



DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE
MANAGEMENT PLAN





DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE MANAGEMENT PLAN

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Dedication

This edition of the management plan is dedicated to all those individuals who have contributed to the successes of the Delaware NERR throughout its existence:

- Past and present members of the Reserve staff and Advisory Committees
- Friends of the DNERR
- Volunteers
- Our program partners

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LIST OF ACRONYMS

BMP	Best Management Practice
CDMO	Central Data Management Office
CEOE	College of Earth, Ocean, and Environment, University of Delaware
CFR	Code of Federal Regulations
CIB	Center for Inland Bays
CTP	Coastal Training Program
CZMA	Coastal Zone Management Act (of 1972, and subsequently amended)
DCMP	Delaware Coastal Management Program
DCP	Delaware Coastal Programs
DDA	Delaware Department of Agriculture
DEC	Division of Energy and Climate, DNREC
DHCA	Division of Historic and Cultural Affairs, Department of State
DFS	Delaware Forest Service
DFW	Division of Fish and Wildlife, DNREC
DNERR	Delaware National Estuarine Research Reserve
DNREC	Department of Natural Resources and Environmental Control
DNS	Delaware Nature Society
DPR	Division of Parks and Recreation, DNREC
DSG	Delaware Sea Grant
DSU	Delaware State University
DWS	Division of Watershed Stewardship, DNREC
EPA	Environmental Protection Agency
EPO	Environmental Protection Officer
ERD	Estuarine Reserves Division
ECSC	Environmental Cooperative Science Center
GIS	Geographic Information System
GRF	Graduate Research Fellow(ship)
JDP	John Dickinson Plantation
KCD	Kent County Conservation District
MACWA	Mid-Atlantic Coastal Wetland Assessment
MOU	Memorandum of Understanding
NCCD	New Castle County Conservation District
NEP	National Estuary Program
NERR	National Estuarine Research Reserve
NERRS	National Estuarine Research Reserve System
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuaries
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRCS	Natural Resources Conservation Service
NWR	National Wildlife Refuges
PDE	Partnership for the Delaware Estuary

OCRM	Ocean and Coastal Resource Management, Office of
OTS	Office of the Secretary, DNREC
SHPO	State Historic Preservation Office
SWMP	System-Wide Monitoring Program
TNC	The Nature Conservancy
UD	University of Delaware
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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EXECUTIVE SUMMARY





Delaware National Estuarine Research Reserve

The Delaware Department of Natural Resources and Environmental Control (DNREC) is the state agency responsible for the operation and management of the Delaware National Estuarine Research Reserve (Delaware NERR, DNERR or Reserve), in cooperation with the Estuarine Reserves Division of the National Oceanic and Atmospheric Administration (NOAA).

Designated in 1993, the Delaware NERR is one of 28 protected areas encompassing 1.3 million acres that comprise the National Estuarine Research Reserve System (NERRS). The NERRS promotes stewardship of our nation's coasts and estuaries through innovative research, education and training using a place-based system of protected areas. The Delaware NERR consists of two Reserve components, the Blackbird Creek Reserve and the St. Jones Reserve, which are about 20 miles apart. These components include both brackish and freshwater estuaries, and represent the diverse estuarine ecosystems found throughout the Mid-Atlantic States.

The National Estuarine Research Reserve System was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. Reserves are required by Federal regulation, 15 C.F.R. Part 921.13, to have a NOAA approved management plan that is updated on a periodic basis and serves as the framework for directing and tracking the progress of Reserve programs.

The Delaware National Estuarine Research Reserve supports coastal communities through science. It is a regional leader with regard to management driven estuarine science: science that is conducted by in-house researchers and in collaboration with scientists in the region who are attracted by the long term monitoring information and infrastructure that the Reserve provides to support their work.

The Reserve draws upon research conducted at DNERR and elsewhere to promote informed coastal management. The Reserve's Education programs promote the wise use of our coastal and estuarine resources. The Education programs include the Community Public Education and Outreach, Coastal Training, and K-16 Estuarine Education programs.

The DNERR's Stewardship Program utilizes adaptive management techniques to preserve and restore the natural resources within the Reserve as a place for research and education that promote a better understanding of Delaware's estuarine and coastal areas. Natural resource management on the Reserve is guided by the results of research conducted at the Reserve and elsewhere and is shared throughout the region through education and training.

With the approval of this management plan, the Reserve boundary will be amended to incorporate 2 parcels, increasing the total acreage of the Reserve to 6,206 acres. Property at 802 Blackbird Landing Road is 62 acres in size and includes wetlands, forest, and agricultural lands. The property at 515 Union Church Road is 2.3 acres in size and includes a tributary that connects to the Blackbird Creek, wetlands and forest. Both properties will be added at the Blackbird Creek Reserve component.

This edition of the Delaware NERR management plan is the 3rd plan to be approved by NOAA. It describes the background history, programs and administration of the Delaware NERR and outlines the strategy for meeting the Reserve's mission during 2013-2018 (Table 1).

Vision: Delaware National Estuarine Research Reserve is a regional leader and resource for the protection and conservation of estuarine and coastal resources through science-based management and informed public stewardship.

Mission: Improving the understanding, stewardship and appreciation of estuarine and coastal resources in the State of Delaware and Mid-Atlantic Region.

Goals:

- Improve the scientific understanding of estuarine and coastal ecosystems and the human influence on them.
- Improve public awareness and environmental literacy in our communities to enable environmentally sustainable decision-making.
- Protect, manage and restore the natural functions, diversity and cultural integrity of estuarine and coastal ecosystems within the Reserve to serve as a model site for sustainable community stewardship in the Region.
- Improve the operations, infrastructure and stature of the Reserve.

Coastal areas throughout the United States are hubs of commerce, recreation, and tourism. More than half of the nation's population lives near the coast. As the coastal population continues to grow, the health of valuable natural resources, many of which sustain local economies, is increasingly at risk.

In Delaware this dynamic area, also known as the Coastal Zone, provides critical habitat for many species including waterfowl, wildlife, fish, and marine mammals. It also provides recreational opportunities, port access, and water resources critical to the State's economy. Managing conflicts between uses of irreplaceable resources is a complex and continuously changing challenge in Delaware.

There are several overarching issues faced by the entire Delaware coast that also threaten the components of the DNERR. These include both anthropogenic influences as well as natural processes. Issues affecting all DNERR components include coastal population increase, altered land use, storm water runoff and eutrophication, invasive and non-native species, coastal storm impacts, sea level rise and climate change.

The Delaware NERR 2013-2018 program and operational support plans are summarized below:

Administration: The Reserve will effectively manage its existing resources, search for funding and additional resources that would enhance its programs, develop and maintain relationships with existing and new partners, and provide support and skill-building opportunities for staff.

Facilities & Public Access: The Reserve will plan for additional construction that meets existing and emerging needs. Through managed access, the Reserve will help visitors gain a sense of better understanding for estuarine and coastal resources.

Education, Outreach & Training: Reserve staff will increase understanding of coastal resources and encourage a positive environmental stewardship ethic among Reserve users, visitors and coastal decision-makers.

Research & Monitoring: Reserve staff will continue to conduct and coordinate management-oriented research, will continue monitoring efforts, including the NERRS system-wide monitoring program, will develop partnerships and provide technical and advisory services that address questions pertaining to significant coastal management issues.

Stewardship: Through natural resource management, restoration, and planning, the Reserve will serve as a model site for sustainability. The Reserve will utilize adaptive management techniques to preserve and restore the natural resources within the Reserve as a place for research and education that promote a better understanding of Delaware's estuarine and coastal areas.

By actively using this Management Plan to guide the Reserve, the Delaware NERR is striving to become a recognized resource for NOAA, the Mid-Atlantic Region, and the State of Delaware by conducting relevant research that is interpreted through education and outreach to our coastal communities.

Table 1: Delaware NERR Focus for 2013-2018

Delaware NERR Focus for 2013-2018			
Vision	Delaware National Estuarine Research Reserve is a regional leader and resource for the protection and conservation of estuarine and coastal resources through science-based management and informed public stewardship		
Mission	Improving the understanding, stewardship and appreciation of estuarine and coastal resources in the State of Delaware and Mid-Atlantic Region.		
Goal	Objectives	Actions	
Improve the scientific understanding of estuarine and coastal ecosystems and the human influence on them.	Conduct and coordinate research in the DNERR ecosystems that increases the scientific understanding of Mid-Atlantic estuaries and coastal ecosystems.	Prioritize research on coastal management issue needs and data gaps annually.	
		Assist state and federal agencies in evaluating the effects of climate change and sea level rise.	
		Pursue and support research on riparian and estuarine habitat restoration.	
	Promote the use of Reserve’s components by State or Federal agencies, academic institutions, and local or private environmental organizations as long term field laboratories.		Work collaboratively with coastal decision makers to provide research and information for effective management of estuarine and coastal resources.
			Support critical estuarine research with available resources and facilities.
			Develop and maintain partnerships and cooperative efforts with other research organizations or institutions to facilitate and augment research and monitoring projects to meet the goals of the Reserve.
			Enhance research facilities, field monitoring stations and scientific equipment and gear as necessary to support the Reserve’s research and monitoring efforts
			Continue to develop the on-site library’s collection of research and reference material and data repository.
			Recruitment of researchers through various strategies including: increased publicity, development of database catalogue, increased DNERR presence in local coastal/estuarine meetings, public events, participation in research symposia, conferences, workshops, internship programs, announcements of available data and research opportunities.
			Provide internship opportunities for university students and recent graduates to acquire hands-on experience and understanding of issues facing coastal and estuarine resources.
	Assess and monitor the status of estuarine habitats in the DNERR in order to track short-term variability and long-term changes in estuarine habitats and communities.		Examine and catalogue the biodiversity of the DNERR estuarine habitats including establishing a long-term monitoring location (sentinel site) to provide long-term evaluation of marsh biodiversity.
			Support the development of improved GIS habitat data for the Reserve and surrounding watersheds
			Continue involvement in the NERRS System-Wide Monitoring Program
Use information acquired as part of the DNERR Research and Monitoring Program to provide technical assistance and advisory services that contribute to efficient and effective management of estuaries and coastal resources in the State of Delaware and Mid-Atlantic Region.		Establish DNERR as a Sentinel Site.	
		Transfer research findings to education programs.	
		Disseminate research results and other pertinent information to local/regional/national decision-makers and the community to foster proper management and protection of estuarine and coastal ecosystems.	

Delaware NERR Focus for 2013-2018		
Vision	Delaware National Estuarine Research Reserve is a regional leader and resource for the protection and conservation of estuarine and coastal resources through science-based management and informed public stewardship	
Mission	Improving the understanding, stewardship and appreciation of estuarine and coastal resources in the State of Delaware and Mid-Atlantic Region.	
Goal	Objectives	Actions
Improve public awareness and environmental literacy in our communities to enable environmentally sustainable decision-making.	Enhance public awareness and understanding of the value and functions of estuarine and coastal ecosystems in the Mid-Atlantic Region	Promote the Reserve, its resources and its programs through publications, social media, public displays, and guest speaking appearances to community groups.
		Promote awareness of the NERRS, and the values of estuaries/marine protected areas by maintaining interpretive displays at the Visitor Centers, trails and participating in a variety of public events.
		Provide on-site education and interpretive services directly to the general public and students through regularly scheduled public activity programs, field-based estuarine science education experiences, in-classroom activities and workshops.
	Promote the wise use of estuarine resources and encourage a positive environmental stewardship ethic among Reserve users, visitors, and coastal decision-makers.	Provide teacher training, internships and guidance for student projects
		Provide technical assistance and training to coastal decision makers through the implementation of the Delaware Coastal Training Program.
		Provide community public programming that encourages a positive environmental stewardship ethic

Delaware NERR Focus for 2013-2018		
Vision	Delaware National Estuarine Research Reserve is a regional leader and resource for the protection and conservation of estuarine and coastal resources through science-based management and informed public stewardship	
Mission	Improving the understanding, stewardship and appreciation of estuarine and coastal resources in the State of Delaware and Mid-Atlantic Region.	
Goal	Objectives	Actions
Protect, manage and restore the natural functions, diversity and cultural integrity of estuarine and coastal ecosystems within the Reserve to serve as a model site for sustainable community stewardship in the Region.	Effectively manage Reserve lands with an emphasis on conservation and sustainable uses of ecological and cultural resources while balancing the needs of research and education	Develop and implement land management plans for newly acquired parcels.
		Monitor conditions of sites based on season and use.
		Manage invasive species through identification, monitoring and removal
	Provide for a diversity of high quality estuarine and coastal habitats representative of the Mid-Atlantic region	Conserve lands necessary to protect Reserve resources, ensure a stable environment for research and education, and broaden the Reserve's ecological diversity.
		Utilize fee-simple acquisition and conservation easements to protect essential habitats within the Reserve's watersheds
		Identify significant unprotected estuarine and coastal areas within the State of Delaware
		Increase local awareness of land preservation options
	Manage and restore habitats and ecosystem processes associated with the NERR using an adaptive management approach	Identify habitats for restoration
		Develop and implement science-based restoration plans
	Collaborate with local, regional, national agencies and organizations to address natural resource management issues affecting estuarine and coastal watersheds.	Monitor activities, policies, review reports, regulations, etc that affect the Reserve
		Use resource management practices as a demonstration and teaching resource for similar coastal habitats in the Region

Delaware NERR Focus for 2013-2018

Vision Delaware National Estuarine Research Reserve is a regional leader and resource for the protection and conservation of estuarine and coastal resources through science-based management and informed public stewardship

Mission Improving the understanding, stewardship and appreciation of estuarine and coastal resources in the State of Delaware and Mid-Atlantic Region.

Goal	Objectives	Actions
Improve the operations, infrastructure and stature of the Reserve	Implement an administrative framework that promotes collaboration to effectively operate the Reserve and take advantage of funding opportunities	Utilize Advisory Committees effectively
		Develop and maintain partnerships and collaborative efforts to fulfill the Reserve's mission
	Facilitate the development and implementation of clear policy direction and guidance in the management of the Reserve	Develop standard operating procedures for Reserve programming
		Improve awareness of Reserve policies
	Develop and maintain facilities necessary to the operations of the Reserve and that support the needs of visitors and staff	Provide safe, comfortable buildings for staff and partners to accomplish program objectives and provide visitors with facilities in which to learn about coastal and estuarine ecology and the natural and cultural history of the region
		Actively seek funding to implement prioritized facility and equipment needs at the St. Jones and Blackbird Creek Reserves as resources become available
	Develop, maintain and operate facilities that minimize environmental impacts and resource consumption by using innovative design, construction methods, and technologies	Evaluate facilities and operations as it pertains to Delaware Executive Order 18
		Continue to improve Reserve facilities as resources allow that minimize environmental impacts and which can function as a demonstration of sustainable design
	Develop and maintain integrity of Reserve for research, long-term resource protection and education while permitting traditional uses that do not conflict with Reserve goals	Improve access and signage at the Reserve to ensure all sites are properly marked including boundary markers and visitor use information
	Provide a stimulating professional environment to ensure that all staff members are adequately trained and strive for outstanding performance and interpersonal relationships	Promote and encourage the training of Reserve staff
Create opportunities for public participation that increase the understanding and stewardship of estuaries, expand the operational capacity of the Reserve, and provide meaningful experiences and benefits to participants	Enhance volunteer recruitment, retention and recognition strategies to attract, nurture, and retain a dynamic group of volunteers diverse in age, interests and talents to augment all aspects of the Reserve's programs	

INTRODUCTION





DELAWARE ENVIRONMENTAL SETTING

On the Eastern Seaboard of the United States, Delaware is bordered by the Atlantic Ocean and Delaware Bay, as well as by the states of New Jersey, Pennsylvania and Maryland (Map 1). Delaware's location affords easy access to the major metropolitan areas of the Northeast. Washington, D.C., Philadelphia, and Baltimore are all within a 2-hour drive. Though small in size, Delaware is rich in natural treasures. From the coastal beaches and dunes to freshwater wetlands and upland forests, the First State harbors a bounty of wildlife and habitats within its borders.

The State of Delaware ranks 49th in the nation in total area with a total area of 1,982 square miles. New Castle County is 438 square miles. Kent County is 594 square miles. Sussex County is 950 square miles. Delaware is 96 miles long and varies from 9 to 35 miles in width. Delaware has four major drainage basins: the Piedmont, Chesapeake Bay, Inland Bays/ Atlantic Ocean, and Delaware Bay and Estuary.

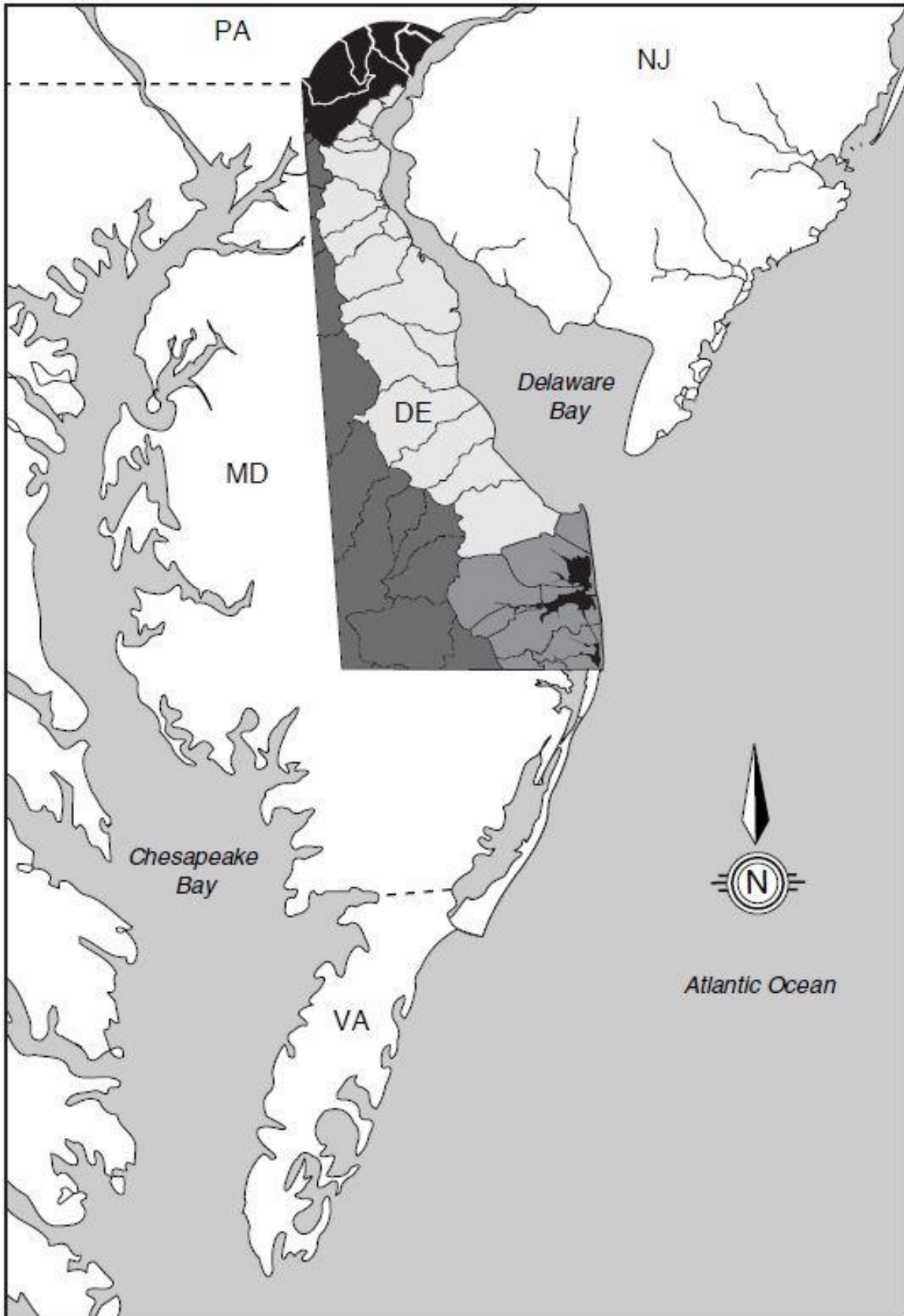
The Coastal Plain and Delaware Estuary

The State of Delaware is divided into two distinct topographical regions (the Coastal Plain and the Piedmont Plateau) and is located in the Virginian biogeographical province.

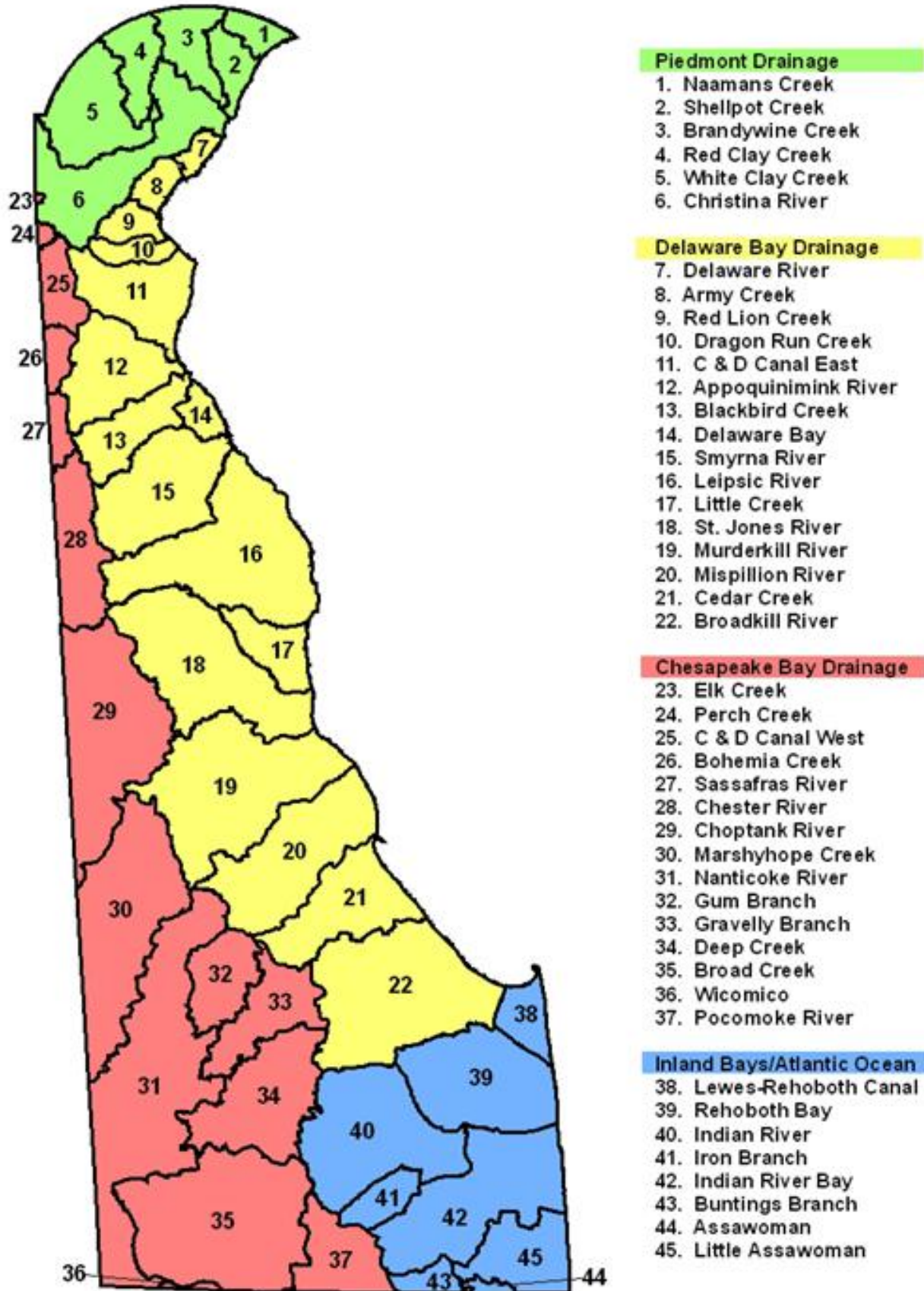
The Delaware Bay and Estuary Basin (Map 2) is located in eastern New Castle, Kent, and Sussex counties and is the largest of the four basins. The basin is named for the water bodies into which it drains – the Delaware Bay and the Delaware Estuary. The basin encompasses approximately 520,960 acres, or 814 square miles. The Delaware Reserve sites are centrally located within the coastal plain of Delaware on the west side of the Delaware Estuary (Map 3), about 32 km. (20 mi) apart. The Blackbird Creek Reserve component lies in southeastern New Castle County, between Odessa and Smyrna. The St. Jones Reserve component is located southeast of Dover in east-central Kent County and Delaware Bay Basin. Both sites are in the Middle Atlantic sub-region of the Virginian biogeographic region.

