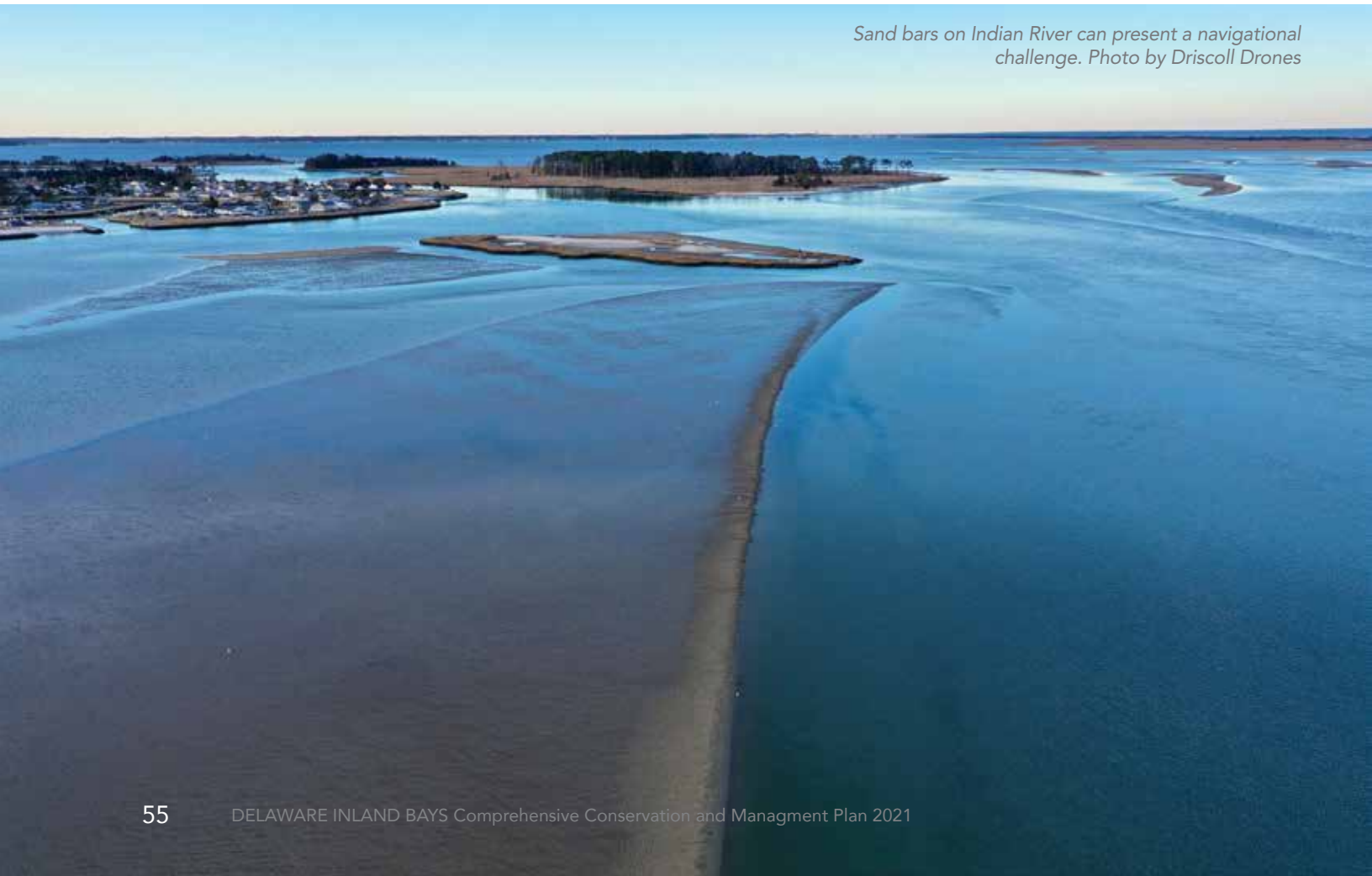
As the population has increased dramatically over the past decade, public access to the Bays has been limited due to capacity at access locations and deterrence from access associated with increased traffic during the summer. The provision of additional public access points has not kept pace with population growth, and currently no coordinated plan exists to provide additional public access. An abundance of public access points distributed evenly along the shoreline of the Bays such that travel times and costs are not prohibitive are needed to maximize the probability that people with the desire to access public water resources regularly can do so.

Upon gaining access to the Bays, waterways must support navigation for recreation and commercial purposes. Sediment washing into the Bays silts in established navigational channels, making it difficult for boats to pass. Suspended sediment also impacts water quality, blocking light and contributing nutrients to the water column. While too much sediment in some places is problematic, too little sediment in other areas also poses a challenge. Some tidal wetlands are drowning under increased rates of sea-level rise

and need sediment to maintain a certain elevation. “Beneficial reuse of sediment” solutions take clean sediment from where it is not wanted (like channels frequented by boats) and move it to places where it could be helpful, like drowning wetlands and eroding beaches.

Over 60,000 boaters are registered in the State of Delaware and the majority of the state’s boating activity is centered in the Inland Bays. Eleven navigable and maintained waterways are located within the Inland Bays. All but the Indian River Inlet area are now maintained by the State of Delaware due to reductions in federal funds to the U.S. Army Corps of Engineers and Coast Guard. Funding for waterway maintenance by the State has not kept pace with the need. The lack of funding has resulted in difficult and sometimes dangerous navigation in multiple waterways. Boater registration fees were increased by the state in 2015 to address the \$3 million to \$5 million annual need for maintenance, generating approximately \$1 million dollars annually. These additional funds contributed to the dredging and beneficial reuse of sediment from the heavily used Massey’s Ditch area between Rehoboth and Indian River Bay in 2019. Additional funding and planning are essential to realizing the regular maintenance of waterways that results in beneficial reuse of sediments.

*Sand bars on Indian River can present a navigational challenge. Photo by Driscoll Drones*



## ACTIONS

**CM 1-1:** Increase opportunities for the public to access the water for recreation.

**CM 1-1a:** Develop a comprehensive public water access inventory and water use map for the Inland Bays.

**Responsible Parties:** Center (Lead); DNREC (Supporting)

**Performance Measure:** Inventory and map produced.

**Timeframe & Key Milestones:** Completed by 2023

**Location:** Indian River, Little Assawoman, Rehoboth Bays, and their tributaries

**Cost & Potential Funding Sources:** \$-\$\$ Local partner operating funds, grants

**CM 1-1b:** Develop a plan to improve and provide additional public water access focused on low-impact recreation and education to the public of where current access is located.

**Responsible Parties:** Center (Lead); DNREC, County, SCAT (Supporting)

**Performance Measure:** Additional public water access points are identified. Existing public access points are improved if needed. Plan developed and published.

**Timeframe & Key Milestones:** Plan is produced by 2025. Plan implemented by 2030.

**Location:** Indian River, Little Assawoman, Rehoboth Bays, and their tributaries

**Cost & Potential Funding Sources:** \$-\$\$ Local partner funding, grants, state funding

**CM 1-2:** Improve waterway and sediment management.

**CM 1-2a:** Continue to develop dedicated and sustainable finances for waterway and sediment management.

**Responsible Parties:** DNREC (Lead)

**Performance Measure:** Dedicated and sustainable finances for waterway and sediment management are developed and implemented.

**Timeframe & Key Milestones:**

Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:**

\$-\$\$\$ State funding

**CM 1-2b:** Increase the beneficial reuse of sediment to enhance shorelines and tidal wetlands.

**Responsible Parties:** DNREC (Lead); Center, SCAT (Supporting)

**Performance Measure:** Tons of sediment used in wetland enhancement and living shoreline projects.

**Timeframe & Key Milestones:**

Ongoing

**Location:** Indian River, Little Assawoman, Rehoboth Bays, and their tributaries

**Cost & Potential Funding Sources:**

\$\$\$-\$\$\$\$ Federal, state, local funding

**CM 1-2c:** Develop an Inland Bays regional sediment management project plan for Indian River and Little Assawoman Bay.

**Responsible Parties:** DNREC (Lead); Center (Supporting)

**Performance Measure:** Regional sediment management project plan produced.

**Timeframe & Key Milestones:** Plan developed by 2025. Implementation timeframe based on the number of projects and available funding.