The Delaware Bay and Estuary Basin encompasses major habitats for diverse living resources within its vast expanse of coastal salt marsh and its upland forests. Many rare reptile, amphibian, birds, shellfish, and insect species reside within the basin. However, wildlife habitat is being reduced by ever-present human activity, and the fragility of aquatic and other species becomes more apparent every year.

Diversity best describes land use in the Delaware Bay and Estuary Basin. From marshes to rural farms and housing, to small towns and cities, the Delaware Bay and Estuary Basin encompasses a highly diverse set of land use types. Balancing land development and the increasing population pressures at the northern and southern portions of the basin with development around the state capital at the basin's midpoint will be one of the most important land use planning issues for the next 20 years.



Map 1: State of Delaware and surrounding States.



Piedmont Drainage

1. Naamans Creek
2. Shellpot Creek
3. Brandywine Creek
4. Red Clay Creek
5. White Clay Creek
6. Christina River

Delaware Bay Drainage

7. Delaware River
8. Army Creek
9. Red Lion Creek
10. Dragon Run Creek
11. C & D Canal East
12. Appoquinimink River
13. Blackbird Creek
14. Delaware Bay
15. Smyrna River
16. Leipsic River
17. Little Creek
18. St. Jones River
19. Murderkill River
20. Mispillion River
21. Cedar Creek
22. Broadkill River

Chesapeake Bay Drainage

23. Elk Creek
24. Perch Creek
25. C & D Canal West
26. Bohemia Creek
27. Sassafras River
28. Chester River
29. Choptank River
30. Marshyhope Creek
31. Nanticoke River
32. Gum Branch
33. Gravelly Branch
34. Deep Creek
35. Broad Creek
36. Wicomico
37. Pocomoke River

Inland Bays/Atlantic Ocean

38. Lewes-Rehoboth Canal
39. Rehoboth Bay
40. Indian River
41. Iron Branch
42. Indian River Bay
43. Buntings Branch
44. Assawoman
45. Little Assawoman

Map 2: Basins within the State of Delaware

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Map 3: Reserve sites in the Delaware Bay and Estuary Basin.

Climate and Weather

Delaware's climate is moderate year round. Average monthly temperatures range from 0 C (32.0 F) to 24.3 C (75.8 F) degrees. Average temperature in the summer months is 23.5 C (74.3 F) degrees. About 57% of the days are sunny. Annual precipitation is approximately 45 inches. Temperatures along the Atlantic Coast are about 10 F degrees warmer in winter and 10 F degrees cooler in summer. The average growing season varies from 170 to 200 days.

The DNERR components have a climate of well-defined seasons, typical of the Middle Atlantic States region. The surrounding water bodies of Delaware Bay, Chesapeake Bay, and the Atlantic Ocean considerably modify climate on the Delmarva Peninsula. The Delmarva Peninsula is named for the three states (Delaware, Maryland and Virginia) located in part on it. Easterly winds tend to raise winter temperatures and lower normal summer temperatures, while maintaining a humid environment. The warmest period of the year is towards the end of July, when maximum afternoon temperatures average 31.7 C (89 F). Temperatures over 32.2 C (90 F) occur on average 31 days a year. Extremes of 37.8 C (100 F) or higher can be expected in one year out of four. The coldest period is the end of January and the beginning of February, when the early morning temperature averages 4.4 C (24 F). On average the minimum temperature is below freezing 90 days of the year. Temperatures of 17.8 C (0 F) or lower can be expected one year in six.

The annual precipitation for central Delaware averages 117 cm (46 in.). The monthly distribution is fairly uniform during the year, with monthly ranges from a minimum of 7.6 cm (3 in.) to a maximum of 12.7 cm (5 in.). Due to the predominance of storms during the summer months, rainfall amounts can vary widely across the region. The remainder of the year has a more even precipitation distribution. The average seasonal snowfall (October through April) is 40 cm (16 in.), with annual totals ranging from a trace to more than 114 cm (45 in.). A drought may occur in any season, but a serious drought is most likely in the summer.

The prevailing winds are from the west to northwest most of the year, but tend to be more southerly or southwestern in the summer. The average annual windspeed is approximately 4 meters/second (9 mph), but winds of 22 meter/second (50 mph) or more may accompany severe thunderstorms, hurricanes, and winter storms (nor'easters).

Thunderstorms occur on average 30 days a year with the majority occurring between May and August. Tornadoes average only one a year throughout Delaware, causing little damage. Typically, central Delaware can expect a hurricane or its remnants once a year, usually between August and October, usually causing little damage. However, winter coastal storms ("nor'easters") occur more frequently, often accompanied by significant coastal flooding and shoreline erosion.

Climate has a profound and defining influence on coasts. Climate change will alter and intensify these influences and may exacerbate other stresses on estuaries such as coastal pollution and habitat loss. Climate experts predict that coastal areas will experience various changes depending on the region of the country. Rainfall will come in stronger, wetter events in some regions and drought will become more extreme and pervasive in other regions. Storms like hurricanes may become stronger and more frequent.

As a coastal state, Delaware's economy and quality of life have historically been linked to its shores, its vast expanses of protected tidal wetlands, and its fertile farm fields. Because of its location, low average elevation, and dependence on the coast, Delaware is particularly vulnerable to the effects of rising sea levels including loss of low-lying land and structures, saltwater intrusion into ground and surface waters, and increased coastal flooding from storm events.

Estuaries

Estuaries, in simplest terms, are defined as areas where freshwater rivers and the salty oceans meet and mix. These areas are transformed with the tides, making estuarine ecosystems crucial transition zones between land and water. Bays, sounds, marshes, swamps, inlets, and sloughs are all types of estuarine systems.

Estuaries are dynamic ecosystems that are formed and controlled mainly by physical processes, all of which determine their biotic makeup. These ecosystems are variable as a result of exchange with their surrounding environs. The stressors of salinity and temperature greatly affect the species found in estuarine systems; adaptability is key for survival. Estuarine trophic levels are complex, including several types of primary producers, grazing and detrital food chains, interactions between the water column and the bottom, complex food webs, and many generalist feeders.

Estuaries have not always been seen as valuable ecosystems worthy of protection and conscientious management. However, they have always served important economic, aesthetic, and intrinsic purposes in both the natural and the “human” world. Estuaries act as buffers for coastal storms, absorbing flood waters and dissipating storm surges that would otherwise flood inland development. They serve as nurseries for numerous plant and animal species, some of which we greatly depend on – in fact, most of the seafood that we consume spends at least part of its life cycle in an estuary. Many pollutants produced by human society are filtered from the waters as they travel through estuarine ecosystems. Estuaries provide beautiful recreational areas for people who fish, boat, hunt, or simply bird watching and enjoying the outdoors. By supporting a plethora of species, estuarine systems contribute to biodiversity and help to sustain the natural balance of life on earth.

The Water Resources Agency at the University of Delaware published a comprehensive study titled *Economic Value of the Delaware Estuary Watershed* in 2011 for the Partnership for the Delaware Estuary, A National Estuary Program. This study demonstrates how the Delaware Estuary and its natural resources provide real economic benefits to the region including \$10 billion in annual economic activity from recreation, water quality, hunting and fishing, forests, agriculture and parks. (Kauffman et al 2011 http://www.delawareestuary.org/pdf/NatCap/estuary_economic_value.pdf).

Recognition of all the vital functions of estuaries highlights the obvious need for coastal zone management, not only for the protection of the natural world but for human sustenance as well. Often, however, it is only with the assistance of governmental programs that we come to appreciate our valuable coastal ecosystems, and thus to safeguard them through legislation and action. The NERRS is one such program, enabling scientists and educators to provide decision-makers, from the local to national level, with research findings that uphold the value of estuaries and reflect their importance to the public.



PROTECTION OF ESTUARIES AND COASTS: THE COASTAL ZONE MANAGEMENT ACT

To protect Delaware's and the Nation's valuable estuarine resources, Congress passed the Coastal Zone Management Act (CZMA) and its subsequent reauthorizations to officially recognize that resources of the coastal zone are of national significance and that these resources are rapidly disappearing. The CZMA also recognizes the interrelationships between uplands and tidelands: the "coastal zone" was defined in the Act as including all uplands "to the extent necessary to control shoreland." A portion of the 1996 reauthorization of the CZMA states:

The increasing and competing demands upon the lands and water of our coastal zone...have resulted in the loss of living marine resources, wildlife, nutrient-rich areas, permanent and adverse changes to ecological systems, decreasing open space for public use, and shoreline erosion.

The habitat areas of the coastal zone, the fish, shellfish, other living marine resources, and wildlife therein, are ecologically fragile and consequently extremely vulnerable to destruction by man's alteration.

In recognition of these growing problems, the CZMA established a national goal:

...to preserve, protect, develop and, where possible, to restore and enhance the resources of the Nation's coastal zone for this and succeeding generations.

The CZMA also recognized that coastal waters are significantly affected by land uses: Land uses in the coastal zone, and the uses of adjacent lands which drain into the coastal zone, may significantly affect the quality of coastal waters and habitats, and efforts to control water pollution from land use activities must be improved.

The CZMA authorizes two national programs: 1) the National Coastal Zone Management Program; and 2) the National Estuarine Research Reserve System.

National Coastal Zone Management Program

The National Coastal Zone Management Program (CZMP) is dedicated to comprehensive, sustainable management of the nation's coasts, seeking to manage and protect coastal resources while balancing often competing land and water uses. For those coastal states participating in the coastal zone management program, state programs must accomplish the following:

- Define the coastal zone boundary and permissible land and water uses;
- Outline methods by which the state will exert control over the uses;
- Define the organizational structure of the program and responsibilities of agencies involved; and
- Establish a planning process to address public access, energy facilities, and assessing shoreline erosion rates.

A National Oceanic Atmospheric Administration (NOAA) approved coastal management plan also gives states some control over federal actions affecting the state's coastal zone.

Reauthorizations of the CZMA have incorporated the Coastal Nonpoint Pollution Control Program, for states to manage the effects of nonpoint source pollution, and Management Program Enhancements, for states to make improvements to their coastal programs. States utilize a variety of tools to implement the coastal management programs including planning, permitting, and enforcement. The CZMP provides federal technical assistance, funding, and national coordination to support states' coastal zone management planning and plan implementation.

The Delaware Coastal Management Program, established in 1979, has been structured to help meet the challenge of managing conflicts between the use of irreplaceable resources by humans and the natural importance of these resources in the coastal management area.

National Estuarine Research Reserve System

The National Estuarine Reserve System was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. The CZM Program is dedicated to comprehensive, sustainable management of the nation's coasts.

The reserve system is a network of protected areas (Figure 1) established to promote informed management of the Nation's estuaries and coastal habitats. The reserve system currently consists of 28 reserves in 23 states and territories, protecting over one million acres of estuarine lands and waters.

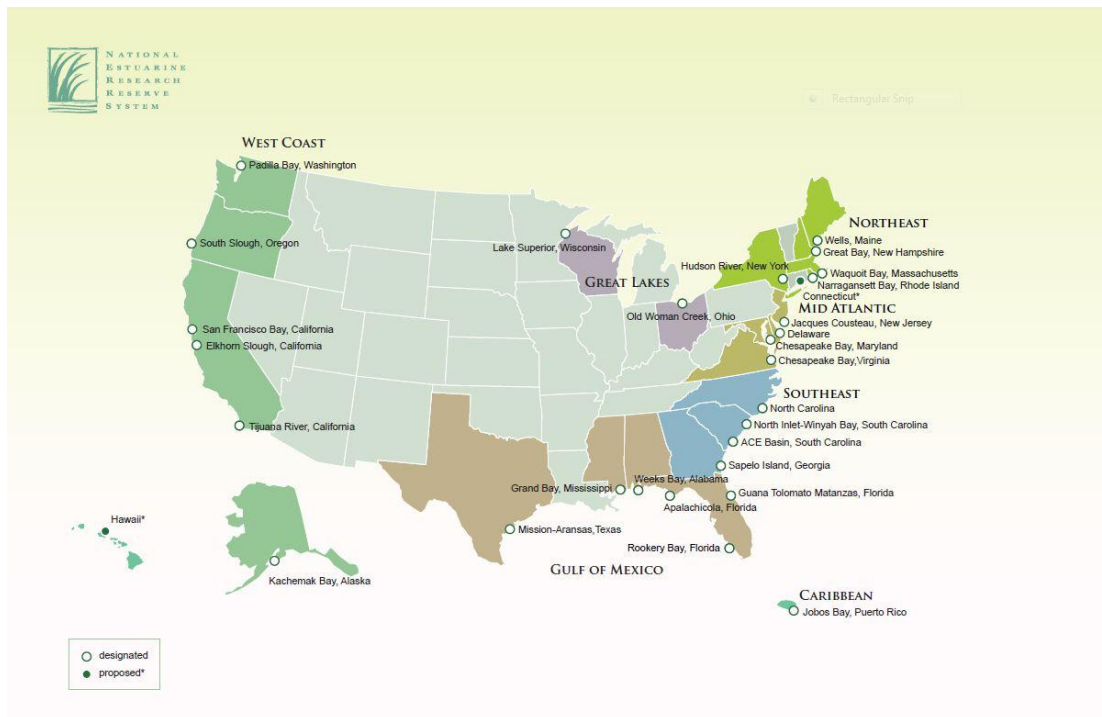


Figure 1: The National Estuarine Research Reserve System

Mission

As stated in the NERRS regulations (Appendix A), 15 C.F.R. Part 921.1(a), the National Estuarine Research Reserve System mission is:

the establishment and management, through Federal-state cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.

Goals

Federal regulations, 15 C.F.R. Part 921.1(b), provide five specific goals for the reserve system:

- (1) Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
- (2) Address coastal management issues identified as significant through coordinated estuarine research within the System;
- (3) Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- (4) Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
- (5) Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

National Estuarine Research Reserve System Administrative Framework

The Estuarine Reserves Division of the Office of Ocean and Coastal Resource Management (OCRM) administers the reserve system. The Division establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates reserves for compliance with Federal requirements and with the individual reserve's Federally-approved management plan.

The Estuarine Reserves Division currently provides support for four system-wide programs: the System-Wide Monitoring Program, the Graduate Research Fellowship Program, the K-12 Estuarine Education Program, and the Coastal Training Program. They also provide support for reserve initiatives on restoration science, invasive species, community education, and reserve specific research, monitoring, education and resource stewardship initiatives and programs.

National Estuarine Research Reserve System Strategic Goals 2011 – 2016

Strategic planning has been an integral part of the National Estuarine Research Reserve System for nearly twenty years. The planning process is designed to bridge national program direction with on-the-ground coastal management needs through a representative and participatory process that supports NOAA's mission of science, service, and stewardship.

The Reserve System 2011-2016 strategic plan focuses its core strengths of research, education, and training on climate change, habitat protection, and water quality. In recognition that estuaries are biologically rich, economically valuable, and highly vulnerable ecosystems, the Reserve System adopted a *Vision*: Resilient estuaries and coastal watersheds where human and natural communities thrive and a *Mission*: To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas. The following goals are outlined in the 2011-2016 Strategic Plan (Appendix B).

Goals:

1. Protected Places: Estuaries and coastal watersheds are better protected and managed by implementing place-based approaches at Reserves.
2. Science: NERRS scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds.
3. People: NERRS education and training increases participants' environmental literacy and ability to make science-based decisions related to estuaries and coastal watersheds.

High priority science and training needs for coastal stakeholders were selected based on their appropriateness to the NERRS mission to focus the System's efforts locally and nationally. These topics will be addressed by implementing the strategic goals.

Reserve System Priority Coastal Management Issues:

1. Climate Change
2. Habitat Protection
3. Water Quality

Reserve Designation and Operation

Under Federal law (16 U.S.C. Section 1461), a state can nominate an estuarine ecosystem for Research Reserve status so long as the site meets the following conditions:

1. The area is representative of its biogeographic region, is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
2. The law of the coastal State provides long-term protection for the proposed Reserve's resources to ensure a stable environment for research;
3. Designation of the site as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation; and
4. The coastal State has complied with the requirements of any regulations issued by the Secretary [of Commerce].

Reserve boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation.

If the proposed site is accepted into the reserve system, it is eligible for NOAA financial assistance on a cost-share basis with the state. The state exercises administrative and management control, consistent with its obligations to NOAA, as outlined in a memorandum of understanding. A reserve may apply to NOAA's ERD for funds to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction, and land acquisition.

Biogeographic Regions

NOAA has identified eleven distinct biogeographic regions and 29 subregions in the U.S., each of which contains several types of estuarine ecosystems (15 C.F.R. Part 921, Appendix I and II). When complete, the reserve system will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2012, the reserve system includes 28 reserves and two reserves in the process of designation (Figure 2). The reserves are listed below by biogeographic region and subregion with their designation date denoted in parentheses.

Acadian - Southern Gulf of Maine

- Wells Reserve, Maine (1984)
- Great Bay Reserve, New Hampshire (1989)

Virginian - Southern New England

- Waquoit Bay Reserve, Massachusetts (1988)
- Narragansett Bay Reserve, Rhode Island (1980)
- Hudson River Reserve, New York (1982)

Virginian - Middle Atlantic

- Jacques Cousteau Reserve, New Jersey (1998)
- Delaware Reserve (1993)

Virginian - Chesapeake Bay

- Chesapeake Bay Reserve, Maryland (1985,1990)
- Chesapeake Bay Reserve, Virginia (1991)

Virginian & Carolinian - North Carolina

- North Carolina Reserve (1985, 1991)

Carolinian - South Atlantic

- North Inlet-Winyah Bay Reserve, South Carolina (1992)
- ACE Basin Reserve, South Carolina (1992)
- Sapelo Island, Georgia (1976)

Carolinian - East Florida

- Guana Tolomato Matanzas Reserve, Florida (1999)

West Indian - Caribbean

- Jobos Bay Reserve, Puerto Rico (1981)

West Indian - West Florida

- Rookery Bay Reserve, Florida (1978)

Louisianan - Panhandle Coast

- Apalachicola Reserve, Florida (1979)
- Weeks Bay Reserve, Alabama (1986)

Louisianan - Mississippi Delta

- Grand Bay Reserve, Mississippi (1999)

Louisianan - Western Gulf

- Mission-Aransas Reserve, Texas (2006)

Californian - Southern California

- Tijuana River Reserve, California (1982)

Californian - Central California

- Elkhorn Slough Reserve, California (1979)

Californian - San Francisco Bay

- San Francisco Bay, California (2003)

Columbian - Middle Pacific

- South Slough Reserve, Oregon (1974)

Columbian - Puget Sound

- Padilla Bay Reserve, Washington (1980)

Great Lakes - Lake Erie

- Old Woman Creek, Ohio (1980)

Great Lakes - Lake Superior

- Lake Superior Reserve, Wisconsin (2010)

Fjord - Aleutian Islands

- Kachemak Bay Reserve, Alaska (1999)

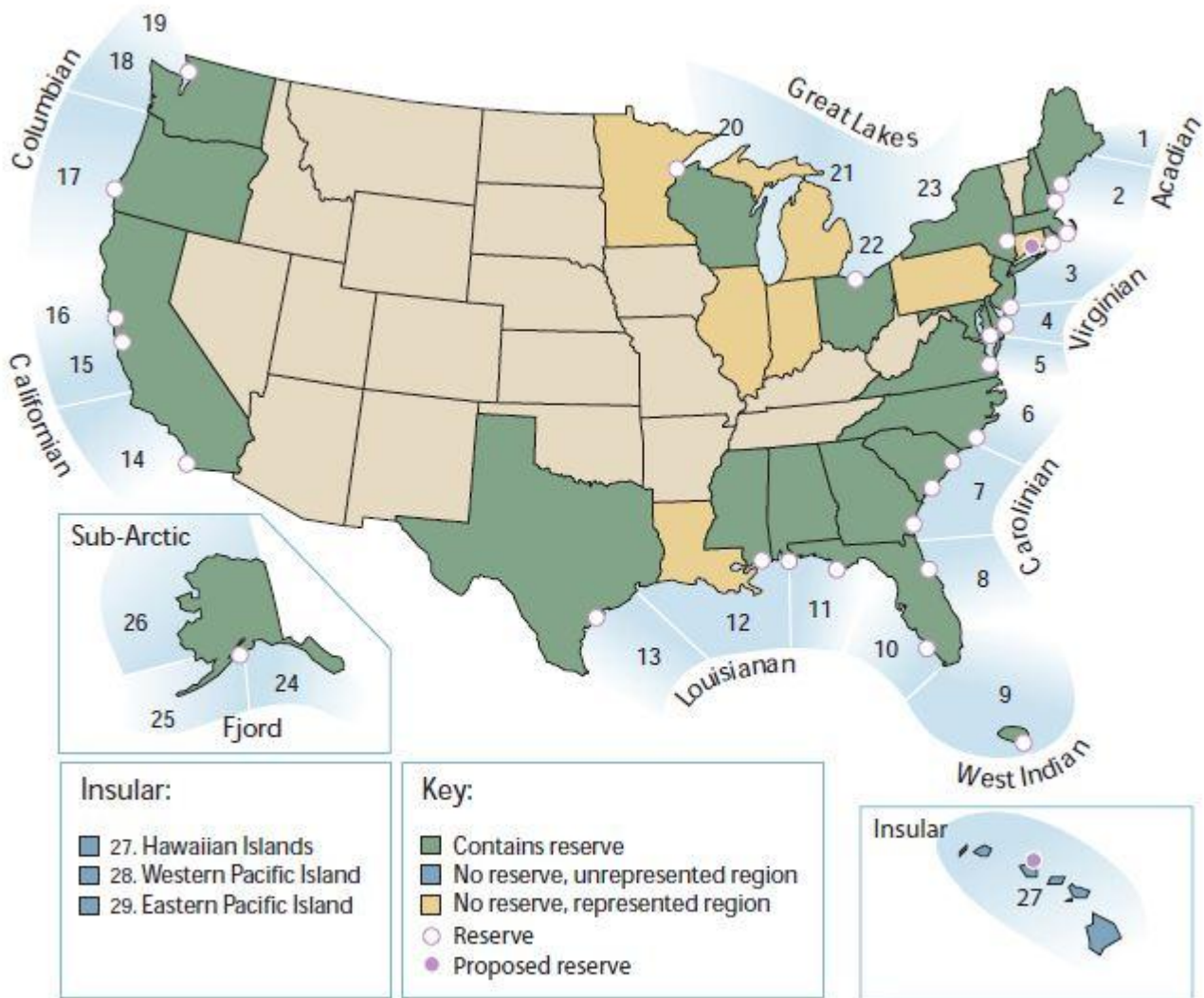


Figure 2: National Estuarine Research Reserve System map and biogeographic region

Reserve Management Plans

Every Reserve is required by Federal Regulation to have an Estuarine Reserves Division -approved management plan. The plan must describe the Reserve's goals, objectives and management issues, and must identify the Reserve's intended strategies or actions for research, education/interpretation, public access, construction, acquisition, and resource management.