**Location:** Indian River Bay and Little Assawoman Bay

**Cost & Potential Funding Sources:**

\$\$-\$\$\$\$ State funds, local partner funds, grants

**CM 1-2d:** Review current no-wake areas to determine and carry out a plan to designate and mark additional sensitive areas.

**Responsible Parties:** Center, DNREC (Lead)

**Performance Measure:** Additional sensitive areas are identified. A plan to designate and mark identified sensitive areas is explored and carried out if possible.

**Timeframe & Key Milestones:** Current no-wake areas reviewed by 2024 and additional sensitive areas identified. Plan to designate and mark additional sensitive areas carried out if possible by 2027.

**Location:** Inland Bays and tributaries

**Cost & Potential Funding Sources:** \$-\$\$\$ State and local funding, Section 320 funds

*Young boy paddleboarding at the James Farm.*



## OBJECTIVE 2:

Increase sustainable growth practices to reduce environmental impact.

With the rapidly growing population in Sussex County and the Inland Bays watershed, there has been a simultaneous increase in building activity. Changes on the land are directly linked to changes in the water. The development of new housing and infrastructure designed to accommodate the growing populations in the Inland Bays watershed is no exception. From 2008 to 2015, over 13,500 building permits were issued in Sussex County.<sup>13</sup> From 2017 to 2019, 66 new subdivisions with 5,827 units were given preliminary approval by Sussex County Planning and Zoning. Over the same period, another 20 developments with a total of 1,294 residential units were approved as conditional uses or changes of zone by County

officials. Not only is this a substantial increase in development, but a significant portion of this development has also been in areas at risk of flooding. From 2010 to 2017, Sussex County had the third-highest number of homes (1,233) built in the 10-year flood risk zone of any county in the United States.

Development can be sited and designed in ways that are more or less taxing on the environment. Construction slated for areas with valuable resources or habitats could be moved to less sensitive locations with tactics such as clustered-housing developments or a transfer of development rights program. Impervious or hardened surfaces, which prevent water from filtering naturally into the ground and contribute to pollutants in stormwater, can be minimized in new developments and retrofitted in existing developments. Vegetated buffers can be added to resources like streams and wetlands, ensuring that these resources are protected from development, biota dependent on the resources can live and grow, and runoff carrying pollutants can filter into the ground before running directly into waterways. Planning and working closely with Sussex County, Inland Bay municipalities and communities, scientists, and the conservation community will be critical to this objective's success. Codifying certain practices will ensure that future generations of people living and working in the Inland Bays have the tools they need to protect the resources that make their home unique.

## ACTIONS

**CM 2-1:** Conduct tech transfer workshop(s) with municipalities on impervious surface limits.

**Responsible Parties:** Center, DNREC (Lead); SCAT, STAC (Supporting)

**Performance Measure:** Municipalities implement impervious surface limits.

**Timeframe & Key Milestones:** Minimum of two tech-transfer workshops held before 2026.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ Local partner operating funds

**CM 2-2:** Convene a stakeholder group to explore a transfer of development rights program that results in incentives for the preservation of environmentally sensitive areas and incentives for growth designated areas.

<sup>13</sup> 2018 Sussex County Comprehensive Plan. <https://sussexcountyde.gov/sites/default/files/PDFs/2018CompPlan-Final.pdf>

**Responsible Parties:** Center (Lead), Sussex County (Supporting)

**Performance Measure:** Stakeholder group formed with regular meetings.

**Timeframe & Key Milestones:** Stakeholder group convened by 2024.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ Local partner operating funds

**CM 2-3:** Convene a stakeholder group composed of members of the conservation community to develop a natural lands habitat protection strategy that will establish priorities and actions in the Inland Bays watershed.

**Responsible Parties:** Center, Sussex County (Lead); DNREC (Supporting)

**Performance Measure:** Stakeholder group formed with regular meetings.

**Timeframe & Key Milestones:** Stakeholder group convened by 2020. Land and habitat protection strategy developed by 2021. \*This is different and separate from the Habitat Plan that the Center will develop by 2024.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ Local partner operating funds

**CM 2-4** Increase protection of land through acquisition or easement for the purpose of conservation and restoration.

**Responsible Parties:** Center (Lead); Sussex County, DNREC, DDA (Support)

**Performance Measure:** Number of acres protected relative to baseline period of 2009-2019.

**Timeframe & Key Milestones:** GIS tool for land conservation developed by 2022. Land identified by conservation partners through planning activities ongoing. One major partnership acquisition by 2025.

**Location:** Non-developed lands in the Inland Bays watershed

**Cost & Potential Funding Sources:** \$\$-\$\$\$\$ County funds, Delaware Open Space program funds, foundation grants, U.S. Forest Service funds, USDA funds

**CM 2-5:** Revise the Sussex County Code related to buffers for improved water quality aligned with the Center's Recommendations for an Inland Bays Watershed Water Quality Buffer System (published in 2008).

**Responsible Parties:** Sussex County (Lead); Center (Supporting)

**Performance Measure:** New ordinance introduced to County Council.

**Timeframe & Key Milestones:** Ordinance introduced by 2022.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ County funds, operating budget

**CM 2-6:** Implement conservation landscape projects in partnership with coastal communities.

**Responsible Parties:** Center (Lead); DNREC (Supporting)

**Performance Measure:** Number of projects implemented.

**Timeframe & Key Milestones:** Cost and benefit analysis to determine feasibility and nutrient removal potential completed by 2023. Projects identified (pending outcome of cost and benefit analysis) by 2025. Implementation ongoing.

**Location:** Communities in the Inland Bays

**Cost & Potential Funding Sources:** \$-\$\$\$ Section 319 grants, Section 320 grants, Community Water Quality Improvement Grants, federal grants, foundation grants

*A group enjoys a day of clamming at the James Farm Ecological Preserve. Photo by J&J Photography*



# EDUCATION, OUTREACH, AND MARKETING



*A kiosk at the Preserve offers information about the Center's programs and projects.*

## GOAL:

**Educate communities about the environmental and economic importance of the Inland Bays and provide opportunities for the public to support restoration efforts.**

Education and outreach have been integral parts of the CCMP since its inception. Informing, educating, and engaging people in the watershed provides myriad benefits, including building a connection to the Inland Bays and supporting an interest in the Center's mission to preserve, protect, and restore these essential waterbodies. Engaging people through citizen science, programs at the James Farm Ecological Preserve, volunteer opportunities, printed materials, social media, and e-mail communication is key to getting the word out about the hard work that the Center and its partners are undertaking throughout the watershed. It also creates a sense of stewardship, which helps to instill environmentally conscious behavior. Pairing scientific information with clear messages and fun experiences will help to foster a strong sense of place and affinity in residents and visitors. This will also encourage them to support the Center and its partners to preserve, protect, and restore the watershed.

## OBJECTIVE 1:

**Enhance the James Farm Ecological Preserve and Education Program.**

Owned by Sussex County and managed by the Center, the James Farm Ecological Preserve (James Farm) is a 150-acre oasis of natural habitat located on the Indian River Bay near Ocean View, Delaware. The land was donated to Sussex County by the late Mary Lighthipe on the condition that it be preserved and used for educational and recreational activities. Today, the James Farm is the focal point of the Center's education efforts and provides free outdoor recreation to thousands of visitors every year.

The James Farm Education Program engages hundreds of school-aged children each year. Programming is designed as an 'extension activity' aligned with the schools' science curriculum. The Center also incorporates the Meaningful Watershed Educational Experience, Next Gen Science, and Science, Technology, Engineering, and Mathematics standards into the educational curriculum offered at the James Farm. After learning concepts in the classroom, students come to the James Farm to take soil samples, measure

water quality, and catch and sample aquatic life in the Indian River Bay. But there are opportunities for other types of learning at the James Farm, too— which is why the Center is dedicated to expanding the educational opportunities offered at the James Farm.

In 2014, the James Farm Master Plan was developed to guide improvements allowing for safer access and an improved natural experience for an increasing number of visitors and environmental education students, while also upholding the vision of Mrs. Lighthipe. Because of the support of several important partners, the implementation of the Master Plan is coming to fruition after four years of raising funds to complete design and construction. Phase one of the Master Plan was completed in the Spring of 2019. Phase two of the James Farm Master Plan implementation focuses on improved education and maintenance facilities, trail realignment and maintenance that address ecological and human stressors, updated and expanded interpretive signage, and permanent restroom facilities. These components will allow the Center to better educate local youth and the public about the importance of environmental conservation in Sussex County while protecting the Preserve so that it may provide meaningful natural experiences for generations to come.