Staff roles in each of these areas must also be addressed. Reserve management plans are important for a variety of reasons, including:

- Provide a framework to direct and evaluate Reserve programs;
- Gauge how successfully Reserve goals have been met and determine necessary changes in direction; and,
- Guide Section 312 programmatic evaluations of the Reserve.

To serve these purposes, management plans are currently required by NOAA to be updated every five years. This revised management plan for the Delaware National Estuarine Research Reserve has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the Section 315 of the CZMA of 1972, as amended, and the provisions of the Delaware Coastal Management Program.



DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE

Establishment of the Reserve

During the early 1980s, the DNREC examined the precursor to the NERRS, the National Estuarine Sanctuary Program, which had been established by Section 315 of the CZMA in 1972. Although that program had several desirable attributes, it did not have enough flexibility or utility within the context of Delaware's resource needs to warrant the State's support. However, when the CZMA was reauthorized in 1986, the National Estuarine Sanctuary Program became the NERRS, which has a greater emphasis on applied research and environmental education while allowing more flexibility in the administration of reserve components to accommodate multiple uses and respond to management needs. Given this new direction for estuarine reserves, the State of Delaware began in 1988 to identify potential sites. The intensive site-selection criteria that were used assessed ecological representation, values for environmental research and education, and acquisition and management considerations.

Delaware's diverse estuarine systems are representative of the Virginian biogeographic region. The diverse range of habitats in Delaware makes it an ideal location for a National Estuarine Research Reserve. In order to capture the full breadth of this diversity, a multi-component NERR was planned for the State. This approach allowed for a diversity of estuarine ecosystems present in the State to be represented and protected.

Two sites were selected and nominated by then-Governor Michael Castle to be a multiple-site Reserve that include parcels of land held by private landowners as well as parcels that are owned in fee simple by the State of Delaware. In 1993, following NOAA's approval of the submitted management plan, the DNERR became the 22nd Reserve in the System.

With the approval of this revision of the management plan, the Delaware Reserve will be approximately 6,206 acres in size. This includes the addition of 62 acres at 802 Blackbird Landing Road Tract and 2.3 acres at 515 Union Church Road Tract to the Blackbird Creek Reserve component. It should be noted that GIS and GPS tools have enabled the Delaware NERR to more accurately define and calculate actual acreage owned. When using the more accurate mapping and calculation with GIS tools, the acreage of the two components include:

1. The 5,119 acre St. Jones Reserve component located in Kent County, just south of the City of Dover and Delaware Bay;
2. The 1,087 acre Blackbird Creek Reserve component located in southern New Castle County.

The DNERR is a federal-state partnership between NOAA and the Delaware Department of Natural Resources & Environmental Control (Appendix D). Refer to the Administration Plan within this document for more information regarding the administrative framework of the DNERR.

Coastal Management Issues in Delaware

For thousands of years, people have been drawn to the world's coastal areas. Today, coastal areas throughout the United States are hubs of commerce, recreation, and tourism. More than half of the nation's population lives near the coast. As the coastal population continues to grow, the health of valuable natural resources, many of which sustain local economies, is increasingly at risk.

In Delaware this dynamic area, also known as the Coastal Zone, provides critical habitat for many species including waterfowl, wildlife, fish, and marine mammals. It also provides recreational opportunities, port access, and water resources critical to the State's economy. Managing conflicts between uses of irreplaceable resources is a complex and continuously changing challenge in Delaware.

There are several overarching issues faced by the entire Delaware coast that also threaten the components of the DNERR. These include both anthropogenic influences as well as natural processes. Issues affecting all DNERR components include coastal population increase, altered land use, storm water runoff and eutrophication, invasive species, coastal storm impacts, and sea level rise.

Coastal Population Increase

The DNERR properties are especially vulnerable to impacts associated with increased coastal population. The counties that contain the DNERR properties have witnessed dramatic population increases over the 2000 to 2010 time period. New Castle County (includes Blackbird Creek Reserve) has seen a 7.6% increase and Kent County (includes St. Jones Reserve) has seen a 28.1% increase (U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171 Summary File)).

As the human population increases, so do the impacts upon the environment including increased storm water runoff and eutrophication, increased sewage, trash, and emissions. The increased population also leads to increases in the number of people using the Reserve properties. While most visitor use of the Reserves is benign and causes no harm, occasional misuse of the properties does occur. These are usually associated with visitors not knowing the allowed uses for the properties and include things like, illegal hunting and camping, dogs off leash, and accumulation of trash.

Land Use and Eutrophication

Altered land use and cover is a critical issue because it impacts the ability of the land to sequester nutrients and pollution. Natural land covers such as forest and marsh have large buffering capacities and tend to trap nutrients and sediment prior to their entering surface waters. With increased impervious surfaces such as roofs, roads, and parking lots, developed lands tend to have very little capacity to absorb nutrients.

These surfaces do not allow water to infiltrate the ground and high percentages of impervious surfaces have been correlated with degraded water and sediment quality. Consequently runoff from these surfaces, especially during storm events, picks up whatever contaminants and nutrients are on them and rapidly moves these materials to surface waters. This stormwater runoff has the ability to severely impact receiving waters by increasing eutrophication.

Eutrophication is a process through which natural waters receive too many nutrients. Nutrients, especially nitrogen and phosphorus, stimulate phytoplankton production. This increased production can lead to a multitude of water quality problems including hypoxia, decreased light penetration, altered community composition, and decreased fish and shellfish populations. Recovery from eutrophication can take long periods of time even if the causes of the eutrophication are immediately halted. Because of the population increases noted above and the associated land use changes, the DNERR properties are vulnerable to water quality declines as a result of eutrophication.

Coastal Storm Impacts

Delaware shores are often impacted by coastal storms, locally called “Nor’easters”. As a result of the winds and flooding that occur in conjunction with coastal storms and their associated storm surges, Nor’easters frequently generate the most coastal damage (property damage, infrastructure, and beach loss), especially during the winter months, during very short timeframes. Shoreline erosion is also exacerbated by coastal storms as a result of high winds and pounding wave action. Periodic beach nourishment efforts are utilized to help maintain the dune system. The risks associated with coastal hazards, including sea level rise are increasing as development continues to grow along the coastal areas of Delaware.

Sea Level Rise and Climate Change

Delaware experiences inundation from the sea on a regular basis. Coastal Storms and their associated heavy rainfall and storm surge routinely cause flooding. The resulting inundation causes significant social and economic impacts in the short-term. Future inundation impacts will be further exacerbated by local changes in sea level.

Documented data from NOAA has shown that Sea level has increased in Delaware at a rate of 3.20mm/year in Lewes and 3.46mm/year at Reedy Point. The conclusion of the Intergovernmental Panel of Climate Change is that the rate of sea level rise will increase over the next century. While evidence has shown that the sea level has changed dramatically over the course of time, the coastline can no longer adapt naturally as it has in the past due to human development and alterations of the landscape. Sea level rise will cause increased inundation and shoreline erosion; increased tidal surge, flooding from severe weather events; accelerate saltwater contamination of ground water and surface water supplies, elevate water tables, and expedite loss of critical habitats.

Development in Delaware’s coastal zone that does not account for increasing inundation levels puts homes, businesses and infrastructure at risk resulting in human hardship and higher cost to government for response and recovery. Additionally, marshes and other critical low-lying habitats may also be at risk due to the inability to naturally migrate landward with rising sea levels.

There are many potential problems associated with an increase in sea level. The most important in terms of the Reserve properties is loss of marsh or habitat. If the sea level rise is faster than the ability of the marsh to accrete sediment and build itself up, then the marshes will be flooded. This would cause not only a decrease in the size of all the Reserve properties, but also would represent a loss of vital nursery habitat and other values of marshes. Increased sea level will also enhance shoreline erosion within the Reserve properties potentially leading to loss of upland areas as well.

Invasive and Non-native Species

Invasive species are one of the most pervasive problems facing not only DNERR but also the nation. An invasive species is an organism that is introduced into an area in which it did not evolve. Lack of predators and competitive advantages allow invasive species to grow uncontrollably within the new environment causing harm to the environment, the economy, and human health. Invasive species are usually very opportunistic and hard to get rid of once established. Invasive species known to occur on the Reserve properties include Kudzu (*Pueraria lobata*), Multiflora rose (*Rosa multiflora*), Autumn Olive

(*Elaeagnus umbellata*), Parrot feather (*Myriophyllum aquaticum*), Common Reed (*Phragmites australis*), Garlic Mustard (*Alliaria petiolata*) and the Asian shore crab (*Hemigrapsus sanguineus*). Invasive species known to occur in Delaware, but not yet found on the Reserve properties include Nutria (*Myocaster coypus*) and Northern snakehead (*Channa argus*).

Delaware NERR Focus for 2013-2018

Vision

Delaware NERR is a regional leader and resource for the protection and conservation of estuaries and coastal resources through science-based management and informed public stewardship.

Mission

Improving the understanding, stewardship and appreciation of estuarine and coastal resources in the State of Delaware and Mid-Atlantic Region.

Goals, Objectives and Actions

Goal 1: Improve the scientific understanding of estuarine and coastal ecosystems and the human influence on them.

Objective: Conduct and coordinate research in the DNERR ecosystems that increases the scientific understanding of Mid-Atlantic estuaries and coastal ecosystems.

Action: Prioritize research on coastal management issue needs and data gaps annually.

Action: Assist state and federal agencies in evaluating the effects of climate change and sea level rise.

Action: Pursue and support research on riparian and estuarine habitat restoration.

Action: Work collaboratively with coastal decision makers to provide research and information for effective management of estuarine and coastal resources.

Objective: Promote the use of Reserve's components by State or Federal agencies, academic institutions, and local or private environmental organizations as long term field laboratories.

Action: Support critical estuarine research with available resources and facilities.

Action: Develop and maintain partnerships and cooperative efforts with other research organizations or institutions to facilitate and augment research and monitoring projects to meet the goals of the Reserve.

Action: Enhance research facilities, field monitoring stations and scientific equipment and gear as necessary to support the Reserve's research and monitoring efforts.

Action: Continue to develop the on-site library's collection of research and reference material and data repository.

Action: Recruitment of researchers through various strategies including: increased publicity, development of database catalogue, increased DNERR presence in local coastal/estuarine meetings, public events, participation in research symposia, conferences, workshops, internship programs, announcements of available data and research opportunities.

Action: Provide internship opportunities for university students and recent graduates to acquire hands-on experience and understanding of issues facing coastal and estuarine resources.

Objective: Assess and monitor the status of estuarine habitats in the DNERR in order to track short-term variability and long-term changes in estuarine habitats and communities.

Action: Examine and catalogue the biodiversity of the DNERR estuarine habitats including establishing a long-term monitoring location (sentinel site) to provide long-term evaluation of marsh biodiversity.

Action: Support the development of improved GIS habitat data for the Reserve and surrounding watersheds

Action: Continue involvement in the NERRS System-Wide Monitoring Program

Action: Establish DNERR as a Sentinel Site.

Objective: Use information acquired as part of the DNERR Research and Monitoring Program to provide technical assistance and advisory services that contribute to efficient and effective management of estuaries and coastal resources in the State of Delaware and Mid-Atlantic Region.

Action: Transfer research findings to education programs.

Action: Disseminate research results and other pertinent information to local/regional/national decision-makers and the community to foster proper management and protection of estuarine and coastal ecosystems.

Goal 2: Improve public awareness and environmental literacy in our communities to enable environmentally sustainable decision-making.

Objective: Enhance public awareness and understanding of the value and functions of estuarine and coastal ecosystems in the Mid-Atlantic Region

Action: Promote the Reserve, its resources and its programs through publications, social media, public displays, and guest speaking appearances to community groups.

Action: Promote awareness of the NERRS, and the values of estuaries/marine protected areas by maintaining interpretive displays at the Visitor Centers, trails and participating in a variety of public events.

Action: Provide on-site education and interpretive services directly to the general public and students through regularly scheduled public activity programs, field-based estuarine science education experiences, in-classroom activities and workshops.

Action: Provide teacher training, internships and guidance for student projects

Objective: Promote the wise use of estuarine resources and encourage a positive environmental stewardship ethic among Reserve users, visitors, and coastal decision-makers.

Action: Provide technical assistance and training to coastal decision makers through the implementation of the Delaware Coastal Training Program.

Action: Provide community public programming that encourages a positive environmental stewardship ethic.

Goal 3: Protect, manage and restore the natural functions, diversity and cultural integrity of estuarine and coastal ecosystems within the Reserve to serve as a model site for sustainable community stewardship in the Region.

Objective: Effectively manage Reserve lands with an emphasis on conservation and sustainable uses of ecological and cultural resources while balancing the needs of research and education.

Action: Develop and implement land management plans for newly acquired parcels.

Action: Monitor conditions of sites based on season and use.

Action: Manage invasive species through identification, monitoring and removal.

Objective: Provide for a diversity of high quality estuarine and coastal habitats representative of the Mid-Atlantic region.

Action: Conserve lands necessary to protect Reserve resources, ensure a stable environment for research and education, and broaden the Reserve's ecological diversity.

Action: Utilize fee-simple acquisition and conservation easements to protect essential habitats within the Reserve's watersheds.

Action: Identify significant unprotected estuarine and coastal areas within the State of Delaware.

Action: Increase local awareness of land preservation options

Objective: Manage and restore habitats and ecosystem processes associated with the NERR using an adaptive management approach.

Action: Identify habitats for restoration

Action: Develop and implement science-based restoration plans.

Objective: Collaborate with local, regional, national agencies and organizations to address natural resource management issues affecting estuarine and coastal watersheds.

Action: Monitor activities, policies, review reports, regulations, etc that affect the Reserve.

Action: Use resource management practices as a demonstration and teaching resource for similar coastal habitats in the Region.

Goal 4: Improve the operations, infrastructure and stature of the Reserve.

Objective: Implement an administrative framework that promotes collaboration to effectively operate the Reserve and take advantage of funding opportunities.

Action: Utilize Advisory Committees effectively.

Action: Develop and maintain partnerships and collaborative efforts to fulfill the Reserve's mission

Objective: Facilitate the development and implementation of clear policy direction and guidance in the management of the Reserve

Action: Develop standard operating procedures for Reserve programming.

Action: Improve awareness of Reserve policies.

Objective: Develop and maintain facilities necessary to the operations of the Reserve and that support the needs of visitors and staff.

Action: Provide safe, comfortable buildings for staff and partners to accomplish program objectives and provide visitors with facilities in which to learn about coastal and estuarine ecology and the natural and cultural history of the region.

Action: Actively seek funding to implement prioritized facility and equipment needs at the St. Jones and Blackbird Creek Reserves as resources become available.

Objective: Develop, maintain and operate facilities that minimize environmental impacts and resource consumption by using innovative design, construction methods, and technologies.

Action: Evaluate facilities and operations as it pertains to Delaware Executive Order 18

Action: Continue to improve Reserve facilities as resources allow that minimize environmental impacts and which can function as a demonstration of sustainable design.

Objective: Develop and maintain integrity of Reserve for research, long-term resource protection and education while permitting traditional uses that do not conflict with Reserve goals.

Action: Improve access and signage at the Reserve to ensure all sites are properly marked including boundary markers and visitor use information.

Objective: Provide a stimulating professional environment to ensure that all staff members are adequately trained and strive for outstanding performance and interpersonal relationships.

Action: Promote and encourage the training of Reserve staff.

Objective: Create opportunities for public participation that increase the understanding and stewardship of estuaries, expand the operational capacity of the Reserve, and provide meaningful experiences and benefits to participants.

Action: Enhance volunteer recruitment, retention and recognition strategies to attract, nurture, and retain a dynamic group of volunteers diverse in age, interests and talents to augment all aspects of the Reserve's programs.

Guiding Principles

The approach by which Reserve programs are developed, implemented, and evaluated are to

- Engage local communities and citizens to improve stewardship of coastal resources
- Create strong partnerships to enhance the success of Reserve programs
- Integrate science, education and stewardship to address complex coastal problems
- Lead by example by implementing best management practices at the Reserve
- Seek regional collaborations to extend the influence of Reserve programs and products.

Coastal Resource Stewardship

- Our actions serve to protect Delaware's historical, cultural, economic and natural resources heritage.
- Our decisions are based on sound science, the law and ethical standards.
- Our actions will empower individuals, communities and others to further their efforts toward sustainable stewardship of Delaware's historical, cultural, economic and natural resources.
- We value environmental awareness and education for inspiring Delawareans to embrace a conservation ethic.

Customer Service

- We are committed to the delivery of quality services, resource information and technical assistance.
- Public participation is essential to the development and ongoing improvement of programs.
- We are committed to creating a safe, healthy and rewarding experience for all who use and enjoy Delaware's coastal resources.

Performance Excellence

- We value our human resources and help them to achieve the most in their professions by encouraging skill development, building diversity and embracing institutional knowledge.
- We foster a culture that practices continuous improvement throughout the workplace.
- We take advantage of emerging technology to enhance our productivity and the quality of our services.

Delaware NERR Programs

DNERR is operationally divided into three sectors: education, research, and stewardship. Each sector is devoted to fostering that aspect of the program, under the guidance of the Reserve manager and according to the management plan. The Education sector, through the Community Public Education and Outreach, K-16 Estuarine Education Program (KEEP) and the Coastal Training Program (CTP) and activities, promotes stewardship of Delaware's coastal resources by increasing understanding and awareness of estuarine systems and improved decision-making among key audiences. The Research sector addresses scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated research program including site-directed research, monitoring, the NERRS System Wide Monitoring Program (SWMP), and the Graduate Research Fellowship (GRF) Program. The Stewardship sector is involved in a wide range of activities including land acquisition, ecological restoration, resource inventories, watershed management projects, endangered species protection, visitor use management, regional planning, policy development and more. Each sector supports the overall mission of the Reserve to promote informed management and stewardship of Delaware's estuarine and coastal habitats.

Delaware NERR Component Descriptions

The Delaware NERR was established as a multi-component Reserve (Map 3). Two components, the St. Jones Reserve and Blackbird Creek Reserve which are about 30 miles apart are characterized by tidal rivers or creeks traversing extensive tidal wetlands classified as Washover Barrier Marsh Systems, typical of the lower and middle-western Delaware Bay. These components include both brackish and freshwater estuaries, and represent the diverse estuarine ecosystems found throughout the Mid-Atlantic subregion of the Virginian biogeographic region.

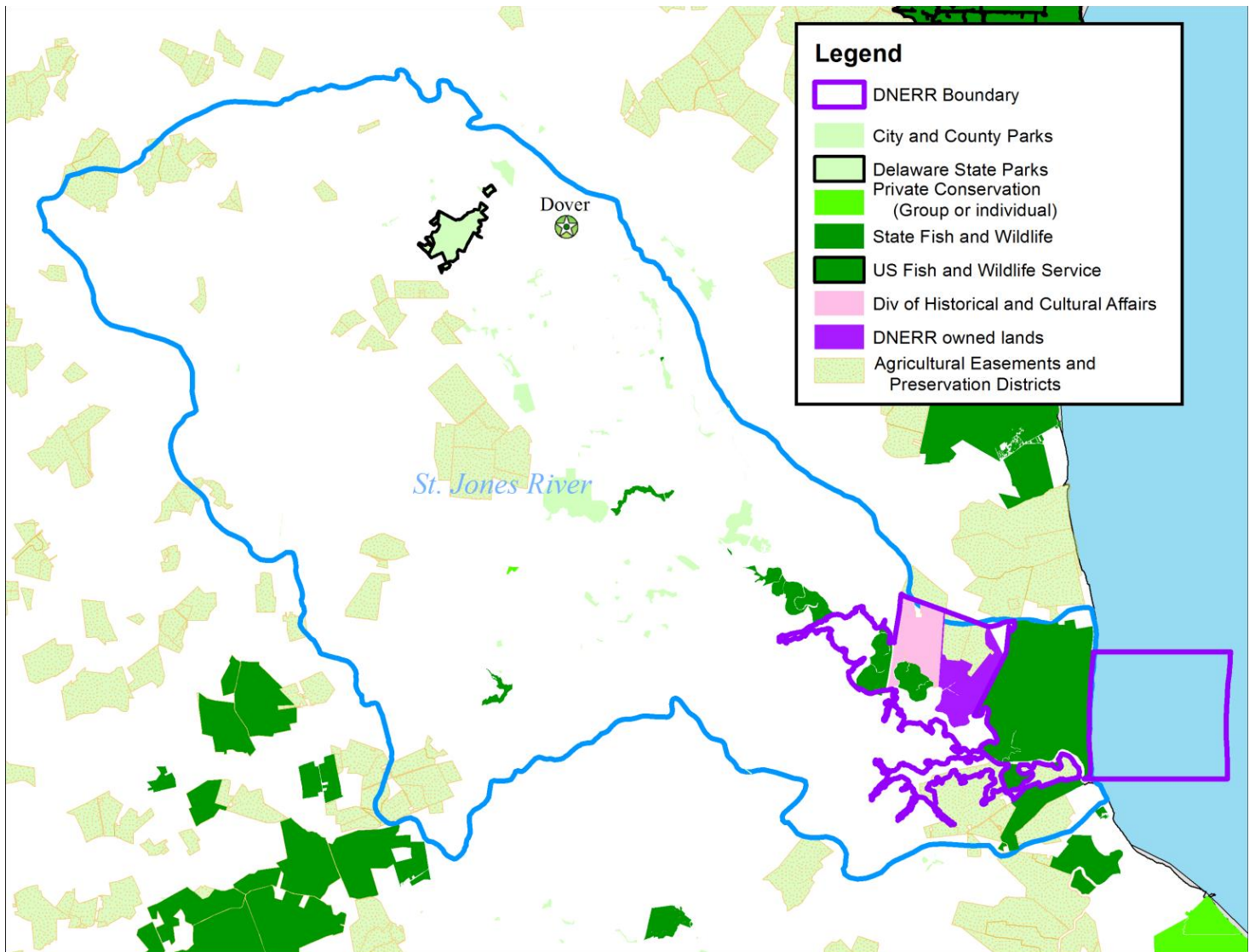
St. Jones Reserve



Location and Description

The St. Jones Reserve component is about 5,119 acres in designated size, situated along 5.5 miles of medium-salinity tidal river at the lower end of the St. Jones River watershed, and includes about 2,375 acres of Delaware Bay subtidal bottom and near-shore waters, running for 2 miles along the Ted Harvey Conservation Area's bay shoreline and extending outward 2 miles into the open bay of the Delaware Bay watershed.

The St. Jones Reserve component contains 69 parcels of land held by 63 private landowners, the DNERR, and two other state agencies (the Division of Fish and Wildlife and the Division of Historical and Cultural Affairs). Within the St. Jones site's designated boundaries, about 698.5 acres of tidal marshes, upland fields, woodlots, and croplands were purchased or protected by the DNERR in 1991-1992 (431.3 acres purchased through fee-simple acquisition, and approximately 266 acres protected through conservation easement). The remaining majority of the St. Jones Reserve component is still in private ownership.



Map 4. Map of St. Jones River Watershed, boundary

The State exercises direct management control of the designated lands through ownership, conservation easement or legislative authority including the State Wetlands Act (7 Del. C. Chapter 66), Delaware Coastal Zone Act of 1971 (7 Del. C. Chapter 70), Subaqueous Lands Act, (7 Del. C. Chapter 72), Delaware Antiquities Act (7 Del. C. Chapter 53), The 1978 Natural Areas Preservation System Act (7 Del. C. Chapter 73), Conservation easement (7 Del. C. Chapter 69), Erosion and Sedimentation Control and Stormwater Management (7 Del. C. Chapter 40), Sediment and Stormwater Regulations, Endangered Species Act, (7 Del. C. Chapter 6), Wildlife and Fish Management (7 Del. C. Chapters 1-27), Hunting and Fishing Regulations, Environmental Protection Act (7 Del. C. Chapter 60), Land Use and Zoning Restrictions – New Castle County, Kent County, Public Lands, and State Parks (9 Del. C. Chapter 26, Chapter 30, Chapter 48, Chapter 49) (7 Del. C. Chapter 45, Chapter 47). (Appendix E) At the time of Reserve designation all private landowners were informed that a portion of their property was to be included in the Reserve boundaries. The Reserve must receive permission from any private landowners to conduct research or education on their property.

Located in Kent County, the St. Jones River covers 57,643 acres of the Delaware Bay Basin. The St. Jones River is dammed at Silver Lake in Dover and then winds approximately 10.5 miles through residential and commercially developed areas, until it reaches the Reserve and Ted Harvey Wildlife Area before emptying into the Delaware Bay. The Delaware Bay and Estuary basin drains approximately 520,960 acres or 814 square miles from the Delaware River in New Castle County to the Broadkill River in Sussex County.

Adjacent to the St. Jones Reserve component on its eastern side is the Ted Harvey Conservation Area, owned and managed by DNREC's Division of Fish and Wildlife (DFW), consisting of 2,019 acres of woodlands, upland fields, croplands, freshwater ponds and wetlands, coastal wetland impoundments, and Delaware Bay shoreline. Although the Ted Harvey Conservation Area is not within the designated Reserve boundaries, it is nonetheless available through cooperative arrangements with the DFW for use in DNERR research and educational activities. The DFW's Roberts Tract, a 176-acre parcel of the Little Creek State Wildlife Area, borders the St. Jones Reserve component at its western end. In conjunction with the Ted Harvey Conservation Area, the Roberts Tract provides conservation-oriented land ownership on both upstream and downstream ends of the St. Jones site.

A small boat ramp and fishing pier at Scotton Landing, owned and managed by the DFW, provides good boat and water access to the main channel of the St. Jones River towards the reserve component's western end. On its far eastern end, the Delaware Bay sub-component of the St. Jones Reserve component also contains about 2,375 acres of Delaware Bay subtidal bottom and near-shore waters, running for 2 miles along the Ted Harvey Conservation Area's bay shoreline and extending outward 2 miles into the open bay.

A total of 32 prehistoric archeological sites in upland areas fringing the St. Jones River marsh have been reported in the Cultural Resource Survey. Historic period sites in the reserve component include the earliest settlements in Kent County (i.e., Kingston-Upon-Hull and Town Point), and present an opportunity to study an early period of European settlement, removed from population centers in New Castle and Philadelphia.

The historic John Dickinson Plantation and Mansion, owned and managed by the Delaware Division of Historical and Cultural Affairs, provides another 262.8 acres of protected area within the Reserve's designated boundaries, adjacent to the DNERR property's western border. Dover Air Force Base is a considerable presence on the north/northwestern sides of the Reserve. The largest tributaries of the Lower St. Jones River Reserve component are Trunk Ditch, Beaver Gut Ditch, and Cypress Branch, all entering on the south side of the St. Jones River.

The St. Jones River watershed has significant development in upstream non-tidal areas, where urbanized Dover (Delaware's State Capital) dominates the middle and upper watershed. However, downstream portions of the St. Jones River watershed, where the Lower St. Jones River Reserve component is located, are still primarily agricultural.

The Delaware Bay sub-component to the St. Jones Reserve component provides extensive intertidal and subtidal research opportunities in the Delaware Bay. This area is representative of much of the western Delaware Bay waterfront and nearshore. It is one of the preferred spawning areas for horseshoe crabs and the consequential foraging area of migratory shorebirds.

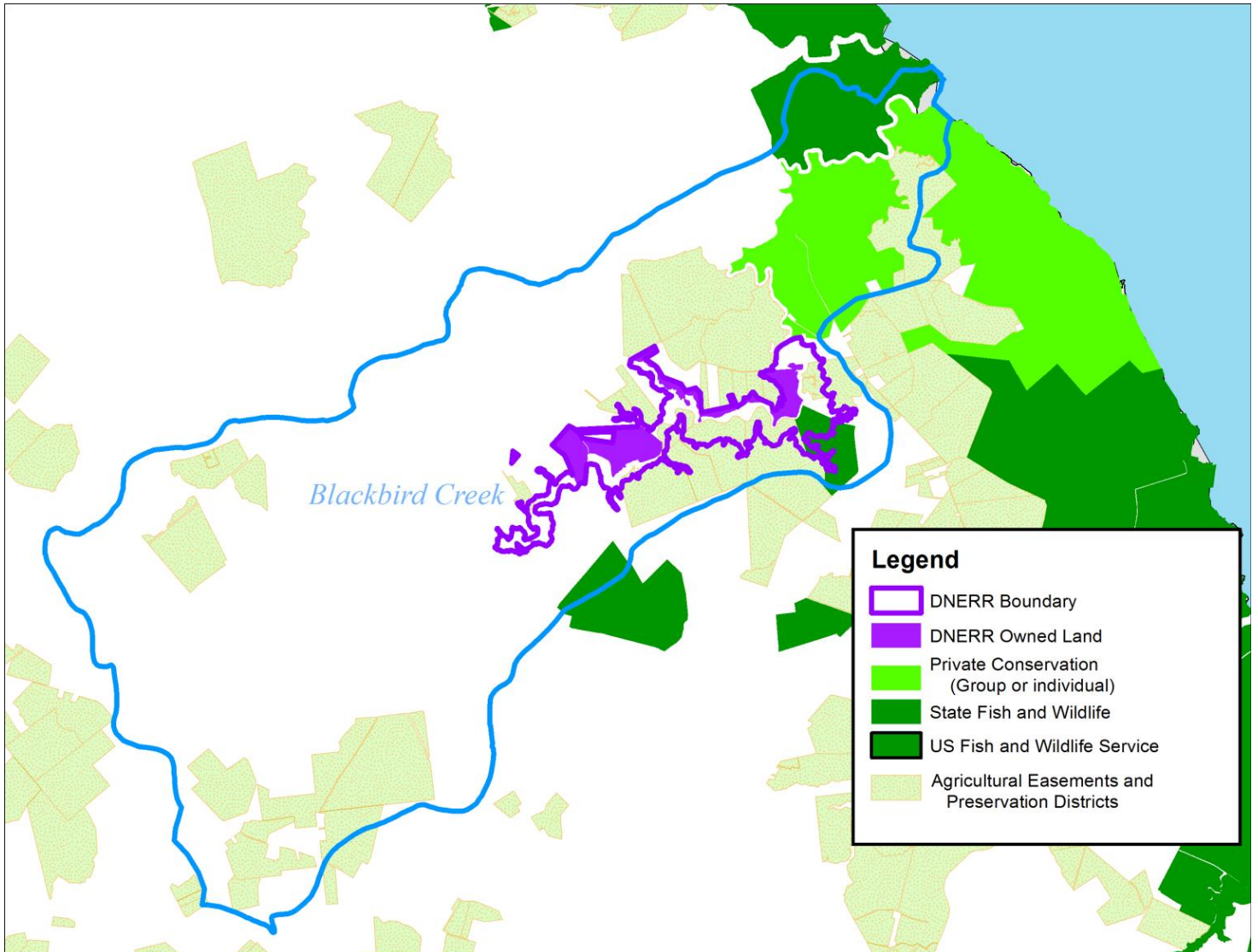
Blackbird Creek Reserve



Location and Description

The Blackbird Creek Reserve component is 1,087 acres in designated size, situated along 5.7 miles of low-salinity brackish and freshwater tidal creek, starting about 5.8 miles upstream from where Blackbird Creek empties into the Delaware Bay. The total length of tidal Blackbird Creek is about 11.5 miles.

The Blackbird Creek Reserve component contains 62 parcels of land held by 55 private landholders, plus the DNERR and the Division of Fish and Wildlife. Within the Blackbird Creek site's designated boundaries, about 212 acres of tidal marshes, upland fields, woodlots, and croplands were purchased by the DNERR in 1990. An additional 183 acres of tidal marsh, woodlands, and croplands, across Blackbird Creek from the DNERR property and within the Reserve's designated boundaries, were purchased in 1996 by DNREC's Division of Fish and Wildlife (as part of the Division's Cedar Swamp Wildlife Area), and is available for use in DNERR activities. In 2003, an 8 acre parcel was added to the Reserve to improve public access to the Blackbird Creek. In 2004, 62 acres was added at 801 Blackbird Landing Road, and in February 2005 85 acres were added at 803 Blackbird Landing Road. Two additional properties, totaling 64 acres, were acquired in late 2005 and 2011. They will be incorporated into the Reserve boundaries with the approval of this plan (See Stewardship Plan – Boundary Amendment page 105 for details). The remaining majority of the reserve component is still in private ownership.



Map 5 – Map of Blackbird Creek Watershed and Boundary

The State exercises direct management control of the designated lands through ownership or legislative authority including the State Wetlands Act (7 Del. C. Chapter 66), Delaware Coastal Zone Act of 1971 (7 Del. C. Chapter 70), Subaqueous Lands Act, (7 Del. C. Chapter 72), Delaware Antiquities Act (7 Del. C. Chapter 53), The 1978 Natural Areas Preservation System Act (7 Del. C. Chapter 73), Conservation easement (7 Del. C. Chapter 69), Erosion and Sedimentation Control and Stormwater Management (7 Del. C. Chapter 40), Sediment and Stormwater Regulations, Endangered Species Act, (7 Del. C. Chapter 6), Wildlife and Fish Management (7 Del. C. Chapters 1-27), Hunting and Fishing Regulations, Environmental Protection Act (7 Del. C. Chapter 60), Land Use and Zoning Restrictions – New Castle County, Kent County, Public Lands, and State Parks (9 Del. C. Chapter 26, Chapter 30, Chapter 48, Chapter 49) (7 Del. C. Chapter 45, Chapter 47). At the time of Reserve designation all private landowners were informed that a portion of their property was to be included in the Reserve boundaries. The Reserve must receive permission from any private landowners to conduct research or education on their property.

The Blackbird Creek watershed drains a portion of southern New Castle County roughly 31 square miles into the Delaware Bay and is dominated by forest, wetlands and agriculture. It is primarily used for fishing, boating, research and hiking.

The largest tributary of the upper creek segment is Beaver Branch, entering on the north side of Blackbird Creek about midway within the Reserve. Downstream of the seaward end of the Reserve, from Taylors Bridge to Delaware Bay, Lower Blackbird Creek passes by Red Bank and Stave Landing before reaching the bay. Much of the expansive tidal marshes and upland borders along Lower Blackbird Creek, downstream of the Blackbird Creek Reserve component's designated boundaries, primarily consisting of a large parcel known as The Rocks (which is also part of the Cedar Swamp State Wildlife Area), are owned and managed by DNREC's Division of Fish and Wildlife (DFW). Upstream of the reserve component, in non-tidal areas west of Route 13, are extensive areas of forested wetlands containing unique coastal plain ponds ("Delmarva Bays"), much within Blackbird State Forest, which is managed by the Delaware Forest Service.

A total of 73 prehistoric archaeological sites in upland areas fringing Blackbird Creek Marsh were reported in the Cultural Resource Survey maintained by the Delaware Bureau of Archaeology and Historic Preservation. Blackbird Creek uplands and stream courses were intensively used from 3000 B.C. to A.D. 1000. Changes in settlement patterns from A.D. 1000 to A.D. 1650 focused primarily on estuarine resources in the floodplain, rather than in upland areas. The earliest historic period settlement in the Blackbird Creek is the Huguenot House (built in the first quarter of the 18th century), which is listed on the National Register of Historic Places. Blackbird Creek's watershed is still primarily agricultural or forested, although low-density residential development is increasing.

Special Designations of the Delaware National Estuarine Research Reserve

Ramsar Wetlands

The Convention on Wetlands came into force for the United States of America on 18 April 1987. The Delaware Bay Estuary was designated in 1992. The site consists of more than 70 separate protected wetlands areas of varying salinity supporting various marsh communities.

Western Hemisphere Shorebird Reserve Network

The Western Hemisphere Shorebird Reserve Network (WHSRN) is a conservation strategy launched in 1986 with the designation of the first site, Delaware Bay. The extensive wetlands in the Delaware River Estuary provide excellent resting habitat and nesting sites for many species of migratory waterfowl, bald eagles, ospreys, northern harrier, waders, and migrating raptors. The area functions as a major staging area for 80% of the Atlantic flyway populations for Snow Geese. Delaware Bay is also the site of the largest spawning concentration of horseshoe crabs along the Atlantic coast.

America's Great Outdoors, Delaware National Bayshore

President Obama launched the America's Great Outdoors (AGO) Initiative on April 16, 2010, to foster a 21st-century approach to conservation that is designed by and accomplished in partnership with the American people. In 2011, the America's Great Outdoors Fifty-State Report summarizes project ideas in each state for the Department of the Interior and other federal agencies to partner with state and local governments and other stakeholders on a shared conservation and recreation agenda. The Delaware Bayshore was included in this report as being widely recognized area of global ecological significance. Extensive coastal marshes, beaches, and agricultural lands annually support more than a half-million shorebirds during both spring and fall migration. This makes the Bayshore one of the best birding and hunting areas on the East Coast. More than half of the Bayshore region is protected as refuges, wildlife areas, agriculture preserves, parks, and cultural heritage sites. Potential action identified in the report includes collaborating to conserve and restore the Delaware Bayshore and to enhance recreation. Evaluate the possibility of designating the area as the first National Bayshore.

Delaware Bayshore Initiative

Extending from Pea Patch Island in New Castle County to the City of Lewes in Sussex County, the Delaware Bay shoreline is widely recognized as an area of global ecological significance. Its expansive coastal marshes, shoreline, agricultural lands and forests provide diverse habitat to many species, including migratory shorebirds. Birders and biologists from around the world come to central Delaware to witness the annual spring spectacle of more than a half million shorebirds taking a rest stop to dine on eggs laid by spawning horseshoe crabs.

The Delaware Bayshore Initiative will collaboratively build on the region's reputation as a unique and beautiful natural resource, and help improve the shoreline economy by encouraging more Delawareans and visitors to enjoy it through activities such as recreational fishing, hunting, boating and ecotourism. This non-regulatory approach will continue the tradition of DNREC's commitment to preserving the state's coastal zone, which has been protected by Delaware's Coastal Zone Act for the past 40 years. Due in large part to the legacy of that landmark legislation, more than half of the Delaware Bayshore's acreage remains undeveloped, and is today protected as state or federal wildlife lands.

By building on public-private partnerships and leveraging state, federal and private resources, the Bayshore Initiative targets three major areas for improvement:

- Conservation and ecological restoration – Connect wildlife areas by acquisition or easement of unprotected lands; restore native habitat; and protect resources.
- Recreation and connectivity – Focus strategic investments to connect wildlife areas to urban centers; maximize enjoyment of the outdoors by providing safe, healthy recreational experiences; and enhance access to wild areas.
- Engagement and marketing – Engage, educate and inspire the next generation of environmental stewards; partner with local communities and organizations to promote the area regionally, nationally and internationally; and promote local volunteerism.

In addition to economic benefits, the Delaware Bayshore Initiative stands to improve quality of life through enhanced outdoor recreational opportunities; to provide students with outdoor living classroom educational options; and to help prepare Delaware for future climate changes and impacts. It was recently recognized by the U.S. Department of the Interior as one of the country's most promising ways to reconnect Americans to the natural world.

National Estuary Program

In 1988, Governor Mike Castle of Delaware, Governor Robert Casey of Pennsylvania, and Governor Tomas Kean of New Jersey nominated the Delaware Estuary for inclusion in the National Estuary Program established by Section 320 of the Water Quality Act of 1987 based on its regional and national importance as an environmental and economic resource. In response, hundreds of organizations and dedicated citizens worked together with local, state, regional, and federal agencies to create the Comprehensive Conservation Management Plan for the Delaware Estuary identifying the most significant environmental issues/needs and strategies to address them. In 1996, the Delaware Estuary's inclusion in the National Estuary Program was made official with acceptance of this plan and a pledge to work collective to implement it by the Governors of Delaware, New Jersey, and Pennsylvania and the Regional Administrators of Regions 2 and 3 of the U.S. Environmental Protection Agency. The Delaware Estuary Program (DELEP) was originally administered by the Delaware River Basin Commission, but DELEP responsibilities were transferred to the tri-state non-profit organization Partnership for the Delaware Estuary in 2004 to provide greater flexibility, identity, and fundraising capacity.

St. Jones Greenway

The St. Jones River Greenway is a planned 14 mile long riverside pathway linking the Greater Dover, Central Kent County area to the Delaware Bay. The Greenway will connect isolated residential communities, the City of Dover and recreation areas along the St. Jones River. Kent County residents will have access to a pathway designed for pedestrians and bicyclists, providing a choice of a non-vehicular means of commuting to work, accessing services and visiting family and friends. The greenway will also offer recreational, natural resource, cultural and educational experiences. The St. Jones Reserve falls under the Bay segment of the Greenway.

Coastal Heritage Scenic Byway

The Route 9 Coastal Heritage Scenic Byway (designated by DNREC as a Coastal Heritage Greenway in 1992) winds along the north and central Delaware coast, passing through several wildlife refuges and areas. The byway begins in the historic city of New Castle and ends just south of the Dover Air Force Base near the entrance to the Division of Historic and Cultural Affairs John Dickinson Plantation and the St. Jones Reserve. The two-lane, north-south road runs 52 miles, paralleling the western shore of the Delaware River and Bay and offers an intimate interaction with one of the largest area of preserved coastal wetlands on the east coast.

National Historic Landmarks within the Boundary of the Reserve

John Dickinson House, Dover, Del. Listed Jan. 20, 1961. Built in 1740, this house, known as Poplar Hall, was the childhood home, and later, the country estate of John Dickinson, "Penman of the Revolution," president of Delaware, chairman of the Annapolis Convention and one of Delaware's five signers of the U.S. Constitution.

Blackbird Millington Corridor

A band of open space stretches across the Delmarva Peninsula, from the Cypress Branch and Millington area in Maryland to the Delaware Bay at the mouth of the Blackbird Creek. This area - the Blackbird-Millington Corridor - is recognized by The Nature Conservancy and other conservation organizations as a regional conservation priority based on 3 factors:

- 1) There is a concentration of important ecological features and natural communities
- 2) Private landowners have a history of balanced stewardship in the Corridor
- 3) There is a solid foundation for conservation.

Over 30 organizations and 150 local residents in 2004 worked to develop the Blackbird-Millington Corridor Conservation Area Plan for conserving the region's natural and rural heritage.

ADMINISTRATIVE PLAN





ADMINISTRATIVE PLAN OVERVIEW

The goal of the Delaware National Estuarine Research Reserve (DNERR) administration is to improve the operations, infrastructure, and stature of the DNERR to better support and enable the education, research, and stewardship programs. The administration of the DNERR supports and enables the implementation of the education, research, and stewardship programs to fulfill its mission. Administration is defined for the purposes of this management plan as working with the National Oceanic and Atmospheric Administration (NOAA), Department of Natural Resources and Environmental Control, Delaware Coastal Programs (DNREC/DCP) and partner agencies to fulfill the DNERR mission and meet agency mandates, assessing and addressing infrastructure needs, appropriately staffing the Reserve and providing staff with the skills and resources necessary to perform their jobs.

Reserve administration also provides long-term direction and vision for the program. These duties form the administration plan and include the facilities plan and staffing plan.



ADMINISTRATIVE FRAMEWORK

The administration of the DNERR is achieved through a collaborative process involving the following agencies and organizations: NOAA, Department of Natural Resources and Environmental Control, and partners.

National Oceanic and Atmospheric Administration

The National Estuarine Research Reserve System (NERRS) operates as a federal-state partnership. State partners manage the individual Reserves and NOAA's Office of Ocean and Coastal Resource Management provides direction, funding, and review for the System and individual Reserves through the Estuarine Reserves Division and the National Policy and Evaluation Division.