The education program at the James Farm Ecological Preserve allows children to get up close to nature.

## ACTIONS

### EO 1-1: Implement the James Farm Master Plan.

**Responsible Parties:** Center (Lead); Sussex County (Supporting)

**Performance Measure:** James Farm Master Plan implemented.

**Timeframe & Key Milestones:** Phase 2 implemented by 2022.

**Location:** James Farm Ecological Preserve, Indian River Bay watershed

**Cost & Potential Funding Sources:** \$\$\$\$ County funds, Outdoor Recreation, Parks, and Trails (ORPT) grant, other grant opportunities, public donations

### EO 1-2: Develop and deliver watershed education programs.

**EO 1-2a:** Programs for K-12 students are offered at the James Farm Ecological Preserve and incorporate Meaningful Watershed Educational Experience, Next Gen Science, and STEM standards.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Number of students reached through educational programming annually.

**Timeframe & Key Milestones:** Minimum of 2,000 students annually.

**Location:** James Farm Ecological Preserve, Indian River Bay watershed

**Cost & Potential Funding Sources:** \$-\$\$\$ CWA Section 320 funds, grants

**EO 1-2b:** Programs at the James Farm Ecological Preserve are developed for and offered to intergenerational audiences.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Number of people reached through intergenerational programming annually.

**Timeframe & Key Milestones:** Minimum of 350 people annually.

**Location:** James Farm Ecological Preserve, Indian River Bay watershed

**Cost & Potential Funding Sources:** \$-\$\$ CWS Section 320 funds, grants

People celebrate being out in nature during an “Ales After Trails” event at a future reforestation project site.



## OBJECTIVE 2:

Educate residents, visitors, and tourists in the watershed about their impacts on water quality and how they can help improve the Bays.

The Inland Bays attract hundreds of thousands of users each year. As every user will impart some impact on the environment, it is critical to educate residents, visitors, and tourists about how their actions affect the Inland Bays and surrounding areas. Focused campaigns on specific issues or topics, such as littering, are proven to be effective at achieving desired behavior changes. The State of Delaware has already taken steps to address issues such as plastic pollution. In 2019, the State passed a law banning single-use plastic bags. This ban restricts retailers over a certain size from giving plastic bags to customers. Only under certain circumstances would plastic bags still be provided. This legislation went into effect in 2021 and is one example of how focused campaigns are effective at tackling issues that impact the Bays.

Engaging the public on policy issues is important as well. The Clean Water Alliance is an education and outreach campaign focused on informing residents, visitors, businesses, and elected officials about the need for dedicated clean water funding sources. Dedicated funding for clean water is essential for a cleaner environment, healthier crops and food sources, improved economy,

and increased tourism. Additional clean water funding could be used for upgrades to wastewater treatment facilities and stormwater systems, environmentally sound solutions to remove contaminants from our water, and protection of wetlands and open space. Strong community support for legislation to provide sustainable funding for clean water should show how precious the resource is to decision makers.

Through the development of a Public Education and Engagement Plan, the Center intends to form a group to assist other organizations in meeting educational and outreach goals set in this CCMP. A five-year plan identifying actions, timelines, and responsible partners will be produced. Program participants will benefit from learning about the watershed through interactive, intergenerational programs, and educational partners will benefit from increased access to resources and trained staff.

## ACTIONS

**EO 2-1:** Develop and implement a Public Education and Engagement Plan for the Inland Bays.

**Responsible Parties:** Center (Lead), CAC (Supporting)

**Performance Measure:** Public Education and Engagement Plan developed. Number of actions completed annually.

**Timeframe & Key Milestones:** Plan developed by 2022. Implementation ongoing once Plan is finalized.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ CWA Section 320 funds

**EO 2-2:** Reduce marine debris through source reduction programs and initiatives and debris clean-ups.

**Responsible Parties:** Center, DNREC (Lead)

**Performance Measure:** Number of clean-ups completed annually. Marine debris reduction campaign initiated.

**Timeframe & Key Milestones:** Marine debris reduction campaign initiated by 2023. At least one clean up event is held annually.

**Location:** Inland Bays and tributaries

**Cost & Potential Funding Sources:** \$-\$\$ State and local funding, grants



**EO 2-3:** Promote sustainable funding for water quality improvements.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Sustainable funding for water quality improvement projects is secured.

**Timeframe & Key Milestones:** Ongoing participation in the Clean Water Alliance.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$ State operating budget, partner funds

*The Don't Chuck Your Shucks oyster demonstration tank shows how quickly oysters can improve water quality.*



---

### OBJECTIVE 3:

Communicate environmental results and raise awareness about the importance of the Inland Bays and their watershed to promote public involvement and influence behaviors and actions to foster stewardship.

---

Engaging people through a variety of media, including printed materials, social media, and e-mail, is key to the NEP's success. It gets the word out about the issues affecting the Inland Bays watersheds, the work that the Center and its partners are undertaking to address priority issues, and opportunities for the public to be involved in protecting and restoring the Bays. It also creates a sense of stewardship, which helps to instill environmentally conscious behavior. The Center will continue to grow its social media following, send monthly email communications and biannual journals, and maintain its website to promote the work that the Center and its partners are doing and to keep the public informed.

Getting people involved virtually, however, is only half the story. Getting people out to experience the Bays firsthand is equally, if not more, important. State and local decision makers have arguably the most influence on how the watershed is managed, whether by providing funding, passing legislation, or voting on land use proposals. Taking decision makers out on field visits to show them the issues firsthand, the solutions that have been effective in addressing these issues, and the sheer beauty of the resources we are protecting will strengthen their support for the CCMP.

Beyond offering educational opportunities for the general public, the CCMP also includes actions directed at providing opportunities for decision makers and other leaders to experience the wonders of the Inland Bays. The rapid population growth in the Inland Bays watershed makes it essential that decision makers and other leaders in the community are empowered to make environmentally informed decisions, as these can make great waves in terms of responsible growth. The beauty and bounty of the Inland Bays attract homeowners and visitors to make investments in the watershed and are important to people in resource-based industries who rely on the water for their livelihoods.

The Center and its partners are committed to showing just how important the Bays are to the economy by completing an economic valuation of the Bays. The study will highlight the connection between a healthy Inland Bays estuary and a healthy Sussex County economy. This project intends to establish a repeatable and cost-efficient method for estimating the direct, indirect, and induced economic values attributable to the Inland Bays. Quantifying these values and the Bays' total annual economic contributions serve to emphasize the region's economic interdependence with the Bays and the importance of sustaining and increasing investment in restoration efforts to implement the CCMP.

Additionally, sharing the results of environmental studies and the success of the numerous projects that aim to benefit the environment can show how well the work we are doing is impacting the environment. Every five years the Center publishes a "State of the Inland Bays" report which shows the status and trends of environmental indicators throughout the watershed. This comprehensive reporting helps to determine how the decades of hard work and hundreds of millions of dollars in federal, state, and local taxpayer dollars and investments are paying off.

## ACTIONS

**EO 3-1:** Create and disseminate printed and electronic materials such as social media, video, brochures, postcards, and signage to address specific education/outreach needs to target audiences.

**Responsible Parties:** Center (Lead), CAC (Supporting)

**Performance Measure:** Number of people reached through education and outreach.

**Timeframe & Key Milestones:**

Educational materials, including social media posts, blog posts, journal articles, etc. produced on an annual basis.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$-\$\$\$ Operating funds, grants, local partners

**EO 3-2:** Conduct field visits with decision makers to educate them on the importance of protecting and restoring natural ecosystems.

**Responsible Parties:** Center, DNREC (Lead); CAC (Supporting)

**Performance Measure:** Number of decision makers engaged annually.

**Timeframe & Key Milestones:** Goal of engaging three decision makers annually.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ CWA Section 320 funds, State operating funds

**EO 3-3:** Results of Inland Bays environmental studies or projects are published.

**Responsible Parties:** Center, DNREC, STAC (Lead)

**Performance Measure:** Number of reports published through multiple mediums and outlets, including print and online.

**Timeframe & Key Milestones:** "State of the Inland Bays" report is published and disseminated every five years. Press releases and project reports are published at the completion of projects.