Estuarine Research Reserves Division

Direction is provided by the Estuarine Reserves Division (ERD) through the NERRS Strategic Plan and regular interaction with Reserve managers and sector coordinators. Daily coordination between the federal and state partners is provided by ERD program specialists. The program specialist communicates directly and regularly with Reserve staff building a level of trust between the partners and familiarizing the federal and state personnel with Reserve management procedures and policies. Section 315 of the Coastal Zone Management Act (CZMA) provides non-competitive operations funding and competitive construction and acquisition funding for the System.

ERD administers these funding programs and program specialists review operations work plans and performance reports to ensure compliance with program policies and special award conditions. ERD also provides technical assistance and oversight of system-wide programs including the System-wide Monitoring Program, K-12 Estuarine Education Program, Graduate Research Fellowship, and the Coastal Training Program.

National Policy and Evaluation Division

The National Policy and Evaluation Division conducts performance evaluations on the operation and management of individual Reserves pursuant to sections 312 and 315 of the CZMA. The purpose of NOAA review is to ensure that a state partner is complying with NERRS goals, approved funding awards and work plans, and Reserve management plans. Deficiency findings must be addressed in operation awards and management plan updates in an appropriate and timely manner to avoid withdrawal of National Estuarine Research Reserve designation.

Delaware Department of Natural Resources and Environmental Control

The state partner in the DNERR federal-state partnership is the Delaware Department of Natural Resources and Environmental Control (DNREC), Office of the Secretary (OTS), Delaware Coastal Programs (DCP). The organizational chart for DNREC/DCP is presented in Figure 3.

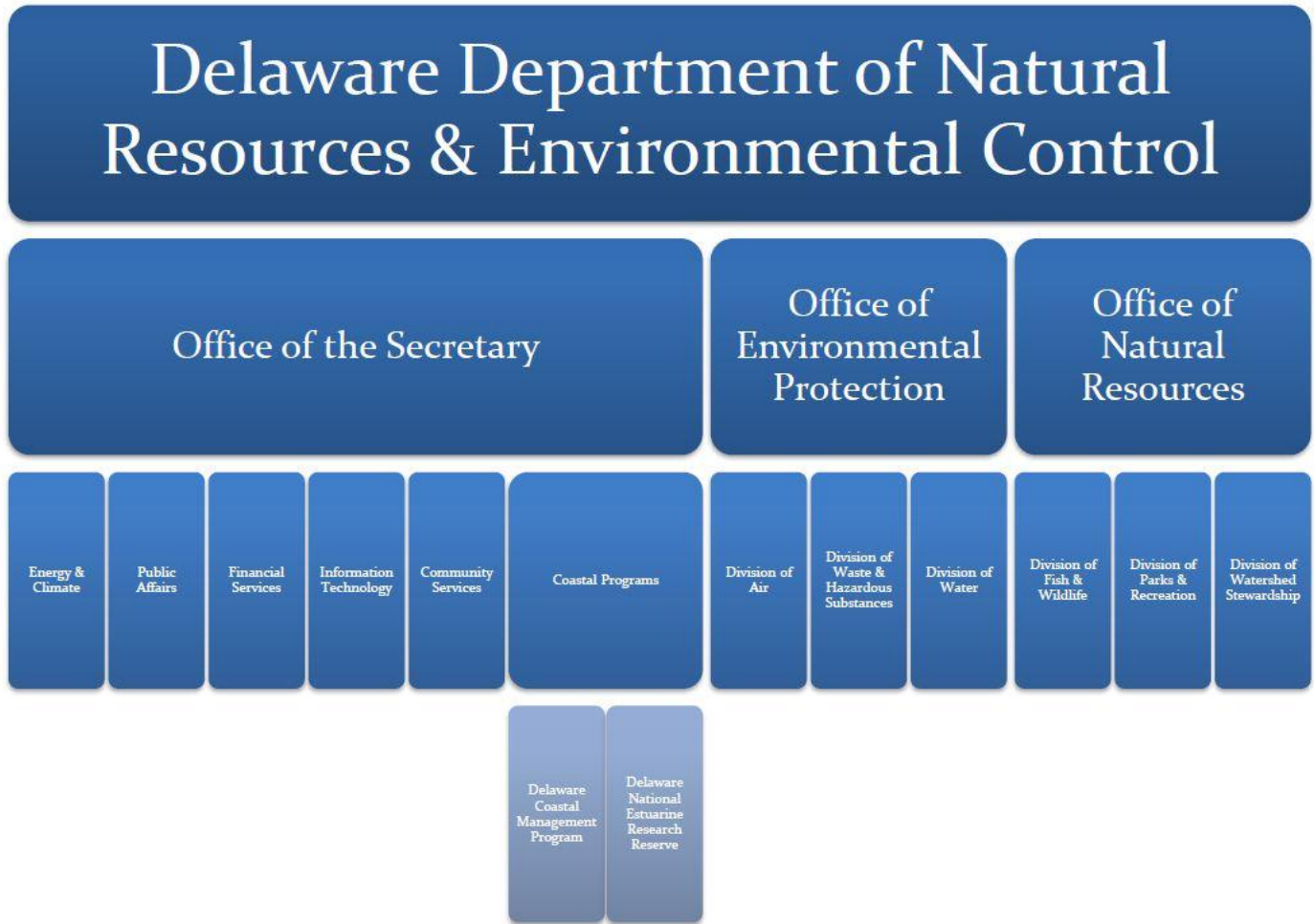


Figure 3: Organizational Chart for the Delaware Department of Natural Resources and Environmental Control

Delaware Coastal Programs

The DCP is an appropriate state partner for the DNERR because:

- Both organizations have similar missions as both are authorized by CZMA legislation to protect coastal resources through education, research, and stewardship programs, albeit the mechanisms through which these programs are conducted are different;
- DCP administers associated CZMA authorized programs that receive funding under sections 306, 306A, 309, 310 and the Coastal and Estuarine Land Conservation Program;
- Reserve education, research, and stewardship programs seek to address pertinent coastal management issues;
- The results of Reserve education, research, and stewardship programs are directly accessible to the DCP and the coastal management community; and
- The Reserve benefits from the 309 program, land use planning, policy and regulatory programs, and has direct involvement in coastal management issues.

Advisory Committees

Advisory Committees serve as advisory groups through which local citizens and partners work with DNERR staff to provide feedback and recommendations on site management, research, and education activities, and review management plan policies and implementation strategies. These committees function as both ad hoc and standing committees.

Management Advisory Committee

The DNERR Management Advisory Committee is structured and functions on an ad hoc basis and typically represents many of the Federal, State, county, and local agencies, commissions, societies, and organizations that may have an interest in, impact, or be impacted by the development and management of the Reserve. The role of this committee is to provide assistance to the DNERR staff in the decisions required to implement the management plan. Assistance is especially valuable in the operations of the Reserve's programs. The committee ensures that Reserve goals are realistic and keep pace with relevant issues.

Research Advisory Committee

The DNERR Research Advisory Committee is structured and functions on an ad hoc basis, led by the Research Coordinator and typically includes representatives from the DNREC and the academic and scientific communities. Committee members provide advice on research and technical matters relevant to achievement of the DNERR Research and Monitoring Program goals and objectives.

Education Advisory Committee

The DNERR Education Advisory Committee is structured and functions as a standing committee, led by the Education Coordinator, who meet annually or more frequently as needed. The members of this committee are selected from various educational and environmental interests in the State. The Education committee is responsible for providing guidance for the implementation of a comprehensive estuarine education program, which is a long-outstanding need in Delaware

Coastal Training Advisory Committee

The DNERR Coastal Training Advisory Committee is structured and functions as a standing committee, led by the Coastal Training Coordinator, composed of stakeholders who meet annually or more frequently as needed. The members of this committee are selected from various state, academic and NGOs that work on coastal management issues in the State. The Coastal Training Program committee is responsible for providing guidance for the implementation of a comprehensive Coastal Training Program.

Partnerships

Partnerships are essential to organization relevancy and growth. The DNERR maintains a variety of partnerships to accomplish its mission and will continue to do so through current Memoranda of Understanding and collaborative projects (Appendix G).



STAFFING PLAN

Current Staff Responsibilities and Duties

The Reserve Manager, Research Coordinator, and Education Coordinator are core staff positions prescribed by the NERRS, and assume major responsibilities in the function of the Reserve (Figure 4). Reserve staff offices are located in the Reserve headquarters at the St. Jones Reserve component and the Stewardship Center at the Blackbird Creek Reserve.

Management Staff

Reserve Manager (100% state funded):

- Provides overall coordination of Reserve operations and programming
- Ensure the policies in the management plan are followed and that Reserve programs successfully meet the mandates of the NERRS and the DCP
- Seek and administer federal and other grants, contracts, and state budget appropriations
- Provide oversight and coordination of education, research and monitoring, and stewardship programs
- Develop and maintain partnerships with local, state, and federal agencies, groups and individuals to enhance DNERR exposure and capacity
- Supervision of NERR staff
- Responsible for all activities, land management, acquisition, and facilities within the Reserve boundaries

Education Staff

Education Coordinator (100% federal funded):

- Manage the K-16, teacher professional development, community outreach programs, bringing estuarine and watershed concepts and science to these audiences, in accordance with the DNERR management plan and NERRS and DCP mandates
- Develop and maintain partnerships to enhance education programs
- Represent the DNERR at local, state, and national levels
- Coordinate with the Coastal Training Program Coordinator to ensure education programs are complementary
- Translate research and monitoring results for incorporation into education programs with research staff
- Oversee development of all educational materials
- Assist management, research and stewardship programs as needed

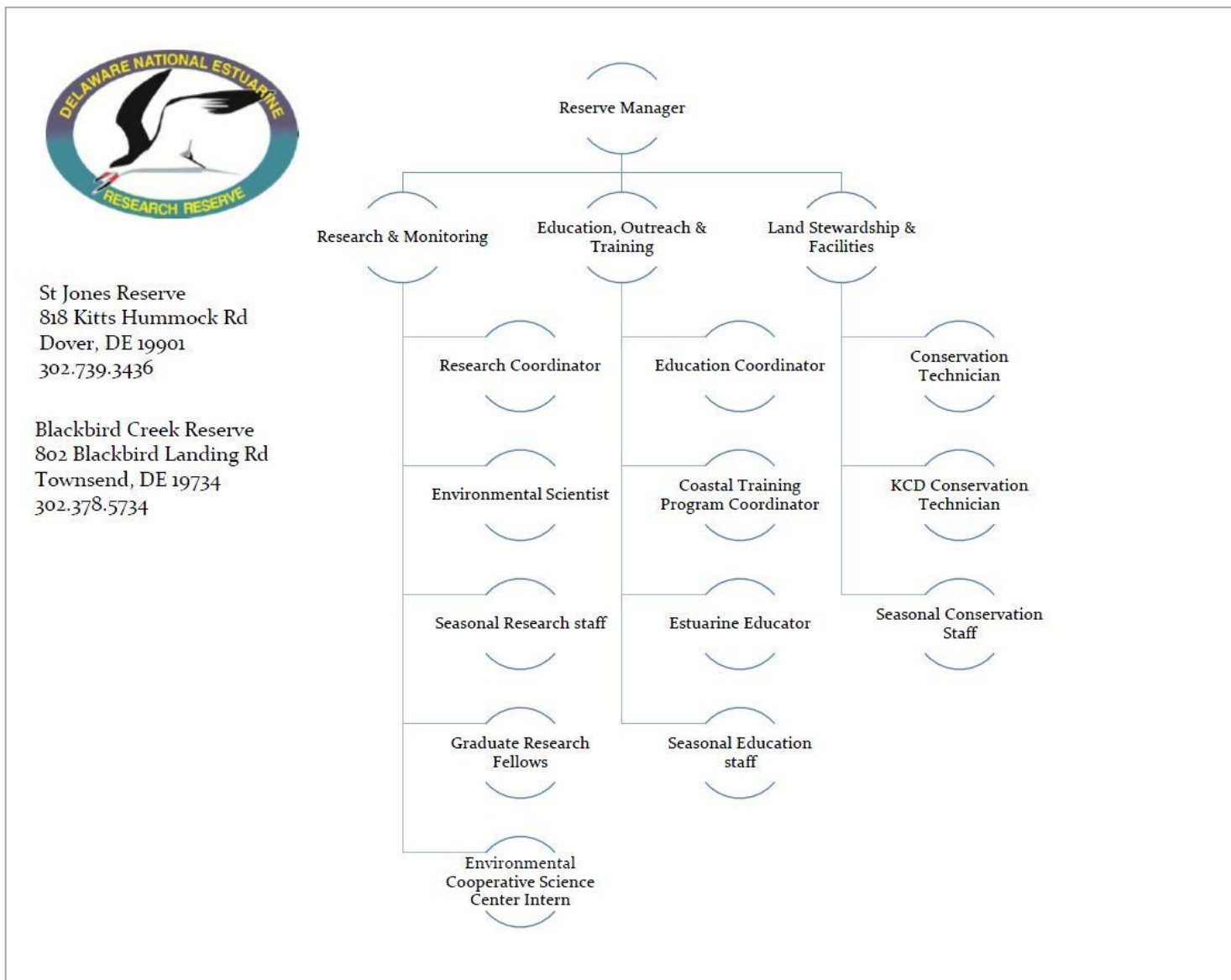


Figure 4: Staffing Chart for the Delaware National Estuarine Research Reserve

Coastal Training Program Coordinator (100% federal funded):

- Develop and produce workshops for coastal decision-makers based on formal and informal needs assessments in accordance with the DNERR management plan and NERRS and DCP mandates
- Develop and maintain partnerships to enhance the CTP
- Represent the DNERR at local, state, and national levels
- Coordinate with the Education Coordinator to ensure education programs are complementary
- Translate research and monitoring results for incorporation into the CTP with research staff
- Develop CTP-related materials
- Assist with education program events as needed
- Assist management and research and stewardship programs as needed

Estuarine Educator (100% federal funded):

- Conduct K-16 student field based estuarine science education and outreach programs
- Develop materials for K-16 and teacher programs
- Assist the public community programs
- Represent DNERR at festivals and meetings
- Assist management and research and stewardship programs as needed

Research Staff

Research Coordinator (100% federal funded – split between DNERR and DCMP):

- Manage the research and monitoring programs, focusing on high priority coastal management needs, in accordance with the DNERR management plan
- Develop and maintain partnerships to further research programs
- Oversight of Graduate Research Fellows
- Represent the DNERR at local, state, and national levels
- Translate research and monitoring results for incorporation into education programs with education staff
- Assist with and stewardship and education programs as needed

Environmental Scientist (100% federal funded):

- Implement the System-wide Monitoring Program in accordance with NERRS and the Centralized Data Management Office (CDMO) requirements
- Procure and maintain SWMP equipment and supplies
- Deploy equipment as scheduled
- Quality Assurance /Quality Control data and prepare annual reports for submittal to CDMO
- Perform data analysis with Research Coordinator
- Assist the Research Coordinator with developing and maintaining partnerships to further research programs
- Assist the Research Coordinator with grant proposals, preparation of manuscripts for publication, presentations and other outreach activities
- Assist with Reserve research projects
- Assist with stewardship and education programs as needed

Stewardship Staff

Conservation Technician (100% federal funded):

- Manage the stewardship program (managing the DNERR components for research, education, and compatible traditional uses) in accordance with the DNERR management plan and NERRS and DCP mandates
- Manage the St. Jones Reserve and Blackbird Creek Reserve facilities and lands of the DNERR
- Develop and maintain partnerships to enhance stewardship programs
- Coordinate with the Manager on site management policies and issues
- Assist with community outreach and education programs as resources allow
- Assist with research at the components in conjunction with research staff

Seasonal Positions (funding varies)

Seasonal positions, including the Environmental Cooperative Science Center interns and Kent Conservation District (KCD) position, are utilized in the Research, Education and Stewardship programs at the DNERR based upon programming needs.

Volunteers

The operation of many DNERR programs has the potential to be enhanced by a well-structured volunteer effort. Development of a volunteer program began in earnest in the year 2000. It was determined that “volunteers” generally fall into one of two categories: one-time task-oriented groups (usually scouts or community service organizations), or individuals making a longer-term commitment, who would receive larger amounts of responsibility. Task-oriented volunteers are utilized when they express interest. There has been successful participation by scouting groups, day schools, and juvenile rehabilitation programs. Projects and responsibilities for long-term volunteers are being developed.

Volunteer activities have included:

- Conducting horseshoe crab spawning surveys
- Guiding field trips for school children
- Adopting and cleaning a 2-mile stretch of road along the Blackbird Creek Reserve component
- Maintaining trails
- Landscaping around the Reserve
- Assisting with restoration projects (invasive removal, tree plantings)
- Assisting with Native Plant Nursery
- Assisting with marsh research
- Assisting with Herbarium specimen collection and mounting

Cooperative Efforts and Partnerships

The DNREC recognizes the need for cooperation and coordination in order to achieve the objectives of the DNERR’s management plan and takes an integrated approach. The Reserve Manager ensures that the functions required implementing this plan – education and research activities, land acquisition, facilities development, and resource protection – are coordinated with the agencies, organizations, and landowners presently active within the Reserve’s components. The Reserve Manager acts as the liaison between outside entities and the Reserve, calling upon the Education Coastal Training and Research Coordinators as appropriate. In coordinating with other regional institutions, authorities, and groups, the Reserve looks at those that can enhance the Reserve’s values while meeting and expanding their own environmental goals and objectives.

Given Delaware’s relatively small size, it is necessary for the DNERR to identify programs that can work cooperatively to more soundly address environmental issues within the Reserve and the State, making the most of limited time and resources. Wesley College and the University of Delaware have provided the DNERR with environmental intern candidates who have been well prepared for assisting with both research and education programs. Delaware State University cooperates with the DNERR for implementation of the Environmental Cooperative Science Center (ECSC) Program and has provided technical expertise in best management practices (BMPs). Numerous departments at the University of Delaware (UD) have coordinated various cooperative research and education programs. The DNERR regularly partners with UD’s Sea Grant and Cooperative Extension programs. Coast Day, held annually by UD’s College of Earth, Ocean and Environment (CEOE) and the Sea Grant Program, is one of the Reserve’s major annual partner outreach events. Cooperative Extension and the US Fish and Wildlife Service have assisted with Coastal Decision-Maker Workshops regarding the agricultural community and restoration practices. In addition, various environmental and cultural organizations including the Friends of the Dickinson Mansion, the Friends of the DNERR, the Delaware Native Plant Society, Partnership with the Delaware Estuary, Center for the Inland Bays, Delaware Wild Lands, The Nature Conservancy and Delaware Nature Society all work cooperatively with the Reserve to increase environmental and estuarine awareness in the State.

Staffing Needs

Stewardship Coordinator

The Stewardship Coordinator would be responsible for carrying out any necessary conservation planning, invasive species monitoring and control, and restoration. Outreach would also be an important role for the Stewardship Coordinator. Due to the fact that the majority of Reserve land is managed by other State agencies, private conservation groups, and landowners, the Stewardship Coordinator would be an essential link to ensure that land management strategies are made available to all. Currently, the Reserve Manager performs the duties of Stewardship Coordinator with the assistance of the Reserve Conservation Technician, Education Coordinator and Research Coordinator until such time that funds and a State position become available to hire a full-time Stewardship Coordinator. The availability and justification for adding a State position to the DNERR program is decided upon by the DNREC.

Volunteer Coordinator

The DNERR currently does not have any designated Volunteer Coordinator. The duties of managing volunteers fall to the Education Coordinator, Coastal Training Coordinator, Conservation Technician, Researchers and Manager. A part-time Volunteer Coordinator is needed to manage the Reserve's volunteer program, freeing up core staff time, and enhancing Reserve operations with consistent trained and motivated volunteers. The Volunteer Coordinator will: produce a volunteer needs assessment; write duty statements for each volunteer position or function; streamline the policies and procedures for recruiting, screening, and placing volunteers; determine volunteer recognition procedures and award scales; develop volunteer orientation and training programs, including a comprehensive docent training program; track and report volunteer hours; and recruit new volunteers through outreach to schools, non-profits, civic organizations, and businesses near the Reserve components.

Administrative Assistant

The DNERR currently does not have any designated administrative assistance located at the two Reserve components. The staff in each office has taken on many of the duties themselves to ensure operation of the office. As the program has grown, however, the time spent handling administrative duties such as ordering supplies, making copies, managing mail, and maintaining files, office equipment and vehicles, has increased. This will provide staff with more time for program development and implementation.



DELAWARE NERR ADMINISTRATIVE OBJECTIVES AND ACTIONS

Goal: Improve the operations, infrastructure and stature of the Reserve.

Administration

Objective 1: Implement an administrative framework that promotes collaboration to effectively operate the Reserve and take advantage of funding opportunities.

Action: Utilize Advisory Committees effectively.

The DNERR staff will work to seek guidance and input from the Reserve Advisory Committees as appropriate.

Action: Develop and maintain partnerships and collaborative efforts to fulfill the Reserve's mission.

The DNERR staff will work to keep current with partnerships and develop Memorandum of Understanding, Memorandum of Agreement, or Cooperative Agreements as appropriate.

Objective 2: Facilitate the development and implementation of clear policy direction and guidance in the management of the Reserve.

Action: Develop standard operating procedures for Reserve programming.

The DNERR staff will review existing operating procedures for Reserve programming and facility use and revise or develop standard operating procedures as deemed necessary.

Action: Improve awareness of Reserve policies.

The DNERR staff will update existing policies pertaining to the Reserve. Signs will be posted as appropriate at Reserve components and a full listing of policies will be added to the Reserve's website.

Staffing

Objective 3: Provide a stimulating professional environment to ensure that all staff members are adequately trained and strive for outstanding performance and interpersonal relationships.

Action: Promote and encourage the training of Reserve staff.

The DNERR will promote and encourage the training of the Reserve staff in areas that will benefit the capabilities of the Reserve and will follow State of Delaware training requirements. These areas could include GIS, statistics, data management, evaluation and research design.

Objective 4: Create opportunities for public participation that increase the understanding and stewardship of estuaries, expand the operational capacity of the Reserve, and provide meaningful experiences and benefits to participants.

Action: Enhance volunteer recruitment, retention and recognition strategies to attract, nurture, and retrain a dynamic group of volunteers diverse in age, interests, and talents who augment all aspects of the Reserve's programs.

Update and Evaluate Volunteer Training Program

The Education sector will work with the Stewardship staff to design and implement a community volunteer program. These individuals will work with the Reserve, other partners, and within their communities to champion the protection of coastal resources.

The first task is to identify volunteer needs of the Reserve and volunteer interests (phase 1) and update the volunteer training program (phase 2). This training program will be specific to the volunteer opportunity and will be conducted in conjunction with the other Reserve volunteer efforts. The training will reward volunteers and in turn benefit the DNERR by producing a more knowledgeable group of volunteers. As part of this task, evaluations of training and volunteer programs will be conducted (phase 3). This will provide valuable feedback in order to continue to improve the volunteer experience and assistance to the Reserve.

Implement Volunteer Program

The volunteer program will be implemented in phases in order to utilize staff time and resources effectively. The program will also require planning for volunteer recruitment, training, and recognition. Continued support is essential. A volunteer email list will be kept for each site. Volunteer forms that include contact information, skills, interests and availability will be used consistently across sites.

DNERR staff will provide continued support to the volunteer program. Staff will also develop on-site volunteer opportunities. There will be both publicly announced volunteer workdays and tasks where volunteers will be asked to participate based on skill level. Some examples of volunteer activities include leading field trips, planting trees, clearing trails, assisting in the Herbarium, and conducting established research surveys.

Increase On-Site Volunteer Opportunities

Volunteers will have more opportunities to help with program needs, visitor needs, and administrative tasks as the Reserve increases programming. In addition to individual volunteers, the community education and outreach program will maintain existing partnerships and establish new partnerships with environmental and service organizations to carry out Reserve-based projects.

FACILITIES AND PUBLIC ACCESS PLAN





PUBLIC ACCESS PLAN

General Access Policies

Public access to the Reserve is permitted on a site-specific basis. The objective of controlled access is to maintain each Reserve component's integrity for research, long-term resource protection, and education while permitting traditional uses that do not conflict with Reserve goals.

Entering or remaining on lands that are under the jurisdiction of the DNERR when such lands are closed, or entering or remaining within any building, structure, or facility when such building, structure, or facility is closed, shall be prohibited without a written permit from the Reserve Manager.

No structure, facility, building, or area administered by the DNERR will be used for any activity other than that for which it was intended without prior written permission of the Reserve Manager.

The Reserve Manager may limit or close specific public-use areas, lands, waters, and facilities, and/or temporarily prohibit certain activities when such action is deemed necessary for resource management, research, education, training and/or when it is in the best interest of health, safety, and the general welfare of the public.

The regulations of the NERRS allow for multiple uses of Estuarine Research Reserves to the degree compatible with each reserve's management plan and consistent with the mission and goals of the NERRS. The DNERR management plan focuses on maintaining areas as field laboratories and on developing a coordinated program of research and education. Public access is encouraged on those parts of the Reserve that are publicly owned or that have received private landowner permission, as long as it is not to the detriment of the resource or does not interfere with approved research. Public access may be restricted in key resource-protection areas.

Future research directed at identifying resources of concern (i.e., Federal or State cultural resources) will help delineate these protection areas as well as direct research, education programs, and overall Reserve management. The Reserve Manager will develop access policies and coordinate enforcement of regulations that will help maintain natural conditions and preserve resources.

Traditional use activities (hunting, fishing, and trapping) in the DNERR may continue up to levels currently permitted under local and State laws, or under regulations in place with property owners, as long as these uses do not unduly conflict with research or educational concerns and the harvests conform to legal practices and limits. All traditional use activities are regulated and permitted through the DNREC's Division of Fish and Wildlife (DFW). Potential conflicts can best be avoided by coordination and reasonable compromise. Care should be given to managing the impacts of traditional use activities occurring in rare-species habitats or in unique biotic communities. These traditional use activities are allowed only in designated areas.

Site-Specific Policies

St. Jones Reserve

The facilities at the St. Jones Reserve are open to the public and provide hiking trails, hands-on interactive activities and exhibits, a recycling center, restoration demonstration areas as well as a variety of programs and volunteer opportunities for the community, teachers, students and families. The Center also supports ongoing research and monitoring, field studies, citizen monitoring programs, and training opportunities for coastal decision makers.

The general public is permitted to access outdoor facilities at the St. Jones River Reserve component, such as the boardwalk, trail, and outdoor exhibits, from dawn to dusk on a year-round basis, except as restricted for special uses. All access is for identified facilities only during posted hours; free roaming through the site is not permitted without written approval of the Reserve Manager. All areas open to the public are handicapped-accessible. All groups are advised to contact the DNERR Education Coordinator or the Reserve Manager to arrange for special programs, guided tours, meeting space, or other uses of the Visitors Center or Reserve property.



Blackbird Creek Reserve

The facilities at the Blackbird Creek Reserve are open to the public and provide several miles of hiking trails through uplands and along the marsh, a canoe/kayak launch, restoration demonstration areas as well as a variety of programs and volunteer opportunities for the community, teachers, students and families. The Reserve also supports ongoing research and monitoring, field studies, citizen monitoring programs, and training opportunities for coastal decision makers.

The general public is permitted to access outdoor facilities at the Blackbird Creek Reserve component, such as the trails, and outdoor exhibits, from dawn to dusk on a year-round basis, except as restricted for special uses. All access is for identified facilities only during posted hours; free roaming through the site is not permitted without written approval of the Reserve Manager. Stewardship Center is open to the public and is handicapped-accessible. All groups are advised to contact the DNERR Education Coordinator or the Reserve Manager to arrange for special programs, guided tours, meeting space, or other uses of the Stewardship Center or Reserve property.



Boat and Canoe Access

Access for canoe and kayak launch or retrieval is permitted only in designated locations and during times permitted for general public visitation.

The St. Jones Reserve component is easily accessed by boat launch from Scotton Landing, approximately 1.5 miles upstream of the boundary. Lebanon Landing and Legislative Landing, both further upstream, provide canoe and/or kayak access to the St. Jones River. The Delaware Bay sub-component is easily accessed by boat launch at the Town of Bowers Beach. Each of these tidal water access areas are managed by the Division of Fish and Wildlife.

The Blackbird Creek can be accessed by the canoe/kayak launch at the Blackbird Creek Reserve or by a boat launch at “The Rocks,” a Division of Fish and Wildlife property several miles downstream of the Reserve boundary.

Fishing, Hunting, and Trapping

Traditional activities of fishing, hunting, and trapping will be permitted up to levels currently permitted under local and State laws (unless these uses interfere with a research or educational activity that cannot avoid a conflict with these traditional uses). The Reserve adjoins the Ted Harvey Conservation Area, a large State hunting area managed by the Division of Fish and Wildlife. At the appropriate times of year, this Division is also responsible for ensuring that appropriate hunting regulations are followed by hunters on DNERR property.

Hunting at the St. Jones site is limited to a small land area due to the numerous public programs conducted at the Reserve. There are 5 deer stands on the property. The DFW also monitors two duck hunting blinds within the DNERR marsh. The DNERR and DFW coordinate locations and hunting seasons each year.

Hunting at the Blackbird Creek Reserve is limited to certain areas due to the numerous public programs and ongoing research at the Reserve. There are 6 deer stands on the property. The DNERR and DFW coordinate hunting seasons each year.

Other Uses

Reserve access for uses other than those listed will be permitted on a case-by-case basis. The Reserve Manager’s written authorization must be received prior to initiating any other uses.



MAINTENANCE OF FACILITIES AND PUBLIC USE AREAS

The DNERR has a responsibility to provide the facilities necessary to implement the education and training, research and monitoring, and stewardship programs of the DNERR in accordance with federal and state guidelines and laws. The Reserve currently operates from two offices due to the geographic distribution of the components: the facilities in Dover supports the St. Jones Reserve component and serves as the headquarters for the Reserve; and the facilities in Townsend supports the Blackbird Creek Reserve component.

The upkeep of buildings and grounds are overseen by the Reserve Stewardship Staff. Vandalism and misuse are report to DNREC Enforcement and the appropriate law enforcement agency.

The facilities for each office and DNERR component are listed below. Needs are identified and are based on current capabilities at the offices and components and program priorities for 2013 -2018.

St. Jones Reserve

Existing Facilities

The DNERR Headquarters is located at the St. Jones Reserve component, 6 miles south of the city of Dover. It is a 7,200-square foot research, education, and training facility. Laboratories, classrooms, dormitory, coastal reference library, shop, recycling center, native plant nursery, herbarium, trail, conference facilities, and Reserve office headquarters are located here. The St. Jones Center for Estuarine Studies was the first building constructed which opened in 1999 with offices, exhibits, laboratory and classroom space. It was then expanded in 2003 with a dormitory, additional meeting space and showering facilities. The last addition to the facilities was in 2005 with the construction of the Coastal Training Center.

The buildings at the St. Jones Reserve are designed with state of the art sustainable infrastructure including a geothermal heating and cooling system, an on-site wetland based tertiary wastewater treatment system and a photo-voltaic (solar panel) system.

Research Laboratories

Two laboratories constitute the principal research areas at the St. Jones Reserve. The first is a small but highly suitable and very well equipped lab used exclusively by Reserve staff and visiting researchers. The second area is a combination teaching and research "wet laboratory." A unique quality of this space is the public's ability to observe projects from a distance when researchers are using the wet-lab. This provides a valuable physical demonstration that true scientific research is being conducted locally. Along with laboratories, the Research and Monitoring Program has several boats, vehicles, and storage areas at its disposal housed at the St. Jones Reserve component.

Education Facilities and Exhibits

The education program has one dedicated classroom that can be split into two and use of the teaching wet-lab area. Each room is equipped to hold approximately 20 program participants. The classroom is equipped with audiovisual equipment. The wet-lab is fully equipped to handle a variety of programming needs.

Indoor and outdoor exhibits are the anchors for many classroom activities. All exhibits reinforce lessons learned during formal educational programs. Outdoor exhibits and teaching stations are particularly important, as are the canoes and a Carolina skiff used as floating classrooms for visiting groups. These transport participants into the heart of the estuary, where a true respect for its beauty and a personal connection to the environmental issues of the area can be formed. The indoor exhibits highlight marsh ecology, estuarine functions, and the historical significance of the area. Many Reserve visitors come to enjoy the outdoor exhibits. They are drawn along a 2-mile trail and boardwalk through the estuary where learning stations are placed periodically to highlight research projects and natural points of interest.

Dormitory

Four dormitory rooms were built onto the main building at the St. Jones Reserve in 2003. The rooms are in great demand for visiting researchers, educators, and volunteers such as AmeriCorps NCCC teams especially during peak field season. The rooms are designed to accommodate up to 16 people. However, currently there are sufficient beds for 11 people. There are full bathrooms and showers available as well as a washer and dryer for those staying in the dormitory rooms. The Reserve will continue to monitor demand of the rooms and space.

Conference Facilities

The Coastal Training Center was constructed in 2005 and has a conference room with a capacity for 75 people seated at tables. A full range of audiovisual equipment is provided to support DNERR-hosted meetings and offers an expanded exhibit area. The conference room has proven to be an invaluable tool in drawing groups to visit the Reserve, thus accomplishing the goal of making the Reserve a place where discussions and exchanges of ideas happen regularly among members of the environmental community.

Coastal Resource Library

In the winter of 2000, it was decided that a single location was needed for coastal resource publications. The facility at the St. Jones Reserve component was selected to house a collection of historical documents and resource publications. To date, the Center has one of the largest collections of such documents in a single location in the State. All materials are available to coastal managers, researchers, and the general public.

The current location of the Coastal Resource Library is in the St. Jones Reserve's office space common area. It is projected to outgrow this space over the course of the next several years. Options to address this issue will be developed. After an evaluation of future space requirements, it will be determined if the library has grown enough in size and importance to require a new dedicated space.

Trail/Boardwalk

Within the St. Jones Reserve component, there is a 2-mile trail through the estuary. This trail links up with other State property managed by the Division of Fish and Wildlife and provides access to Delaware Bay for a total one-way distance of approximately 5 miles. The trail begins with a quarter-mile raised boardwalk over the marsh. There are several teaching stations along this section. There are also several areas where the boardwalk is lowered to allow up-close access to the marsh. Visitors can learn about the Reserve weather station and atmospheric deposition sampler in this section. The trail then follows a narrow corridor bordering farm fields and marsh, allowing visitors to see prime examples of runoff potential and habitat encroachment.

Herbarium

As the landscape changes in part to climate change and sea level rise, it is important to accurately document the vegetation at each Reserve component. One key mechanism in documenting existing vegetation communities, populations, and individuals within the DNERR is in the establishment of a herbarium (vegetation collection including voucher specimens). In 2009, the DNERR developed the Reserve Herbarium in consultation with Dr. Susan Yost of the Clyde Herbarium at Delaware State University in Delaware.

Native Plant Nursery

The Delaware Native Plant Society and the DNERR have a Memorandum of Understanding to operate a Native Plant Nursery at the St. Jones Reserve. This Nursery was established in 2000 building upon mutual goals of both organizations. The Native Plant Nursery is along the trail and includes interpretive signage that promotes the use of native plants to Reserve visitors and program participants.

Shop

A Maintenance shop, bull pen and pole barn is located on the St. Jones Reserve and is where equipment, vehicles and boats are stored for facility and land management.

Identified Future Facility Needs

- Exhibit Renovations
 - St. Jones Visitor Center (Estimated Cost: \$700,000) This will include renovations to the main building facility lobby and classroom exhibits, including updating exhibits to incorporate reserve research and monitoring results as well as improving the aquarium support system to properly care for and to showcase live specimens and habitats of the Delaware Bay thus enhancing the educational experience of all visitors.
 - Coastal Training Center (Estimated Cost: \$50,000) This will include renovations to the lobby exhibits including updating exhibits to incorporate recent reserve research and monitoring efforts and boundary amendments.
 - Outdoor wayside Interpretive Signage (Estimated Cost: \$40,000) On the St. Jones Reserve trail and around the facility new interpretive signage need to be erected. The new trail signage will provide for both resource protection and recreational use of the reserve. The new signage around the facility will highlight green building construction techniques at the Reserve including: photovoltaic panels; tertiary wetland waste water treatment system; geothermal; rain gardens; etc.
- Trail improvements
 - Expansion/Connection with the Division of Historic and Cultural Affairs, John Dickinson Plantation and Division of Fish and Wildlife, Ted Harvey Conservation Area (Estimated Cost: \$100,000) The expansion of the St. Jones Reserve trail and signage to connect the adjacent properties would address goals identified by the St. Jones Greenway, Route 9 Coastal Heritage Byway, and the Delaware Bayshore Initiative.
- Facility Improvements
 - Expansion of Photovoltaic System (Estimated Cost: \$110,000) In 2007, photovoltaic system was installed on the roof of the Coastal Training Center at the St. Jones Reserve. The expansion of the system will utilize all appropriate space available on the roof of the Visitor's Center to further increase the Reserve's use of renewable energy.
 - Pervious Pavers Demonstration Project (Estimated Cost: \$50,000) This project proposes to utilize the St. Jones Reserve as a demonstration site for pervious pavers on the walkways leading to the Visitor's Center and the sidewalk leading to the Coastal Training Center. Pervious paving systems are used for the purpose of reducing surface runoff and increasing infiltration when compared to traditional sidewalks, patios, walkways and parking areas.
 - Access Improvements (Estimated Cost: \$150,000) Improvements are necessary to the Reserve facilities for the safety and security of public users and staff alike. Options include, but are not limited to, keyless entry system, real-time streaming video conferencing, security cameras, replace hazardous flooring.

- Dormitories and Laboratory Facilities (Estimated Cost: \$250,000) Improvements to the dormitories and research laboratories will be implemented as funding allows as needed to accommodate increasing needs for researcher and educator dormitory and support facilities.
- Equipment, Vehicle and Boat Storage (\$50,000) There is a need to expand the shop and bull pen that can serve as a secure place for vehicles and equipment to be stored out of the elements, reducing the need for maintenance and increase the useful years of service of these vehicles.

Existing Equipment

The St. Jones Reserve site is well equipped for programs offered. Laptop computers, projectors, are available for presentations. A Copier and one color printer are available to create handouts for programs. A variety of field test kits and microscopes are available for programming. The Reserve has the use of several boats including: 24 ft Carolina skiff, Small skiff, Jon Boat, SeaArk and has use of larger bay boats and a zodiac. The office also has a Fleet leased 2008 Dodge Durango and 2004 Ford extended cab truck. Lawnmowers, tractors, trailers and accessories are for land management.

Identified Future Equipment Needs

- Furniture (Estimated Cost \$25,000)
 - Coastal Training Center tables, chairs
 - Office desks, chairs

Blackbird Creek Reserve

Existing Facilities

The Blackbird Creek Reserve component of the DNERR is located upstream from Delaware Route 9 at Taylors Bridge in Townsend, New Castle County. The Blackbird Creek Reserve boasts several miles of trails through uplands and along the marsh, a canoe/kayak launch, restoration demonstration areas as well as a Stewardship Center that includes meeting rooms, laboratory, offices and a shop.

Meeting rooms

There are 2 meeting rooms at the Blackbird Creek Stewardship Center. One meeting room can hold up to 30 people sitting at tables and the other can seat 12 people around a conference table.

Research Laboratory

A small but highly suitable and very well equipped lab is used exclusively by Reserve staff and visiting researchers. Along with the laboratory, the Research and Monitoring Program has canoes, kayaks, vehicles, and storage areas at its disposal housed at the Blackbird Creek Reserve component.

Interpretive Trail

A loop trail with signage exists along its length. The Reserve will continue to improve and expand this trail to include adjoining Reserve properties. The trail will address public access needs in the area as well as become an asset to the Reserve education program. The trail head offers a small parking area.

Canoe/Kayak Launch

The Reserve established a canoe and kayak launching area onsite to provide direct access to the Blackbird Creek.

Shop

A Maintenance shop, bull pen and pole barn is located on the St. Jones Reserve and is where the majority of equipment, vehicles and boats are stored for facility and land management. A pole barn is at the Blackbird Creek Reserve and stores equipment for facility and land management.

Identified Future Facility Needs

- Exhibits
 - Stewardship Center (Estimated Cost \$20,000) This will include interpretive panels within the lobby and meeting area of the Stewardship Center.
 - Outdoor wayside Interpretive Signage (Estimated Cost \$40,000) On the Blackbird Creek Reserve trails and around the facility new interpretive signage need to be erected. The new trail signage will provide for both resource protection and recreational use of the reserve.
- Trail improvements
 - Expansion/Connection between Reserve managed parcels (Estimated Cost \$120,000) The connection of trails on Reserve managed parcels would enhance visitors experience
 - Pavilion and Composting Toilets (Estimated Cost \$50,000) There is a need to build a structure to allow an outdoor classroom setting while being able to provide shelter and facilities.
- Facility Improvements
 - Deck and roof renovation (Estimated Cost: \$40,000) Improvements are necessary to the observation deck and roof at the Stewardship Center to ensure safety for users of the facility. Options include, but are not limited to, replacement of deck boards, railings, roof shingle repair, gutter enhancements.
 - Access Improvements (Estimated Cost: \$100,000) Improvements are necessary to the Reserve facilities for the safety and security of public users and staff alike. Options include, but are not limited to, keyless entry system, real-time streaming video conferencing, security cameras, replace hazardous flooring.

Existing Equipment

The Blackbird Creek Reserve site is well equipped for programs offered. Laptop computers, projectors, are available for presentations. A Copier and one color printer are available to create handouts for programs. The Reserve has the use of 8 canoes and 2 kayaks. The office also has a Fleet leased 2008 F250 Pickup Truck. Lawnmowers, tractors, trailers and accessories are for land management.

Identified Future Equipment Needs

- Furniture (Estimated Cost \$15,000)
 - Meeting room tables, chairs
 - Office desks, chairs



CONSTRUCTION PRINCIPLES

All construction activities will be completed under the guidance of the following principles to ensure the Reserve meets its guiding principle of promoting good environmental stewardship and to meet the NERRS Sustainable Design Guidelines.

1. Facilities and access routes will create minimum visual or environmental impacts both within and beyond the component boundaries.
2. Facilities will be designed and located to support multiple Reserve goals to the greatest extent possible.
3. Planning for significant new facilities will solicit input from representatives of user groups or those to be affected by the facilities.
4. Facilities construction and equipment shall strive for energy efficiency, incorporate green building materials and techniques, and anticipate technological advances.

On February, 17, 2010, Governor Jack A. Markell issued Executive Order 18 to all State Agencies and Departments. The Order, *LEADING BY EXAMPLE TOWARDS A CLEAN ENERGY ECONOMY & SUSTAINABLE NATURAL ENVIRONMENT*, sets goals the following key areas:

- Energy conservation and efficiency – All state executive branch agencies will aim to achieve an overall reduction in energy consumption of at least 10% by the end of year 2011, 20% by fiscal year 2013, and 30% by fiscal year 2015 as compared with fiscal year 2008.
- Construction – The State will integrate the US Green Building Council’s Leadership in Energy and Environmental Design (LEED) practices into construction, renovation, and facility operation. Where reasonable, agencies will aim for LEED Silver standards.
- Renewable energy – At least 20% of the annual electricity demand for buildings owned or operated by the State executive branch should come from clean, renewable sources by the end of fiscal year 2012, increasing to 30% by the end of fiscal year 2013.
- Transportation – All agencies will reduce expenses by reducing petroleum consumption by 25%, vehicle emissions by 25%, and vehicle miles traveled by 15% by the end of fiscal year 2012 as compared with fiscal year 2008.
- Recycling – All State executive branch agencies will aim to achieve a 75% rate of diverted waste from landfills by the end of fiscal year 2012.
- Procurement – The State will implement a cost-effective sourcing policy to reduce the impact on the environment and use less toxic substances.



DELAWARE NERR FACILITIES AND PUBLIC ACCESS OBJECTIVES AND ACTIONS

Objective 5: Develop and maintain facilities necessary to the operations of the Reserve and that support the needs of visitors and staff.

Action: Provide safe, comfortable buildings for staff and partners to accomplish program objectives and provide visitors with facilities in which to learn about coastal ecology and the natural and cultural history.

Action: Actively seek funding and implement prioritized facility and equipment needs at the St. Jones and Blackbird Creek Reserves as resources become available.

Objective 6: Develop, maintain, and operate facilities that minimize environmental impacts and resource consumption by using innovative design, construction methods, and technologies.

Action: Evaluate facilities and operations as it pertains to Delaware Executive Order 18

Action: Continue to improve Reserve facilities as resources allow that minimize environmental impacts and which can function as a demonstration of sustainable design.

Objective 7: Develop and maintain integrity of Reserve for research, long-term resource protection and education while permitting traditional uses that do not conflict with Reserve goals.

Action: Improve access and signage at the Reserve to ensure all sites are properly marked including boundary markers and visitor use information.

Excessive visitor use can have a detrimental effect on Reserve ecosystems, particularly those that are fragile. Use of barriers, boardwalks and trails will guide visitor activities to those areas best able to withstand heavy use. Where necessary and allowable, site managers will install structures to provide for access and use while minimizing impacts. Examples of structures designed to minimize impacts include ramps, boardwalks, and designated trails. This effort will balance visitor needs and DNERR habitat and program needs.