**Location:** Watershed-wide.

**Cost & Potential Funding Sources:** \$\$-\$\$\$ State, federal, local funding

**EO 3-4:** Communicate and provide educational information to diverse audiences on the benefits of achieving water quality goals to economic development, tourism, recreation, human health, and quality of life.

**Responsible Parties:** Center, CAC (Lead)

**Performance Measure:** Number of educational and outreach materials produced targeting the benefits of clean water. Data and facts are shared on environmental issues of concern.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ State and local funding, grants

**EO 3-5:** Complete and share publicly an economic valuation of the Inland Bays watershed.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Economic valuation completed. Economic valuation shared publicly.

**Timeframe & Key Milestones:** Economic valuation completed by 2021.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$ State and local funding, grants

**EO 3-6:** Advocate for enforcement of existing environmental regulations concerning Inland Bays restoration.

**Responsible Parties:** Center (Lead), CAC (Supporting)

**Performance Measure:** Technical expertise provided when needed to advocate for enforcement of regulations.

**Timeframe & Key Milestones:** Ongoing

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$-\$\$ State operating budget EPA Section 320 funds will not be used.

Volunteers help tag horseshoe crabs during the Center's annual spawning survey.



#### OBJECTIVE 4:

Encourage more stakeholder support through volunteerism.

Engaging the community in protecting the environment firsthand instills environmentally conscious behavior, resulting in better stewardship of the Bays. Engaging community members also provide the people and materials needed to conduct many of the activities critical to

achieving the NEP's mission. The Center and its partners offer a diverse range of opportunities for volunteering, including citizen science monitoring programs, education at public events, habitat restoration, and assistance with fundraising events. The Center's most popular volunteer opportunities are the annual Horseshoe Crab Survey, the annual Shore-zone Fish Survey, and the Ambient Water Quality Monitoring Program. The Center also initiated a new citizen science monitoring program in 2020 that monitors diamondback terrapin populations. With these surveys, volunteers can see how the data they collected is used to protect natural resources, which is invaluable for maintaining a consistent volunteer base and for growing a passion for preserving the Inland Bays in our volunteers.

#### ACTIONS

**EO 4-1:** Direct a volunteer program that provides citizens with opportunities to partner with the Center.

**Responsible Parties:** Center (Lead)

**Performance Measure:** Number of volunteers engaged annually.

**Timeframe & Key Milestones:** Volunteer engagement increases annually.

**Location:** Watershed-wide

**Cost & Potential Funding Sources:** \$\$-\$\$\$ Operating funds



Volunteers from the Delaware National Guard and The Green Beret Project help prepare the Preserve for the next phase of improvements.

# APPENDIX A: CCMP IMPLEMENTATION AGREEMENT

## INLAND BAYS COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN (CCMP) IMPLEMENTATION AGREEMENT

*Photo Credit: Driscoll Drones*

### PREFACE

The following Agreement is the culmination of planning, collaboration, evaluation, and consensus-building by the Inland Bays Management Conference. Members of the Conference and the public heartily support the CCMP and the objectives and actions within that are designed to reduce both nutrient contamination and habitat loss in the Inland Bays watershed. Each of the signatory agencies and organizations to this Agreement is pledged to actively support the CCMP in its policy, regulatory, and funding determinations and to vigorously implement, to the extent practicable, those actions for which it has a Lead or Support role.

Whereas, water quality and natural habitat are essential for public health and the environment, the viability of the economic base, and the quality of life around Delaware's Inland Bays; and

Whereas, the Inland Bays watershed is affected by actions in many communities, by activities of many individuals, and by decisions made by many agencies and organizations; and

Whereas, participants in the Inland Bays Management Conference have targeted nutrient over enrichment and habitat loss as priority environmental problems; and

Whereas, since 1995, participants in the Inland Bays Management Conference have worked with Federal, State, and Local officials, scientists, organizations, and citizens to implement actions and strategies for solving these problems with great success; and

Whereas, the Management Conference has updated the Comprehensive Conservation and Management Plan (CCMP) to reflect progress that has been made since the original CCMP and that will continue to mitigate these priority problems; and

Whereas, commitments from Federal, State, and Local agencies and organizations responsible for the implementation of the CCMP are critical to its success;

Therefore, The Undersigned hereby resolve to support the Center for the Inland Bays as it oversees CCMP implementation; to endorse the CCMP and its implementation; and to work diligently, to the extent practicable, to implement the actions for which their agency or organization is responsible.

## SIGNATORIES TO IMPLEMENTATION AGREEMENT

*C.A. Simmens*

---

Citizens Advisory Committee

*Michael T. Scuse*

---

Department of Agriculture

*A.M. Li*

---

Department of Natural Resources and Environmental Control

*Jennifer Volk*

---

Scientific and Technical Advisory Committee

*Dain W. Baine*

---

Sussex Conservation District

*David A. Anderson, Pres.*

---

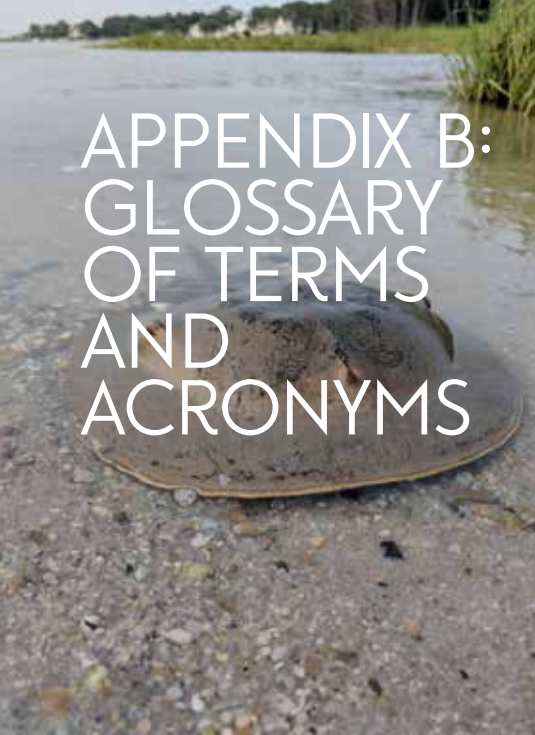
Sussex County Association of Towns

*John J. P...*

---

Sussex County Council

# APPENDIX B: GLOSSARY OF TERMS AND ACRONYMS



*Horseshoe crabs are an iconic species in the Inland Bays.*

*A Monarch butterfly enjoys nectar from the plants at the Delaware Botanic Gardens at Pepper Creek.*

*Diamondback terrapins face many threats in the Bays, both natural and human-caused.*

**Action:** The specific task that Center and other partners will complete to reach the revised CCMP's common goals and objectives.

**Adaptation:** Any adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploit beneficial opportunities (Intergovernmental Panel on Climate Change).

**Aquaculture:** The process of breeding and raising aquatic organisms, such as shellfish and fish.

**BMPs:** Best management practices. A procedure or system that is effective in preventing or reducing nonpoint sources of pollution.

**Bio-Logs:** Logs made of compressed coconut fiber and/or other biodegradable materials that are staked along shorelines to diminish erosion and promote plant growth through the log structure to protect shorelines.

**CAC:** Citizens Advisory Committee.

**CAFO:** Combined animal feedlot operations. Regulations for combined animal feedlot operations are administered by the Delaware Department of Agriculture and the Delaware Department of Natural Resources and Environmental Control.

**CCMP:** Comprehensive Conservation and Management Plan.

**CCVA:** Climate Change Vulnerability Assessment.

**Climate change:** A change in the earth's climate and usual weather patterns associated with an increase in global average temperature and greenhouse gases in the atmosphere.

**County:** Sussex County.

**DDA:** Delaware Department of Agriculture.

**DNREC:** Delaware Department of Natural Resources and Environmental Control.

**Dredging:** The act of removing sediment from a river bottom with a dredge and disposing it elsewhere.

**EBM:** Ecosystem-Based Management

**Ecosystem services:** Benefits to humans and nature that an ecosystem provides. Ecosystem services sometimes can be associated with monetary values.