Signage is a critical component in guiding visitor use. The DNERR will identify opportunities to protect the resources of the Reserve through posting of signs and markers. All Reserve sites will be properly marked with signage, including boundary markers and visitor use rule signs. Signs at each site will: provide guidance to visitors regarding the rules of and appropriate use of the sites; explain visitor impacts to the resources of the Reserve; identify the DNERR and its mission; and provide site-specific information regarding protected habitats and species.

Interpretive signs will be developed for public access areas where appropriate that educate visitors about the Reserve programs, estuarine concepts, local habitats, flora and fauna, proper use of the area, and management concerns. This will promote a better understanding of the resources and will result in better protection of the public access areas. Interpretive signs will be displayed and maintained on trails and boardwalks open to the public.

**ADVANCING ENVIRONMENTAL LITERACY
AND INFORMED DECISION MAKING:
education, outreach & training plan**





EDUCATION PROGRAM OVERVIEW

National Education Program

The Reserve System provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation in the reserves incorporates a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues and incorporate science-based content. Reserve staff members work with local communities and regional groups to address coastal resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education programs, the reserves help communities develop strategies to deal successfully with these coastal resource issues.

Formal and non-formal education and training programs in the NERRS target K-12 students, teachers, university and college students and faculty, as well as coastal decision-maker audiences such as environmental groups, professionals involved in coastal resource management, municipal and county zoning boards, planners, elected officials, landscapers, eco-tour operators and professional associations.

K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with state and national science education standards and frequently involves both on-site and in-school follow-up activity. Reserve education activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. Education and training programs, interpretive exhibits and community outreach programs integrate elements of NERRS science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

Reserve System Education Goals

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. Education at each reserve designed to fulfill the reserve system goals as defined in the regulations (15 C.F.R Part 921(b)). Education goals include:

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

Reserve System Education Objectives

Education-related objectives in the Reserve System Strategic Plan 2011-2016 include:

- Enhance the capacity and skills of teachers and students to understand and use NERRS data and information for inquiry-based learning.
- Increase estuary literacy and promote active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection, and water quality.

Coastal Training Program

The Coastal Training Program (CTP) provides up-to-date scientific information and skill-building opportunities to coastal decision-makers who are responsible for making decisions that affect coastal resources. Through this program, National Estuarine Research Reserves can ensure that coastal decision-makers have the knowledge and tools they need to address critical resource management issues of concern to local communities.

Coastal Training Programs offered by reserves relate to coastal habitat conservation and restoration, biodiversity, water quality and sustainable resource management and integrate reserve-based research, monitoring and stewardship activities. Programs target a range of audiences, such as land-use planners, elected officials, regulators, land developers, community groups, environmental non-profits, business and applied scientific groups. These training programs provide opportunities for professionals to network across disciplines, and develop new collaborative relationships to solve complex environmental problems. Additionally, the CTP provides a critical feedback loop to ensure that professional audiences inform local and regional science and research agendas. Programs are developed in a variety of formats ranging from seminars, hands-on skill training, participatory workshops, lectures, and technology demonstrations. Participants benefit from opportunities to share experiences and network in a multidisciplinary setting, often with a reserve-based field activity.

Partnerships are important to the success of the program. Reserves work closely with State Coastal Programs, Sea Grant College extension and education staff, and a host of local partners in determining key coastal resource issues to address, as well as the identification of target audiences. Partnerships with local agencies and organizations are critical in the exchange and sharing of expertise and resources to deliver relevant and accessible training programs that meet the needs of specific groups.

The Coastal Training Program requires a systematic program development process, involving periodic review of the reserve niche in the training provider market, audience assessments, development of a three to five year program strategy, a marketing plan and the establishment of an advisory group for guidance, program review and perspective in program development. The Coastal Training Program implements a performance monitoring system, wherein staff report data in operations progress reports according to a suite of performance indicators related to increases in participant understanding, applications of learning and enhanced networking with peers and experts to inform programs.

Reserve System Coastal Training Goals

The National Estuarine Research Reserve System Coastal Training program is designed to fulfill the reserve system goals as defined in the regulations (15 C.F.R Part 921.1(b)). Coastal training goals include:

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

Reserve System Coastal Training Program Objectives

Coastal Training-related objectives in the Reserve System Strategic Plan 2011-2016 include:

- Increase estuarine literacy and promote active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection and water quality.
- Improve the capacity and skills of coastal decision-makers to use and apply science-based information in decisions that affect estuaries and coastal watersheds

Delaware NERR Education, Outreach and Training Plan Overview

The Delaware National Estuarine Research Reserve (DNERR) offers educational programs for K-16 school groups, the general public, special interest groups, teachers, and coastal decision-makers. Components of the education program include student curricula, field trips, outreach programs, teacher professional development, volunteer programs, public programming, coastal decision maker workshops, and a wide variety of printed and social media. All education, training, and outreach activities are designed to enhance public awareness of the importance of estuarine systems and provide opportunities for public education and interpretation. A critical aspect of these efforts is the linkage of education to science and stewardship. The overall aim of the education program is to translate scientific information into language that can be understood and applied by program audiences. The DNERR's education programs are developed and administered by the education staff located at the St. Jones Reserve component in Dover, Delaware. These education programs are conducted in concert with other Reserve staff, including the Reserve Manager, research staff, and stewardship staff. Partnerships with other organizations are an integral part of the Reserve's ability to educate a broader population within Delaware. Partners include Delaware Coastal Programs; DNREC Division of Energy and Climate, DNREC's Watershed Assessment Section, DNREC's Shoreline and Waterway Section, the Center for the Inland Bays, Delaware's Department of State, Division of Historical and Cultural Affairs; The Delaware Invasive Species Council; The Nature Conservancy; the Partnership for the Delaware Estuary; Delaware Sea Grant Program at the University of Delaware; Tidewater Utilities, Inc.; and various divisions within the Delaware Department of Natural Resources and Environmental Control, to name a few. All education programs are administered in accordance with NERRS education goals and objectives as outlined in the NERRS Strategic Plan (Appendix B).

The DNERR has two primary objectives for education and training programs to address the goals for 2013-2018.

Goal: Improve public awareness and environmental literacy in our communities to enable environmentally sustainable decision-making.

- Enhance public awareness and understanding of the value and functions of estuarine ecosystems in the Mid-Atlantic Region.
- Promote the wise use of estuarine resources and encourage a positive environmental stewardship ethic among Reserve users and visitors as well as coastal decision-makers.

In order to accomplish these objectives education programs will deliver information regarding Delaware's coastal resources to the general public, coastal decision makers, formal and informal educators, and K-16 and college students to foster environmental stewardship and inform decision-making. Community programming will be increased and effective marketing will be utilized to establish an identity for the Reserve. In addition, Coastal Training Program activities will deliver science-based knowledge and skills appropriate to the needs of the target audiences and relevant to sustainable coastal management. As the educational needs and services in the state changes, the Reserve's education program will adapt to meet those needs and fill identified gaps. Market analyses (MA) and needs assessments (NA) will be conducted on a regular basis and are an integral part of identifying target audience needs and planning future programs. In the past, site-based programs have been popular. Although the Reserve will continue to offer site-based programs, online training opportunities and web-based educational resources will also be made available as appropriate.

Community Public Education and Outreach Program

The community and Public education and outreach program strives to increase public awareness of the goals and mission of the DNERR and to enhance an understanding of estuarine systems and processes among the general public including local citizens and Delaware visitors. The intent of the outreach program is to increase awareness of estuarine functions and values and to foster environmental stewardship in citizens of all ages. The Reserve utilizes a place-based education approach to assist the public in making a personal connection to their local estuary. Community education programs include canoe trips, boat trips, discovery labs, coastal heritage driving tours, and presentations on coastal topics.

Outreach programs include participating in large community events such as Coast Day, Dover Days, University of Delaware Ag Day, and the Delaware State Fair. The Reserve has also brought more awareness to the Blackbird Creek Reserve by hosting the Blackbird Creek Fall Festival and to the St. Jones Reserve by hosting the St. Jones Open House on an annual basis. In efforts to further outreach to the community in and around the Reserve components, Reserve staff has offered programming at the local public libraries, presented to civic and community organizations. Additionally, in 2008 the Reserve partnered with The Nature Conservancy and the Partnership for the Delaware Estuary to develop the Thank You Delaware Bay Campaign. As part of this campaign a website was developed to increase outreach about the Delaware Bay.

Coastal Training Program

The Delaware Coastal Training Program's (CTP) strategic goals from the 2012-2017 approved plan (Appendix I) are to:

Strategic Goal 1: Individuals or groups who make decisions regarding coastal resources will be exposed to the best available science-based information, tools, and techniques when they participate in a CTP event or activity.

Strategic Goal 2: Increased understanding of the environmental, social, and economic consequences of human activity within the coastal landscape with regard to the CTP's priority coastal issues.

Strategic Goal 3: Increase the application of science-based information, tools, and technical information in coastal decision making with regard to the CTP's priority coastal issues.

Strategic Goal 4: Increase networking and collaboration across sectors and disciplines related to decision making on priority coastal issues in Delaware.

The Coastal Training Program addresses critical coastal resource management issues in Delaware by providing current scientific information, access to technologies and skill-building opportunities to Delawareans responsible for making decisions about the state's coastal resources. This can include partnering with other agencies and organizations to provide data relevant to current coastal issues including land use, sea level rise, climate change, and biodiversity.

The CTP's activities can range from seminars, hands-on skill training, and participatory workshops to lectures and technology demonstrations. Through these programs, coastal resource decision makers also have opportunities to share experiences, network in a multidisciplinary setting, and participate in field activities. Past workshops covered subjects such as sea level rise in Delaware, wetlands restoration techniques, public issues and conflict management, and social media skills.

The CTP's programming targets a range of audiences, such as land-use planners, elected officials, regulators, land developers, community groups, environmental non-profits, business, state agencies, and applied scientific groups. These training programs provide opportunities for professionals to network across disciplines, and develop new collaborative relationships to solve complex environmental problems.

One of the primary objectives of the CTP is to provide the best available science-based information, tools, and techniques to those individuals or groups who make important decisions regarding resources within coastal watersheds, estuaries, and near-shore waters. The CTP relies on expert speakers, including researchers, like the DNERR's Research Coordinator, resource managers, and policy makers to present the most current information at training events. Support materials are also developed to inform coastal decision-makers of current coastal and estuarine research.

Partnerships are important to the success of the program. The Delaware NERR works closely with Delaware Coastal Management Program and the Delaware Department of Natural Resources and Environmental Control's (DNREC) education staff, and a host of local partners in determining key coastal resource issues to address, as well as the identification of target audiences. Partnerships with local agencies and organizations are critical in the exchange and sharing of expertise and resources to deliver relevant and accessible training programs that meet the needs of specific groups.

The CTP periodically reviews and refines its niche in the training provider market through audience assessments, program strategy revisions, marketing plan updates, and with the guidance of its Advisory Committee, perspectives conveyed from partners and audiences, and advice from DNERR staff. The Delaware CTP also monitors its performance with an evaluation system, wherein staff report data in operations progress reports according to a suite of performance indicators related to increases in participant understanding, applications of learning and enhanced networking with peers and experts to inform programs.

K-16 Estuary Education Program (KEEP)

K-16 Students

The K-16 student education program provides students with hands-on, inquiry-based learning opportunities where the content is focused on estuarine habitats, watersheds, organisms and/or coastal issues.

Field trips are held primarily at the St. Jones Reserve component although a few are held at the Blackbird Creek Reserve component. Teachers bring their classes to the Reserve to explore the estuary typically through 3-5 planned activities (based on the schools time limitations). These activities are based on the grade level visiting the Reserve and will often include activities focused on estuary habitats, wetland values and functions, species interactions, Delaware Bay ecology; however, other activity topics include watersheds, water quality testing and beach ecology. The education program goal is to have students actively engaged in their learning experience and the best way to accomplish this is through hands-on opportunities. All Reserve K-16 education programs are aligned to the Delaware State Education Standards and National Science Standards. National Ocean Literacy Essential Principles and Estuarine Principles and Concepts are also incorporated into programs. For schools that cannot travel, the Reserve offers a variety of classroom-based programs that are led by Reserve education staff on estuarine-related topics. The Reserve also provides K-16 teachers with written, estuarine-based, curricular material for both classroom and field-based activities. Web resources are also available and include basic estuarine information and specific information about the Delaware Bay.

Teacher Professional Development Program

The purpose of the teacher professional development program is to increase the number of teachers trained to teach students about estuaries, coastal ecosystems, watersheds, and specific interaction of estuary organisms (horseshoe crabs and shorebirds) thus increasing estuarine literacy in both teachers and students. The Reserve accomplishes this through workshops and by providing supplementary curricular materials. Teacher professional development workshops target formal and informal educators across the State as well as pre-service teachers. All educator workshops are based on curricula developed either locally by DNERR educators, DE's Aquatic Resources Education Center, Project WET (water education for teachers), or by the NERRS. All Delaware teacher workshop participants are eligible to receive teaching continuing education credit hours through the Delaware Teacher Center. A new national curriculum was recently developed for K-16 students and teachers as part of NERRS' K-16 Estuarine Education Program (KEEP). This curriculum, called Estuaries 101, teaches key principles and concepts of estuarine ecology and illustrates how estuaries relate to other human and ecological systems, while teaching to national and state science standards. KEEP not only teaches students about coastal and estuarine processes, but it also develops and strengthens data literacy, critical thinking, team building, and problem solving skills in students of all ages. KEEP uses a multifaceted approach that is designed to provide teachers with appropriate estuarine-based lessons plans as well as hands-on field experiences for teachers and students within the Reserves. Post-workshop evaluations are conducted for every workshop to ensure that the content and delivery are meeting participant needs. Many teacher professional development workshops are conducted in partnership with other organizations.



DELAWARE EDUCATION OBJECTIVES AND ACTIVITIES

Goal: Improve public awareness and environmental literacy in our communities to enable environmentally sustainable decision-making.

Objective 1: Enhance public awareness and understanding of the value and functions of estuarine and coastal ecosystems in the Mid-Atlantic Region.

Action: Promote the Reserve, its resources, and its programs through publications, social media, public displays, and guest speaking appearances to community groups.

Deliver Information on DNERR Programs and Coastal Ecosystems.

To inform local citizens and visitors about the Reserve and coastal habitats, informational brochures, posters, newsletters and displays will be produced and updated regularly. The Reserve updated and newly printed the St. Jones River Trail Guide and will be developing a trail guide for the Blackbird Creek Reserve. In addition, brochures will be updated as new information regarding estuarine ecosystems is discovered, as Reserve boundaries expand, or when contact information changes. New flyers will be developed as the DNERR programs and activities continue to grow and expand. For example, flyers will be produced for summer public field trips and student summer camps. Bird lists, field guides, and trail brochures will also be updated as needed. Additional posters on estuarine habitats, plants, and animals will be developed as resources allow.

The DNERR will also continue to expand outreach activities throughout the state and become more visible within the community. These efforts will include coordinating displays at fairs, festivals, volunteer programs, and presentations for civic organizations and visitor groups.

Develop and implement an external marketing and communication plan.

In order for the Reserve to successfully fulfill its mission, the community that the Reserve operates within and serves must recognize the DNERR name, know where the components are, and understand how the DNERR serves the citizens and visitors of Delaware. To accomplish this, the DNERR will develop and implement an external marketing and communications plan to address these goals and audiences. The Education staff will play an integral role in the development and implementation of this plan. The plan will include activities geared towards these audiences such as publishing an accomplishments report, update web site, and maintain social media outlets including Facebook and DNERR blog. Sector-specific communication needs will also be identified to support program marketing and address sector challenges.

Action: Promote awareness of the NERRS and the values of estuarine/marine protected areas by maintaining interpretive displays at the Visitors Centers, trails, and participating in a variety of public events.

Develop and/or Update Interpretive Signs for Public Access Areas.

Reserve site signage is an important aspect of delivering information about and creating awareness of the DNERR. Reserve education and stewardship staff will work together to identify proper location, information, and maps to be included on signage. Education staff will then design the signs with assistance from other sectors.

Develop and/or Update Interpretive Exhibits in Education Center.

The Reserve education staff will work in conjunction with assistance from other sectors, the Education Advisory Committee, and outside contractors (as necessary) to create an exhibit plan for the St. Jones Reserve and Blackbird Creek Reserve components. This will include a maintenance plan of existing exhibits and a plan for new exhibits for the Reserve sites.

Action: Provide on-site educational and interpretive services directly to the general public and students through regularly scheduled public activity programs, field-based estuarine science education experiences, in-classroom activities, and workshops.

Provide Field based Estuarine Science Education Experiences.

The Reserve's K-16 student education program will continue to provide field based estuarine science education experiences for students. Reserve student field trips are ecology-based nature hikes that present basic estuarine information. Most field trips are conducted on the St. Jones Reserve site due to the existing infrastructure including the Education Center. Teachers are offered pre- and post-field trip resources to supplement the outdoor experience. A few field trip opportunities have taken place at the Blackbird Creek Reserve site. This is limited small groups due to the lack of necessary infrastructure (such as restroom facilities and picnic areas). Emerging coastal issues including point and non-point sources of pollutions, invasive species, climate change, and sea level rise are discussed with students when appropriate.

Update Curricula based on current techniques and needs.

The DNERR is currently updating its curricular activities which were originally developed in the early to mid 1990s. Old activities are being updated in content and format and new activities are being written to address current coastal issues and to align with the state standards and the Next Generation Science Standards, once available. The DNERR is also partnering with the John Dickinson Plantation to develop a joint curriculum to encourage the attendance of schools on field trips to both sites in one day. This new curriculum will be offered to 4th grade classes to meet the Land and Water Unit and the Delaware State History Unit located within the Delaware State Standards. The 4th grade level is a natural fit for the Reserve as they cover Land and Water and Delaware State history. This allows the Reserve to partner easily with the Division of Historical and Cultural Affairs, John Dickinson Plantation in order to handle larger groups of students. Additionally, up-to-date educational methods that better address different learning styles, such as inquiry-based activities are being incorporated into new curriculum. An education program needs assessment and market analysis has been conducted in the winter-spring 2010.

Incorporate Research and Monitoring Data into Programs

As the NERRS System-wide Monitoring Program develops more accessible online water quality data and the Integrated Ocean Observing System broadens their partnerships, the education program will incorporate these user-friendly data interfaces into student and teacher activities. In addition, the Estuaries 101 curriculum which utilizes SWMP data will be incorporated into teacher and student education programs. The Education Coordinator is currently working with the Research staff to utilize SWMP data in field trip activities, public programming and professional teacher development trainings. As current research results become available the education staff will work to translate, distill and incorporate the new research information about estuaries and watersheds into educational programs and products.

Conduct Local Outreach Efforts in Schools

The K-16 student education program will expand local outreach efforts in schools. These outreach efforts include conducting hands-on, inquiry-based activities in the classroom, giving classroom presentations on the Reserve and its habitats, and distributing estuarine curricula to teachers. This increased outreach effort will be marketed to teachers through workshops, seminars, personal communications, and the web. The education program will also focus on strengthening their relationship and increasing collaboration with more schools within the local school system by providing teacher professional development workshops, allowing the Reserve's classroom space to be used for in-service teacher training, and offering in-classroom experiences for local schools.

Conduct and Continue to Provide Quality Public Programming

Reserve staff will continue to provide information and interpretation on estuaries and coastal areas; natural, historic, and cultural resources; and coastal management issues through public programming opportunities such as boat trips, canoe trips, coastal heritage driving tours, hikes, discovery labs, and presentations. Reserve staff will continue to seek new opportunities for estuary related programs and foster existing and new partnerships to increase visitation to the Reserve.

In addition, the Reserve plans to make the Blackbird Creek Fall Festival and the St. Jones Open House annual events to encourage visitors to utilize both Reserve components and to connect them with the community. The Reserve will also make efforts to increase the visibility of the Reserve at local events such as Coast Day, Dover Days, State Fair, and Ag Day.

Adjust Programs based on Evaluations

Education programming will periodically be examined to determine how effective they are at increasing participant knowledge of estuaries and the issues impacting Delaware's coastal areas. Post K-16 Estuary Education field trip, community programs and workshop assessments will be disseminated to teachers and participants to help education staff create more effective learning experiences for students and participants and to respond to needs. The number of programs offered and the timing of these events will also routinely be evaluated to deliver the most effective programs possible. Performance measures, which the NERRS collecting, will be applied to educational programs including community education, CTP, and K-16 Estuary Education to measure program impact. Assessment tools are developed and analyzed in-house by the Education Coordinator and the CTP Coordinator.

Action: Provide teacher training, internships, and guidance for student projects.

Conduct Educator Workshops

Reserve education staff will seek to increase the number of professional development opportunities for formal, informal, and pre-service educators to cultivate more estuary literate educators and therefore, more estuary literate students. Education staff will develop workshop content, implement the workshops/trainings, and increase access to resources and guest speakers through partnership opportunities. The new national Estuaries 101 curriculum will be integrated into existing workshops. Emerging coastal issues such as the effect of sea level rise will be incorporated into teacher training workshops. All workshops will be evaluated to determine their effectiveness in communicating estuarine concepts and will be modified to improve relevancy and better serve future participants as needed.

Provide Mentor Opportunities

In order to mentor university students and encourage these students to explore estuary related career paths. The Reserve Education Program will create more opportunities for internships to work jointly with scientists and educators to gain field experience and learn how research activities guide management decisions. The Education staff will work closely with the Research and Stewardship staff to create these opportunities.

Objective 2: Promote the wise use of estuarine resources and encourage a positive environmental stewardship ethic among Reserve users, visitors and coastal decision-makers.

Action: Provide technical assistance and training to coastal decision makers through the implementation of the Delaware Coastal Training Program.

Conduct Assessments of Information and Training Needs of Coastal Decision-Makers

CTP workshops are based on the following: training needs identified through informal needs assessments, training needs prioritized in the formal CTP needs assessment, and emerging issues identified through research at the Reserve and elsewhere. The CTP uses assessments and training evaluations to improve its ability to meet audience needs. The CTP will undertake periodic formal needs assessments to help the program provide current and targeted information to coastal decision-makers. Future needs assessments will focus on updating past needs assessments as well as targeting specific audience needs such as elected local government officials and regional planning and zoning.

Coordinate Trainings for Decision-Makers

Through results of the 2008 Market Analysis and Needs Assessment and consultation with DNERR CTP partners and staff, the DNERR CTP efforts will focus primarily on three priority coastal issues. The issue areas are:

1. Sea Level Rise and Climate Change
2. Habitat Restoration and Protection
3. Coastal Resource Planning

These broad topics encompass needs reflected by the majority of respondent types and are issues that fall historically within the expertise of the Reserve and CTP partners such as Delaware Coastal Programs, Delaware Sea Grant, the Partnership for the Delaware Estuary, and the Nature Conservancy. The following training topics emerged from the Needs Assessment as having the highest need for training or information about the topic:

- Wetlands and Waterways Protection
- Environmental aspects of land use
- Sea Level Rise
- Climate Change
- Buffers

Based on additional needs assessments and post-workshop evaluations, the CTP will coordinate several new trainings each year for coastal decision-makers. Post-workshop evaluations include questions regarding additional training needs.