**Effective Impervious Surface:** If runoff from an area of impervious surface is treated and infiltrated (through a BMP e.g.), it is no longer consider 'effective.'

**ERES:** Exceptional Recreational or Ecological Significance. A DNREC designation for waters that shall be afforded a level of protection and monitoring in excess of that provided most other waters of the state.

**Estuary:** Area of a river that is tidal and where fresh and salt waters mix together.

**GIS:** Geographical information system. It is a computerized system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.

**Goal:** The overall purpose of achieving actions in each Core Element.

**Green Infrastructure:** A network of natural areas, parks, conservation areas, and working lands all with conservation value.

**Invasive Species:** Plant and animal species that are non-native and whose introduction causes or is likely to cause harm, either economically, environmentally, or to human health.

**Living shorelines:** A method of shoreline stabilization that uses natural materials, such as coconut fiber logs, oyster shells, and native plants, to provide shoreline protection and other ecosystem services.

**Mitigation:** Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere (NASA).

**NOAA:** National Oceanic and Atmospheric Administration.

**Nonpoint source discharges:** Discharges originating from areas having no well-defined source. Examples include street and farm runoff.

**NPDES:** National Pollution Discharge Elimination System. It is a national permit program administered by the EPA through appropriate state agencies like DNREC.

**Nutrient loading:** The amount of nutrients entering a waterbody over a certain period.

**Objective:** The desired outcome.

**OWTDS:** Onsite wastewater treatment and disposal system. It is a wastewater treatment system installed directly on the property owner's land.

**PEEP:** Public Education and Engagement Plan.

**PCS:** Inland Bays Pollution Control Strategy. A document produced in 2008 by DNREC through a collaborative public process that contains strategies for cleaning up Delaware's Inland Bays.

**Point source discharges:** Discharges from a defined source like an outfall pipe from a sewage treatment plant or industrial waste discharge.

**Resilience:** The ability to recover or adapt after a disaster occurs.

**SAV:** Submerged aquatic vegetation. In the Inland Bays, it refers to rooted aquatic vegetation like eelgrass that remains submerged through most of its lifecycle.

**SCAT:** Sussex County Association of Towns.

**SCD:** Sussex Conservation District.

**STAC:** Science and Technical Advisory Committee.

**Stormwater Management Districts:** Entities that create water quality and quantity improvements in small watersheds through the sale of credits to owners of development projects creating stormwater impacts and are required to offset those impacts.

**Stormwater runoff:** Water generated by storms in the form of rain or snow that flows over land or impervious surfaces and enters streams rather than infiltrating into the ground. Stormwater runoff often carries nutrients and sediments from the land and therefore, is a type of nonpoint source pollution.

**Study Area:** The geographic boundary within which CCMP actions are implemented. Also referred to as the Center's watershed.

**TMDL:** Total maximum daily load. It is the amount of a given pollutant that may be discharged to a waterbody from point or nonpoint or background sources that still allows the attainment of the applicable water quality standards.

**TN:** Total nitrogen. TN includes dissolved inorganic nitrogen and organic nitrogen in the water.

**TP:** Total phosphorus. TP includes all forms of phosphorus in water, including dissolved inorganic and organically-bound forms.

**Tributary:** A waterway that drains to a larger stream or river.

**Watershed:** Area of the land that drains to a single waterbody, also referred to as a drainage basin or catchment.

**Wetlands:** Land that is saturated with water constantly or seasonally and can include marshes (tidal or non-tidal), bogs, and swamps.

# APPENDIX C: INDEX OF ACTIONS

LIVING WITH A CHANGING CLIMATE			
Objective 1: Increase community and local government understanding and help prepare communities for potential impacts of the changing climate through mitigation and adaptation actions.			
Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>CC 1-1:</b> Develop and implement projects, programs, and policies that encourage and support communities and governments to mitigate and adapt to the high climate change risks identified in the Vulnerability Assessment.	DNREC, Center (Lead); SCAT, CAC (Supporting)	Number of projects and programs developed and offered. Number of policy initiatives introduced on mitigation and adaptation. Demonstrate quantifiable risk reductions within the time period of this CCMP.	Ongoing.
<b>CC 1-2:</b> Educate the public about the benefits of and promote the use of renewable energy including wind, solar, and other sources.	DNREC (Lead); Center, CAC (Supporting)	Number of publications and educational materials produced on the benefits of renewable energy annually.	Ongoing.
Objective 2: Use research, monitoring, and modeling to analyze and project climate change impacts to the Inland Bays watershed.			
Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>CC 2-1:</b> Expand the Coastal Flood Monitoring System to the Inland Bays to provide a publicly-accessible, real-time tool to create flood inundation potential maps and time series of forecasted tidal predictions.	DNREC (Lead); STAC, Center (Supporting)	Online tool developed and active.	Tool developed by 2022 and maintained.
<b>CC 2-2:</b> Monitor the chemical, physical, and biological characteristics in the Bay to determine climate change impacts such as ocean acidification and take actions to help mitigate those impacts and communicate results to the public.	DNREC, Center (Lead); STAC (Supporting)	Results from monitoring efforts are shared with the public through various media including, but not limited to, press releases, social media posts, journal articles.	Results shared when they become available.
<b>CC 2-3:</b> Encourage municipalities within the Inland Bays watershed and Sussex County to complete a comprehensive climate change vulnerability assessment which identifies mitigation and adaptation strategies.	SCAT, Sussex County (Lead); DNREC (Supporting)	Percent of municipalities in the Inland Bays that complete a comprehensive vulnerability assessment. Number of strategies implemented once municipality completes assessment.	By 2030, 75% of municipalities in the Inland Bays watershed will have completed a vulnerability assessment.



## CLEAN WATERS: HEALTHY AGRICULTURAL LANDSCAPES

### Objective 1: Broaden partnerships within the agricultural community.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>AG 1-1:</b> Utilize the CCMP Implementation Committee to engage new and existing partners and improve implementation and tracking of agricultural best management practices and technology transfer.	Center (Lead); DNREC, DDA, SCD (Supporting)	Improved comprehensive tracking and implementation of agricultural BMP implementation.	Tracking system identified by 2022 and in use by 2023. Committee works to enter BMP information into tracking system annually. Complete an update of the PCS Assessment by 2024.
<b>AG 1-2:</b> Promote and celebrate those in the agriculture sector who are good stewards of the environment.	DDA, SCD (Lead)	Members of the agricultural sector are recognized publicly for their innovation and BMP implementation.	Annual recognition of three farmers.
<b>AG 1-3:</b> Conduct educational programs for the general public on best management practices employed by the agricultural sector to protect clean water and habitat.	DDA, SCD (Lead)	Number of individuals that attend programming.	Two programs hosted annually. Goal of 50 people reached.

### Objective 2: Reduce nutrient and sediment loads and other contaminants entering waterways from agriculture.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>AG 2-1:</b> Advance innovative technologies and agricultural practices that reduce nonpoint pollution from farming operations.			
<b>AG 2-1a:</b> Encourage agricultural utilization of treated wastewater where practicable.	SCD, DDA (Lead); STAC (Supporting)	Number of acres utilizing treated wastewater effluent on an "on demand" basis for optimum crop growth.	Ongoing.
<b>AG 2-1b:</b> Encourage on-farm research on nutrient best management practices with farmers.	SCD (Lead); STAC (Supporting)	Number of on-farm research opportunities annually.	Goal of 3 research opportunities by 2029.
<b>AG 2-1c:</b> Encourage the use of the 4R nutrient stewardship approach (right time, right place, right rate, right source) to reduce nutrient losses from cropland.	DDA (Lead)	Number of farms utilizing 4R nutrient stewardship approach.	60% of available cropland treated using 4R nutrient stewardship approach annually.
<b>AG 2-1d:</b> Support the development of and promote diversification of cropping systems that result in improved water quality as opportunities arise.	Center (Lead), DDA, SCD (Supporting)	Percentage of cropland with non-traditional crop rotations resulting in water quality improvement.	Ongoing. Assess opportunities for support every two years.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>AG 2-2:</b> Develop and implement a project plan to achieve the Agricultural Actions of the Inland Bays Pollution Control Strategy.	Center (Lead); SCD, DDA, DNREC (Supporting)	A detailed project plan with location, description, and estimated cost is completed. Number of projects completed annually from the Project Plan once completed.	Project plan completed by 2025. Implementation completed 5-7 years after plan is completed.
<b>AG 2-2a:</b> Increase the amount of cover crops planted annually in the Inland Bays watershed.	SCD (Lead)	Number of acres of cover crops planted annually.	Ongoing - goal of 60% of available acres planted annually.
<b>AG 2-2b:</b> Continue to use and support the construction of poultry manure storage sheds, composters, and animal mortality freezers.	SCD (Lead)	Number of new poultry manure storage sheds and composters constructed and used annually.	Ongoing - goal of 50 additional structures built. As of 2016 PCS Assessment, 28 structures have already been constructed.
<b>AG 2-2c:</b> Relocate poultry manure from the watershed and put into alternative use and encourage participation by integrators.	DDA (Lead)	Number of pounds of manure relocated and put into alternative uses annually.	Ongoing - goal of 20,909 tons of manure relocated annually or put into alternative use.
<b>AG 2-2d:</b> Implement additional water control structures to treat cropland and maintain the 1,530 acres currently treated by these structures.	SCD (Lead)	Number of acres treated by water control structures.	Ongoing.
<b>AG 2-3:</b> Encourage cost share providers to prioritize assistance for the highest priority BMPs.	Center (Lead); DNREC, SCD, DDA (Supporting)	Provide expertise that encourages how cost share dollars are spent when opportunities arise. Track cost share dollars spent annually.	Ongoing.
<b>AG 2-4:</b> Continue County-level cost sharing for voluntary nutrient management practices.	Sussex County (Lead)	Dollars appropriated by the County for cost-share for voluntary nutrient management practices.	Reported annually.
<b>Objective 3: Protect and restore natural ecosystems in the agricultural landscape.</b>			
<b>AG 3-1:</b> Plant riparian forested and grassed buffers.	Center, SCD (Lead); DNREC (Supporting)	Total number of acres of forested and grassed buffers planted.	Goal of 3,246 acres of riparian forest buffer and 1,772 acres of grassed buffers.
<b>AG 3-2:</b> Implement the Watershed Reforestation Plan for the Inland Bays.	Center, SCD (Lead); DNREC (Supporting)	Number of acres of trees planted on cropland included in the Plan.	Watershed Reforestation Plan fully implemented by 2025.
<b>AG 3-3:</b> Restore wetlands in areas that were previously converted to cropland.	SCD (Lead); Center (Support)	Number of acres of wetlands restored that were previously converted to cropland.	Ongoing - goal of 4,175 acres restored. Restoration opportunities identified through planning exercise by 2025.
<b>AG 3-4:</b> Restore streams in the Inland Bays watershed.	Center, SCD (Lead)	Linear feet of streams restored.	Identify areas for restoration by 2026. Restoration ongoing once identified.

## CLEAN WATERS: REDUCING POLLUTION FROM THE DEVELOPED LANDSCAPE

### Objective 1: Conduct education and outreach to encourage management practices that limit pollution from nutrients, sediments, and other contaminants.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>DL 1-1:</b> Continue certification and education of commercial nutrient managers for lawns.	DDA (Lead)	Number of commercial nutrient managers certified annually.	Ongoing.
<b>DL 1-2:</b> Educate homeowners and HOAs on the wise use of fertilizer to reduce nutrient runoff from lawns.	Center (Lead); DDA (Supporting)	Number of people reached through educational programming/materials.	Educational materials (presentation, flyers, targeted social media, journal articles, etc.) produced annually.
<b>DL 1-3:</b> Continue public education on the economic and environmental benefits of central sewerage.	Center (Lead); Sussex County (Supporting)	Number of individuals educated on the economic and environmental benefits of central sewerage.	Educational materials (presentation, flyers, targeted social media, journal articles, etc.) produced annually.
<b>DL 1-4:</b> Conduct an education campaign on the proper maintenance and replacement of septic systems.	DNREC (Lead); Center (Supporting)	Number of individuals educated on septic system maintenance and replacement.	Campaign initiated by 2027.
<b>DL 1-5:</b> Regularly report on the implementation of regulations for small on-site wastewater systems to the CCMP Implementation Committee.	DNREC (Lead)	A report is updated and presented to the CCMP Implementation Committee.	Annual report.

### Objective 2: Reduce the amount of nutrients, sediments, and other contaminants entering waterways from wastewater sources.

<b>DL 2-1:</b> Develop a wastewater planning committee comprised of DNREC, Sussex County, utility industry representatives, and other stakeholders to coordinate the treatment and disposal of wastewater from new and existing developments based on the TMDLs of receiving waters.	Center (Lead); DNREC, Sussex County (Supporting)	A Wastewater Planning Committee is formed with key partners and meets regularly.	Committee formed by 2023. Once formed, the Committee will decide how to handle the issue of wastewater planning, whether through the creation of a plan or other method.
<b>DL 2-2:</b> Enforce the waters of Exceptional Recreational and Ecological Significance (ERES) provisions of the State Water Quality Standards requiring the least environmentally damaging disposal alternatives for wastewater.	DNREC (Lead)	ERES provisions are enforced through inclusion in wastewater disposal permitting.	ERES provisions included in permitting process by 2030.
<b>DL 2-3:</b> Develop a nutrient budget for wastewater to determine existing and projected loads to receiving waters and report biannually; Explore the need for annual updates.	DNREC, STAC (Lead); Sussex County, Center (Supporting)	Nutrient budget for wastewater is developed and reporting is completed biannually, or annually if determined necessary.	Nutrient budget developed by 2027.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>DL 2-4:</b> Improve treatment levels at two Sussex County wastewater treatment facilities managing for improved nutrient retention, wildlife habitat, and recreation where practicable.	Sussex County (Lead); Center (Supporting)	Improve nutrient removal percentage at the Inland Bays wastewater treatment facility by 10% over the next permit cycle.	Reforestation of 360 acres of agricultural lands where treated wastewater is applied at the Wolfe Neck Regional Wastewater Facility completed by 2026. Reforestation of 60 acres of cropland at the Inland Bays Regional Wastewater Facility completed by 2026. Upgrades to both treatment plants ongoing.
<b>DL 2-5:</b> Continue septic system remediation and conversion projects in the Inland Bays' 10-digit hydrologic unit codes with emphasis on projects within 1,000 feet of the mean high-water line of any tidal waterbody, tidal stream, or tidal marsh.	Sussex County (Lead)	Number of equivalent dwelling units transferred to central sewerage annually.	Ongoing.
<b>DL 2-6:</b> Research the attenuation of nutrients and contaminants released from County-owned wastewater systems along flow paths to receiving waters.	Sussex County, STAC (Lead)	Research is coalesced and used to refine loading estimates to receiving waters and influence management activities.	Research completed by 2028.
<b>DL 2-7:</b> DNREC requires that applications for new or renewed groundwater discharge permits for wastewater clearly demonstrate how discharges affect nutrient loading and contribute to meeting TMDL reductions for the ultimate receiving waterbodies.	DNREC (Lead)	Permit application requirement added.	Requirement added by 2025.
<b>DL 2-8:</b> Explore the development of a nutrient trading or offset districts for wastewater.	Center, Sussex County, DNREC (Lead)	Stakeholders meet and discuss developing nutrient trading or offset districts for wastewater and make determination.	Stakeholders begin discussions by 2023. Determination on whether to develop a nutrient trading or offset district for wastewater made within two years of beginning discussions.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>Objective 3: Reduce the amount of nutrients, sediments, and other contaminants entering waterways from stormwater sources.</b>			
<b>DL 3-1:</b> Establish stormwater management offset districts to improve water quality and stormwater permit compliance efficiency.	Sussex County (Lead); SCD, Center (Supporting)	Stormwater management offset districts and associated bank are established.	Stormwater management offset districts established by 2021.
<b>DL 3-2:</b> Achieve actions that reduce the amount of effective impervious surface within the Inland Bays watershed.			
<b>DL 3-2a:</b> County and municipalities consider ordinances that minimize new and reduce existing impervious surfaces.	SCAT (Lead); Center, Sussex County, DNREC (Supporting)	Number of ordinances considered and/or adopted.	Ongoing.
<b>DL 3-2b:</b> Develop a plan to create stormwater retrofits to work toward a goal of treating 4,500 acres of urban and residential lands developed pre-1990.	DNREC, SCAT, Sussex County, Center (Lead)	Plan is developed. Number of acres developed pre-1990 treated by stormwater retrofits.	Plan is developed by 2024. Implementation of plan is ongoing - goal to treat 4,500 acres.
<b>DL 3-3:</b> Explore new ordinances to address the sale and use of fertilizers to reduce nutrient pollution from lawn application.	Center, DDA (Lead)	Number of policy changes explored that would reduce nutrient pollution from lawn fertilizer.	Ongoing.
<b>DL 3-4:</b> Develop a nutrient budget for stormwater to determine existing and projected loads to receiving waters and report biannually; Explore the need for annual updates.	Center, STAC (Lead); Sussex County, DNREC (Supporting)	Nutrient budget for stormwater is developed and reporting is completed biannually, or annually if determined necessary.	Nutrient budget developed by 2027.
<b>DL 3-5:</b> Hold MS4 roundtables to explore cost effective and coordinated approaches to meeting permit requirement should the 2020 Census indicate an MS4 permit designation is possible.	Center (Lead); Sussex County, SCAT, DNREC (Supporting)	Partners convene a discussion on cost-effective and coordinated approaches to meeting MS4 permit requirements, should it be deemed necessary.	Roundtable discussion convened by 2024, should it be deemed necessary.

## HEALTHY BAY ECOSYSTEMS: PROTECT AND RESTORE THRIVING HABITATS FOR ABUNDANT FISH AND WILDLIFE

### Objective 1: Continue to use research, monitoring, and modeling to capture trends that can provide information to help protect and restore prime habitat for fish and wildlife particularly in light of the CCVA findings.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>HB 1-1:</b> Update the Inland Bays estuarine water quality and hydrodynamic model.	STAC (Lead); Center, DNREC (Supporting)	Updated model(s) populated with best available data are functional.	Implementation plan developed in 2020. All plan components implemented by 2025.
<b>HB 1-2:</b> Update the Inland Bays watershed nutrient loading model.	STAC (Lead); Center, DNREC (Supporting)	Updated model populated with best available data is functional.	Model developed by 2023.
<b>HB 1-3:</b> Utilize updated estuarine and watershed models to evaluate if existing TMDLs are adequate to achieve water quality standards for nitrogen and phosphorus.	DNREC (Lead); Center, STAC (Supporting)	Report produced.	Report produced by 2030.
<b>HB 1-4:</b> Monitor the distribution of bay grasses to inform potential restoration projects, and if monitoring shows insufficient or decreasing bay grass coverage, take action to increase the acreage.	Center, STAC, DNREC (Lead)	Bay grass monitoring plan developed; Report including data/maps of areas of Bays with habitat characteristics supportive of reestablishment of SAV species produced.	Monitoring plan within two years; Water Quality Index for eelgrass updated with 2021 State of the Bays report; restoration suitability GIS model and report completed by 2022. Bay grass monitoring completed annually.
<b>HB 1-5:</b> Develop an Inland Bays Habitat Plan to protect and restore critical habitats in the Inland Bays watershed.	Center (Lead); DNREC, STAC, SCD, DDA (Supporting)	Habitat Plan produced. Number of acres or linear feet of habitat restored or protected.	Plan produced by 2024. Implementation of plan ongoing once complete.

### Objective 2: Enhance and restore fish populations and their habitats in the Inland Bays.

<b>HB 2-1:</b> Provide access for native migratory fish to upstream areas for use as spawning and/or nursery sites.	Center (Lead)	Number of fish passage projects completed. Number of miles of fish habitat restored.	Burton Pond dam project completed by 2024. Additional sites explored for more fish passage projects.
<b>HB 2-2:</b> Conduct education and outreach efforts on the importance of migratory fish and the benefits of fish passage restoration.	Center, DNREC (Lead)	Number of publications and/or educational materials produced, including brochures, social media campaigns, videos, infographs, etc. specifically targeting migratory fish and fish passage restoration.	Ongoing.
<b>HB 2-3:</b> Advocate for ecosystem-based management of fisheries.	Center (Lead)	Number of comments on management plans submitted.	Ongoing,

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>Objective 3: Maximize the amount of natural Inland Bays shoreline.</b>			
<b>HB 3-1:</b> Conduct an education and outreach program on shoreline function and management alternatives for shoreline property owners.	Center (Lead); DNREC (Supporting)	Number of education and outreach materials produced, including guidebooks, social media posts, blog posts, brochures, etc., targeting shoreline function and management alternatives.	Ongoing, waterfront property owner's manual produced by 2021.
<b>HB 3-2:</b> Continue conducting living shoreline demonstration projects to encourage widespread use of this practice.	Center (Lead); DNREC (Supporting)	Create a minimum of six demonstration living shorelines in study area.	Demonstration living shoreline projects completed by 2025.
<b>HB 3-3:</b> Convene a stakeholder group to explore policy changes needed to require that living shoreline techniques be employed where feasible for shoreline stabilization.	Center (Lead), DNREC (Supporting)	Report developed by stakeholder group.	Stakeholder group convened by 2025. Report completed by 2026.
<b>HB 3-4:</b> Consider and review ways to reduce the burden for implementing living shorelines for home/landowners as opposed to installing hard structures.	DNREC (Lead)	Review is completed.	Review completed within by 2026.
<b>Objective 4: Increase regulatory protections for wetlands and restore previously lost wetlands.</b>			
<b>HB 4-1:</b> Educate on the benefits of regulating freshwater wetlands, including isolated wetlands, under state jurisdiction and permitting.	Center (Lead)	Technical expertise provided when needed to support the regulation of freshwater wetlands under state jurisdiction and permitting.	Ongoing. Technical expertise provided as opportunities arise.
<b>HB 4-2:</b> Work to reduce the continued loss of wetlands and reverse these loss trends by implementing projects to mitigate for previously lost wetlands and adapt to future rising sea-levels.	Center, DNREC (Lead); SCAT (Supporting)	Number of acres of restored wetlands.	Identify areas for restoration by 2027. Restoration ongoing as sites are identified and funding secured.
<b>Objective 5: Enhance populations of eastern oysters and other shellfish species.</b>			
<b>HB 5-1:</b> Implement the Shellfish Enhancement Plan.	Center (Lead)	Number of acres of oyster reefs established.	Phase 2 of Plan implementation completed by 2027.
<b>HB 5-2:</b> Educate about the environmental benefits of wild shellfish populations and shellfish farming.	Center, DNREC (Lead)	Number of education and outreach materials, including workshops, brochures, booklets, social media posts, blog posts, etc. produced on the benefits of wild shellfish populations and shellfish farming produced.	Ongoing. One publication biennially.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>HB 5-3:</b> Provide technical assistance for shellfish aquaculture.	DNREC (Lead); STAC (Supporting)	Technical guidance specific to the Inland Bays is published and available to shellfish farmers.	Ongoing. At least one meeting/forum or publication annually.
<b>HB 5-4:</b> Increase acreage of Bay bottom approved for shellfish harvest when microbial water quality, potential pollution, and conflicts with other natural resources allow.	DNREC (Lead)	Number of acres reclassified from closed to approved or seasonally approved.	Ongoing.
<b>HB 5-5:</b> Report the number and acreage of shellfish aquaculture leases, the number of each species harvested, and the value paid for the product at harvest by species annually.	DNREC (Lead)	Report produced as Personally Identifiable Information rules allow.	Annually.
<b>Objective 6: Control the spread of invasive species within the Bays and their watershed.</b>			
<b>HB 6-1:</b> Manage terrestrial and aquatic ecosystems to remove invasive species and prevent their establishment.	Center, DNREC, SCD (Lead)	Acres of invasive species removed annually.	Treat a minimum of 25 acres of invasive species each year.
<b>HB 6-2:</b> Educate property owners and bay users about the impacts of invasive species and how to control them.	Center (Lead); CAC (Supporting)	Number of educational materials produced.	Ongoing; Educational information produced when an invasive control project is completed.
<b>HB 6-3:</b> Support policies that prohibit the sale of invasive species.	Center (Lead)	Invasive species are prohibited from being sold for private and public use.	Produce a policy brief of the status and impacts of invasive species in the watershed by 2022. Provide expertise on best management practices as opportunities arise as it relates to invasive species.

## COORDINATED LAND AND WATER USE DECISIONS

### Objective 1: Increase and improve water access and waterway management.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>CM 1-1:</b> Increase opportunities for the public to access the water for recreation.			
<b>CM 1-1a:</b> Develop a comprehensive public water access inventory and water use map for the Inland Bays.	SCAT (Lead); Center, Sussex County, DNREC (Supporting)	Inventory and map produced.	Completed by 2023.
<b>CM 1-1b:</b> Develop a plan to improve and provide additional public water access focused on low-impact recreation and education to the public of where current access is located.	Center (Lead); DNREC, County, SCAT (Supporting)	Additional public water access points are identified. Existing public access points are improved if needed. Plan developed and published.	Plan is produced by 2025. Plan implemented by 2030.



Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>CM 1-2:</b> Improve waterway and sediment management.			
<b>CM 1-2a:</b> Continue to develop dedicated and sustainable finances for waterway and sediment management.	DNREC (Lead)	Dedicated and sustainable finances for waterway and sediment management are developed and implemented.	Ongoing.
<b>CM 1-2b:</b> Increase the beneficial reuse of sediment to enhance shorelines and tidal wetlands.	DNREC (Lead); Center, SCAT (Supporting)	Tons of sediment used in wetland enhancement and living shoreline projects.	Ongoing.
<b>CM 1-2c:</b> Develop an Inland Bays regional sediment management project plan for Indian River and Little Assawoman Bay.	DNREC (Lead); Center (Supporting)	Regional sediment management project plan produced.	Plan developed by 2025. Implementation timeframe based on the number of projects and available funding.
<b>CM 1-2d:</b> Review current no-wake areas to determine and carry out a plan to designate and mark additional sensitive areas.	Center, DNREC (Lead)	Additional sensitive areas are identified. A plan to designate and mark identified sensitive areas is explored and carried out if possible.	Current no-wake areas reviewed by 2024 and additional sensitive areas identified. Plan to designate and mark additional sensitive areas carried out if possible by 2027.
<b>Objective 2: Increase sustainable growth practices to reduce environmental impact.</b>			
<b>CM 2-1:</b> Conduct tech transfer workshop(s) with municipalities on impervious surface limits.	Center, DNREC (Lead); SCAT, STAC (Supporting)	Municipalities implement impervious surface limits.	Minimum of two tech-transfer workshops held before 2026.
<b>CM 2-2:</b> Convene a stakeholder group to explore a transfer of development rights program that results in incentives for the preservation of environmentally sensitive areas and incentives for growth designated areas.	Center (Lead), Sussex County (Supporting)	Stakeholder group formed with regular meetings.	Stakeholder group convened by 2024.
<b>CM 2-3:</b> Convene a stakeholder group composed of members of the conservation community to develop a natural lands habitat protection strategy that will establish priorities and actions in the Inland Bays watershed.	Center, Sussex County (Lead); DNREC (Supporting)	Stakeholder group formed with regular meetings.	Stakeholder group convened by 2020. Land and habitat protection strategy developed by 2023.
<b>CM 2-4:</b> Increase protection of land through acquisition or easement for the purpose of conservation and restoration.	Center (Lead); Sussex County, DNREC, DDA (Support)	Number of acres protected relative to baseline period of 2009-2019.	GIS tool for land conservation developed by 2022. Land identified by conservation partners through planning activities ongoing. One major partnership acquisition by 2025.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>CM 2-5:</b> Revise the Sussex County Code related to buffers for improved water quality aligned with the Center's Recommendations for an Inland Bays Watershed Water Quality Buffer System (published in 2008).	Sussex County (Lead); Center (Supporting)	New ordinance introduced to County Council.	Ordinance introduced by 2022.
<b>CM 2-6:</b> Implement conservation landscape projects in partnership with coastal communities.	Center (Lead); DNREC (Supporting)	Number of projects implemented.	Cost and benefit analysis to determine feasibility and nutrient removal potential completed by 2023. Projects identified (pending outcome of cost and benefit analysis) by 2025. Implementation ongoing.

## EDUCATION, OUTREACH, AND MARKETING

### Objective 1: Enhance the James Farm Ecological Preserve and Education Program.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>EO 1-1:</b> Implement the James Farm Master Plan.	Center (Lead); Sussex County (Supporting)	James Farm Master Plan implemented.	Phase 2 implemented by 2022.
<b>EO 1-2:</b> Develop and deliver watershed education programs.			
<b>EO 1-2a:</b> Programs for K-12 students are offered at the James Farm Ecological Preserve and incorporate Meaningful Watershed Educational Experience, Next Gen Science, and STEM standards.	Center (Lead)	Number of students reached through educational programming annually.	Minimum of 2,000 students annually.
<b>EO 1-2b:</b> Programs at the James Farm Ecological Preserve are developed for and offered to intergenerational audiences.	Center (Lead)	Number of people reached through intergenerational programming annually.	Minimum of 350 people annually.

### Objective 2: Educate residents, visitors, and tourists in the watershed about their impacts on water quality and how they can help improve the Bays.

<b>EO 2-1:</b> Develop and implement a Public Education and Engagement Plan for the Inland Bays.	Center (Lead); CAC (Supporting)	Public Education and Engagement Plan developed. Number of actions completed annually.	Plan developed by 2022. Implementation ongoing.
<b>EO 2-2:</b> Reduce marine debris through source reduction programs and initiatives and debris clean-ups.	Center, DNREC (Lead)	Number of clean-ups completed annually. Marine debris reduction campaign initiated.	Marine debris reduction campaign initiated by 2023. At least one clean up event is held annually.
<b>EO 2-3:</b> Promote sustainable funding for water quality improvements.	Center (Lead)	Sustainable funding for water quality improvement projects is secured.	Ongoing participation in the Clean Water Alliance.

Action	Partners	Performance Measure	Timeframe & Key Milestones
<b>Objective 3: Communicate environmental results and raise awareness about the importance of the Inland Bays and its watershed to promote public involvement and influence behaviors and actions to foster stewardship.</b>			
<b>EO 3-1:</b> Create and disseminate printed and electronic materials such as social media, video, brochures, postcards, and signage to address specific education/outreach needs to target audiences.	Center (Lead); CAC (Supporting)	Number of people reached through education and outreach.	Educational materials, including social media posts, blog posts, journal articles, etc. produced on an annual basis.
<b>EO 3-2:</b> Conduct field visits with decision makers to educate them on the importance of protecting and restoring natural ecosystems.	Center, DNREC (Lead); CAC (Supporting)	Number of decision makers engaged annually.	Goal of engaging three decision makers annually.
<b>EO 3-3:</b> Results of Inland Bays environmental studies or projects are published.	Center, DNREC, STAC (Lead)	Number of reports published through multiple mediums and outlets, including print and online.	"State of the Inland Bays" report is published and disseminated every five years. Press releases and project reports are published at the completion of projects.
<b>EO 3-4:</b> Communicate and provide educational information to diverse audiences on the benefits of achieving water quality goals to economic development, tourism, recreation, human health, and quality of life.	Center, CAC (Lead)	Number of educational and outreach materials produced targeting the benefits of clean water. Data and facts are shared on environmental issues of concern.	Ongoing.
<b>EO 3-5:</b> Complete and share publicly an economic valuation of the Inland Bays watershed.	Center (Lead)	Economic valuation completed. Economic valuation shared publicly.	Economic valuation completed by 2021.
<b>EO 3-6:</b> Advocate for enforcement of existing environmental regulations concerning Inland Bays restoration.	Center (Lead); CAC (Supporting)	Technical expertise provided when needed to advocate for enforcement of regulations.	Ongoing.
<b>Objective 4: Encourage more stakeholder support through volunteerism.</b>			
<b>EO 4-1:</b> Direct a volunteer program that provides citizens with opportunities to partner with the Center.	Center (Lead)	Number of volunteers engaged annually.	Volunteer engagement increases annually.

Terrapin.



DELAWARE CENTER FOR THE  
**INLAND BAYS**

Research. Educate. Restore.

39375 Inlet Road  
Rehoboth Beach, DE 19971  
[inlandbays.org](http://inlandbays.org)