Use Coastal and Estuarine Science in Training and Support Materials

One of the primary objectives of CTP is to provide the best available science-based information, tools, and techniques to those individuals or groups who make important decisions regarding resources within coastal watersheds, estuaries, and near-shore waters. Trainings will be developed based on emerging coastal management research and issues, such as sea level rise. CTP will rely on expert speakers, including researchers, resource managers, and policy makers to present the most current information at training events. Support materials will also be developed to inform coastal decision-makers of current coastal and estuarine research.

Conduct Post-Workshop Evaluations and Improve Training Efforts

Post-workshop evaluations will be administered at every training event to determine the effectiveness of the workshop and if the participants intend to apply the knowledge they learned. These evaluations will assist in ensuring that these trainings are quality events which effectively meet participant needs. Workshop evaluations will also be used to report on performance measures established by the NERRS. Training efforts will also be improved through workshop participant discussions. Often the questions asked by participants or their immediate reactions to information provide valuable insight on training content and delivery.

Interpretation and Distribution of Research Results

The CTP will work with the Reserve's Research staff to interpret and distribute DNERR research products to the coastal management community. This will be accomplished by coordinating training events and technical publications. In addition, education staff will assist in the translation and incorporation of complex science and research information into educational programs, products, and outreach opportunities.



COORDINATION AND PARTNERSHIPS

Coordination

Coordination of Reserve Staff

To enhance the Reserve's abilities through collaboration, the education staff seeks to enhance communication and program consistency among Reserve sectors and sites to ensure integrated Reserve education programs. The Reserve Manager will encourage this enhanced integration among DNERR sectors through regular staff meetings and encouraging participation of other sector staff in education programs. Education staff will coordinate communications among sectors as well as with DNREC's Public Affairs Office to assist with the development of displays and the distribution of education and outreach materials. These activities will encourage the sectors to work together more efficiently as well as create a more integrated education program throughout Delaware.

Coordination with other Reserves and NOAA

The Delaware Reserve's education programs are reported to NOAA's Estuarine Reserves Division (ERD) through biannual progress reports and through performance monitoring data. Additionally, upcoming education programs are outlined in the annual DNERR 315 grant application. The NERRS annual meeting and winter education and coastal training sector meetings, when held, are attended by the appropriate education staff as funds allow. The Reserve's education staff regularly communicates with ERD's Education Coordinator and the Program Specialist who oversees the CTP to ensure the DNERR education programs are consistent with national initiatives. The Delaware Reserve Education Coordinator serves on NERRS workgroups including the MA/NA workgroup and the Conference Planning workgroup.

DNERR intends to incorporate more regional efforts in the future for education opportunities including coastal training programs.

Coordination with the Delaware Coastal Management Program

Coordination with the Delaware Coastal Management Program (DCMP) includes incorporation of emerging coastal management issues into education programs. DCMP staff are routinely expert speakers at CTP events and some teacher professional development programs. DCMP staff provides assistance for outreach events, including Coast Day and the Blackbird Creek Fall Festival. In addition, work collaboratively with the DCMP staff to develop topics for CTP workshops, such as the Sea Level Rise Seminar series. Several examples of how the Education staff is supporting the DCMP include:

- Developing a Sea Level Rise Outreach strategy plan in conjunction with partners;
- Hosting and implementing CTP workshops on priority coastal management issues;
- Provide advice and technical assistance with education, training and community involvement-related initiatives on pressing coastal management issues.

Partnerships

The wide range of audiences and programs at the Reserve provides numerous partnering opportunities. Many of the Reserve partners provide educational assistance, materials, and in some cases facilities. Descriptions of representative education program partnerships follow.

Community Education and Outreach Program

The Reserve has often partnered with the Delaware Coastal Management Program, The Nature Conservancy, the Partnership for the Delaware Estuary, and DNREC to showcase the DNERR and specific campaigns such as the Thank You Delaware Bay campaign at various festivals and large events including Coast Day, the Delaware State Fair, Dover Days, and the University of Delaware’s Ag Day. In festival education tents, the Reserve has provided attendees with general Reserve information, educational activities, and opportunities to volunteer.

Continued partnerships include those with local libraries as well as local civic organizations. Library children story times provide an opportunity for Reserve staff to deliver information on estuarine topics, while assisting libraries in providing programming. Libraries may also host displays on the Reserve for their customers, which may include brochures, volunteer opportunities, and upcoming events. Local civic organizations may assist the DNERR with site-based service projects and other community activities, such as Reserve trash clean-ups and short term restoration projects.

Coastal Training Program

Coastal Training Program partners consist mainly of organizations that help develop training programs and organizations whose staff serve as expert speakers at training events. Speakers from including but not limited to these organizations have participated in a variety of workshops: University of Delaware, Delaware Sea Grant, Partnership for the Delaware Estuary, The Nature Conservancy, Center for the Inland Bays, US Fish and Wildlife Service, Natural Resources Conservation Service, Delaware Department of Natural Resources and Environmental Control, US Army Corps of Engineers, NOAA-Coastal Services Center and local municipalities. Future program development may include sea level rise, habitat restoration, planning workshops with various partners such as DNREC, Delaware Invasive Species Council, Delaware Sea Grant, University of Delaware, and the Partnership for the Delaware Estuary. The CTP will continue to strengthen its partnerships with various universities, state agencies, local governments, and business organizations to ensure that CTP events consistently deliver science-based information through regional experts.

K-16 Estuary Education Program

K-16 Students

The K-16 student education program partners with a variety of organizations. Some organizations, such as University of Delaware, Delaware State University, NOAA, Delaware Department of Natural Resources and Environmental Control provide scientific information and expertise that support teacher professional development training and field trip activities. Other organizations share resources and assist with the production of educational materials. One major partner that has greatly supported the Reserve Education Program is the Division of Historic and Cultural Affairs, John Dickinson Plantation site who assist the Reserve in providing field-based opportunities for large groups and providing experts for public programs. In addition, the John Dickinson Plantation and Tidewater Utilities, Inc. play a large role in the 4th grade annual estuaries celebration entitled “Make a Splash.” Current partnerships will be examined to determine their effectiveness in providing programming, pooling resources, and reaching target audiences. Additional partnerships identified by the education sector needs assessment will be pursued.

Teacher Professional Development Program

It is imperative that the education program continue to seek partnership opportunities and creative collaborative solutions to extend the Reserve's programmatic impact despite fiscal challenges. Many of the Reserve's teacher professional development workshops are already conducted in partnership with other organizations including: the DNREC's Delaware Aquatic Resources Education Center; DNREC's DuPont Nature Center; Maryland Department of Natural Resources; New Jersey Department of Environmental Protection; ANEW, Inc.; Partnership for the Delaware Estuary; Tidewater Utilities, Inc.; and the Delaware Department of Agriculture.

**UNDERSTANDING COASTAL AND
ESTUARINE ECOSYSTEMS: research
& monitoring plan**





RESEARCH PROGRAM OVERVIEW

National Research Program

The Reserve System provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by the reserve system research and monitoring plan 2011-2016 which identifies goals, priorities, and implementation strategies. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries. Research within the reserves is designed to fulfill the reserve system goals as defined in program regulations (15 C.F.R Part 921(b)). These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Promote Federal, state, public and private use of one or more reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

Reserve System Research Funding Priorities

Federal regulations, 15 C.F.R. Part 921.50 (a), specify the purposes for which research funds are to be used:

- Support management-related research that will enhance scientific understanding of the Reserve ecosystem,
- Provide information needed by reserve managers and coastal ecosystem policy-makers, and
- Improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

The reserve system has identified the following five priority research areas to complement the funding priorities outlined above:

1. Habitat and ecosystem processes
2. Anthropogenic influences on estuaries
3. Habitat conservation and restoration
4. Species management
5. Social science and economics

Reserve System Research Goals

The reserve system research and monitoring goals are embedded in Goal 2 of the Reserve System Strategic Plan 2011-2016, 'NERRS scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds.' Increase the use of reserve science and sites to address priority coastal management issues,' and are outlined in the 2006-2011 Reserve System Research and Monitoring Plan, currently under revision, and the NERR System-wide Monitoring Program Plan 2011. They include:

- Expand capacity to monitor changes in water quality and quantity, habitat, and biological indicators in response to land use and climate change drivers.
- Improve understanding of the effects of climate change and coastal pollution on estuarine and coastal ecology, ecosystem processes, and habitat function.
- Characterize coastal watersheds and estuary ecosystems and quantify ecosystem services to support ecosystem-based management of natural and built communities
- Increase social science research and use of social information to foster coastal stewards that value and protect estuaries.

Currently, there are two reserve system-wide efforts to fund estuarine research. The Graduate Research Fellowship Program (GRF) supports students to produce high quality research in the reserves. The fellowship provides graduate students with funding for 1-3 years to conduct their research, as well as an opportunity to assist with the research and monitoring program at a reserve. Projects must address coastal management issues identified as having regional or national significance; relate them to the reserve system research focus areas; and be conducted at least partially within one or more designated reserve sites. Proposals must focus on the following areas: 1) Eutrophication, effects of non-point source pollution and/or nutrient dynamics; 2) Habitat conservation and/or restoration; 3) Biodiversity and/or the effects of invasive species; 4) Mechanisms for sustaining resources within estuarine ecosystems; or 5) Economic, sociological, and/or anthropological research applicable to estuarine ecosystem management.

Students work with the research coordinator or manager at the host reserve to develop a plan to participate in the reserve's research and/or monitoring program. Students are asked to provide up to 15 hours per week of research and/or monitoring assistance to the reserve; this training may take place throughout the school year or may be concentrated during a specific season.

Secondly, research is funded through the NERRS Science Collaborative (NSC), a partnership between NOAA and the University of New Hampshire (UNH). The Reserve System Science Collaborative is a program that focuses on integrating science into the management of coastal natural resources. Currently administered through the University of New Hampshire, the program integrates and applies the principles of collaborative research, information and technology transfer, graduate education, and adaptive management with the goal of developing and applying science-based tools to detect, prevent, and reverse the impacts of coastal pollution and habitat degradation in a time of climate change. The program is designed to enhance the reserve system's ability to support decisions related to coastal resources through collaborative approaches that engages the people who produce science and technology with those who need it. In so doing, the Science Collaborative seeks to make the process of linking science to coastal management decisions, practices, and policies more efficient, timely, and effective.

System-Wide Monitoring Program

It is the policy of the Delaware Reserve to implement the System-Wide Monitoring Program, guided by the NERR System-wide Monitoring Program Plan 2011.

The System-wide Monitoring Program provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purposes of contributing to effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national references sites. The program focuses on three different ecosystem characteristics.

1. *Abiotic Variables*: The monitoring program currently measures pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, water level and atmospheric conditions. In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Each reserve uses a set of automated instruments and weather stations to collect these data for submission to a centralized data management office.
2. *Biotic Variables*: The reserve system is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available.
3. *Watershed and Landuse Classifications*: This component attempts to identify changes in coastal ecological conditions with the goal of tracking and evaluating changes in coastal habitats and watershed land use/cover. The main objective of this element is to examine the links between watershed land use activities and coastal habitat quality.

These data are compiled electronically at a central data management “hub”, the Centralized Data Management Office (CDMO) at the Belle W. Baruch Institute for Marine Biology and Coastal Research of the University of South Carolina. They provide additional quality control for data and metadata and they compile and disseminate the data and summary statistics via the Web (<http://cdmo.baruch.sc.edu>) where researchers, coastal managers and educators readily access the information. The metadata meets the standards of the Federal Geographical Data Committee.

Delaware NERR Research Plan Overview

Estuaries are important to the nation’s economy and recreation, and are an integral part of the Earth’s environment as a whole. Understanding and protecting this resource has become increasingly important due to climate change, unsound land-use practices, and the increased population of coastal areas, which contribute to the degradation of estuaries. There is a need for management-oriented research to define management strategies that allow for multiple land uses, while minimizing detrimental environmental and ecological impacts upon estuaries.

The NERRS emphasis on management-related or management-oriented research is provided in 15 CFR Part 921, Subpart F. A major priority of each reserve in the System is to coordinate, facilitate, and conduct management-oriented research, which will provide information useful for local, regional, and national coastal management decision-making. The creation of permanent field sites for management-oriented research is an important step toward a more comprehensive and integrated program of research, monitoring, and management.

The Blackbird Creek Reserve Component and St. Jones Reserve Component, which includes the St. Jones River sub-component and the Delaware Bay sub-component, of the DNERR expand researchers’ opportunities to perform long-term studies in representative ecological zones of the Delaware Bay Estuary. The three sites in the two components provide the opportunity to observe and explain basic functions of, and changes in these natural estuarine systems, and to apply this information to other estuarine systems along the mid-Atlantic coast. The two Reserve components are managed, in part, to maintain their relatively undisturbed character and serve as controls to compare to other areas outside the Reserve. However, they may be modified or manipulated to accommodate research needs and maximize their research utility. Any habitat manipulations must follow guidelines provided in 15 CFR 921.60 (a) (10).

The characterization of habitats and the natural and anthropogenic impacts that contribute to habitat degradation, change or loss are the research and monitoring task of greatest importance to the DNERR and are relevant to the entire Delaware Estuary.

In addressing these issues, the objectives of the Reserve’s Research and Monitoring Program are:

Goal: Improve the scientific understanding of estuarine and coastal ecosystems and the human influence on them.

- Conduct and coordinate research in the DNERR ecosystems that increases the scientific understanding of the Mid-Atlantic estuaries and coastal ecosystems;
- Promote the use of Reserve's components by State or Federal agencies, academic institutions, and local or private environmental organizations as long term field laboratories;
- Assess and monitor the status of estuarine habitats in the DNERR in order to track short-term variability and long-term changes in estuarine habitats and communities; and
- Use information acquired as part of the DNERR Research and Monitoring Program to provide technical assistance and advisory services that contribute to efficient and effective management of estuaries and coastal resources in the State of Delaware and Mid-Atlantic Region.

The DNERR identifies and promotes research topics that are of particular interest to coastal resource managers in Delaware and the Middle Atlantic region. These topics may be modified based on Reserve and site-specific management needs that are identified through initial baseline surveys and environmental monitoring. Current critical research and monitoring topics for the DNERR are:

- Effects of Climate Change and Sea Level Rise
- Biodiversity, Health and Sustainability of Estuarine Habitats
- Mapping of Estuarine Habitats
- Restoration of Estuarine and Riparian Habitats
- Management of Estuarine Resources and Wildlife

All DNERR-directed research and monitoring will be consistent with 15 CFR 921 subparts F and G which regulate special research and monitoring projects, allowing for projects within the Reserve boundary and to a lesser extent the immediate watershed of the Reserve beyond the site boundaries.

Delaware NERR System Wide Monitoring Program

The DNERR currently supports three water quality datalogger sites and one meteorological station in the St. Jones River watershed and three water quality dataloggers and one meteorological station in the Blackbird Creek watershed. In addition, at all sites water samples are collected monthly to be analyzed for nutrients and chlorophyll and one site once a month is sampled every 2.5 hours through the tidal cycle.

Biological monitoring infrastructure will be in place by 2013 and includes the development of a long-term monitoring site in the St. Jones marsh to track marsh health and species change.

Sediment Elevation Tables (SETs) are located in the St. Jones River watershed and Blackbird Creek watershed. The purpose of the SETs is to monitor the short-term and long term changes in marsh elevation due to local subsidence, biomass changes, accretion and sedimentation. The Reserve watershed SETs are located to examine marsh surface changes along the salinity gradient.

The DNERR will supplement statewide habitat maps, which are currently produced on a 5-year basis with higher resolution data inside the Reserve boundaries as deemed necessary for research and management.

Delaware NERR as a Sentinel Site

The protected status of the Reserve, and its long-term monitoring capability and datasets, make the site an ideal sentinel of longer term climate change. The Delaware NERR, St. Jones Reserve component will build upon SWMP and its bio-monitoring plan by focusing data collection and measurements on specific climate related issues as resources are available by adapting NERRS guidelines for becoming a Sentinel Site. The ultimate goal of the NERRS Sentinel Sites Program in relationship to a larger NOAA Sentinel Site Program is to help determine reserve vulnerabilities to climate change (initially, sea level change and inundation and habitat response), and to translate our understanding to coastal communities and coastal managers.

Collaborative Research

Research should engage a holistic approach to watershed management and its effects on the estuary. Environmental studies may include experimental research relating to natural resources, cultural resources, or socioeconomic topics. Collaborative investigations will be approved and may be supported based on the research priorities of the NERRS Research Plan, NERRS Monitoring Program, DNERR Management Plan, or critical issues identified by coastal managers.

On-site Research Projects

It is anticipated that the DNERR research program will be most helpful in addressing coastal issues that require technical information which is best obtained via empirical study (e.g., controlled testing of alternative hypotheses) or by descriptive surveys, particularly if the issues require inventory of biotic populations or assessments of ecological systems of environmental processes.

Specific factors that contribute to the DNERR's research value include:

- Current baseline databases of water quality, meteorological, and habitat data for use in long-term studies and for making comparisons to other areas;
- An on-site Coastal Resource Library of research and reference materials on various estuarine and coastal topics to aid researchers;
- Availability of data collected on-site and at other National Estuarine Research Reserves;
- Availability of the Reserve's components to the research community as long-term field laboratories;
- The ability to disseminate research results and other pertinent information to local/regional decision-makers quickly and effectively;
- Laboratory facilities, field monitoring stations, and scientific equipment and gear necessary to support various research and monitoring efforts; and
- The ability to coordinate research between other organizations or institutions for the facilitation and augmentation of Reserve research and monitoring projects.

Researchers who would like to work within Reserve boundaries should review the Research Policies and Procedures (Appendix J).



DELAWARE NERR RESEARCH AND MONITORING OBJECTIVES AND ACTIONS

Goal: Improve the scientific understanding of estuarine and coastal ecosystems and the human influence on them.

Objective 1: Conduct and coordinate research in the DNERR ecosystems that increases the scientific understanding of the Mid-Atlantic estuaries and coastal ecosystems.

Action: Prioritize research on coastal management issue needs and data gaps annually.

Action: Assist state and federal agencies in evaluating the effects of climate change and sea level rise.

The DNERR staff, with their knowledge of the watershed monitoring and modeling experiences, will assist other state and federal agencies in evaluating the effects of climate change and sea level rise, based on research and monitoring conducted in DNERR ecosystems. These actions would incorporate the use of predictive models and acquisition of historic data to evaluate differing management strategies for coastal resources.

Action: Pursue and support research on riparian and estuarine habitat restoration.

The DNERR will actively pursue and support research on riparian and estuarine research. The Blackbird component will serve as the primary location for riparian activities. The DNERR will partner with the State Division of Fish and Wildlife and the US Fish and Wildlife Service to assist in restoration of tidal wetlands and coastal impoundments under their jurisdiction.

Action: Work collaboratively with coastal decision makers to provide research and information for effective management of estuarine and coastal resources.

The DNERR will provide scientific support through data collection, data and trend analysis, targeted research and predictive modeling related to DNERR ecosystems to examine management scenarios of estuarine resources of the state and region. The DNERR, will work cooperatively with the DCMP and other national/international agencies (e.g., USGS, USCOE, UD, DNC, BTO) in research that provides information for the proper management of estuarine resources including wildlife management and restoration efforts.

Objective 2: Promote the Reserve's components in the research community as long-term field laboratories to be used by State or Federal agencies, academic institutions, and local or private environmental organizations.

Action: Support critical estuarine research with available resources and facilities.

The DNERR, by awarding research support funds to qualified institutions or agencies will allow for the examination of critical research topics beyond the scope of the DNERR (staffing, expertise, equipment, etc.). These funds will be targeted to specific topics of concern of the DNERR as they relate to estuarine management.

Action: Develop and maintain partnerships and cooperative efforts with other research organizations or institutions to facilitate and augment research and monitoring projects to meet the goals of the Reserve.

Action: Enhance research facilities, field monitoring stations and scientific equipment and gear as necessary to support the Reserve's research and monitoring efforts.

Action: Continue to develop the on-site library's collection of research and reference material and data repository.

Action: Recruitment of researchers through various strategies including: increased publicity, development of database catalogue, increased DNERR presence in local coastal/estuarine meetings, public events, participation in research symposia, conferences, workshops, internship programs, announcements of available data and research opportunities.

Recruitment strategies include:

- Increased publicity of facilities and opportunities, including available data and GIS coverages, through academic seminars and other professional functions
- Development of a database catalogue to include available field data sets, maps, aerial photos, and GIS coverages, for distribution to researchers
- Increased DNERR presence in local coastal/estuarine meetings, gatherings, and public events
- Participation of DNERR staff in research symposia, conferences, and workshops
- Internship programs for graduate students or upper-level college students, funded by Federal, State, or other sources
- Announcements of pertinent estuarine information to local researchers
- Annual announcements of DNERR research opportunities, NOAA research funds, and other pertinent funding opportunities

Action: Provide internship opportunities for university students and recent graduates to acquire hands-on experience and understanding of issues facing coastal and estuarine resources.

The DNERR currently offers a small internship program for university students. Generally, one seasonal position per year is available to individuals who are majoring in an environmental discipline or who express an interest in the field. An internship in the Reserve's Research and Monitoring Program is an opportunity to assist with meaningful experimental projects in the field. Students gain hands-on experience and an understanding of the many issues facing estuarine environments. Local universities have responded positively to this opportunity and there has been no shortage of candidates. However, the internship program may be limited due to supervisory and funding constraints.

Objective 3: Assess and monitor the status of estuarine habitats in order to track short-term variability and long-term changes in estuarine habitats and communities.

Action: Examine and catalogue the biodiversity of the DNERR estuarine habitats including establishing a long-term monitoring location (sentinel site) to provide long-term evaluation of marsh biodiversity.

The DNERR will examine and catalogue the biodiversity of the DNERR estuarine habitats. Based on field sampling and remote sensing technologies the health and sustainability against climate change will be determined. Where partnership support is available, and where the studies are applicable to DNERR ecosystems, this process will be applied in other regions of the estuary. Long-term monitoring location(s) (sentinel site) will be established to provide long-term evaluation of marsh biodiversity.

Action: Support the development of improved GIS habitat data for the Reserve and surrounding watersheds

The DNERR will cooperate with other State agencies in benthic mapping of portions of the Delaware Estuary. The DNERR will support the development of improved GIS habitat data coverages of the Reserve and surrounding watersheds, this includes DNERR compatible maps with the statewide wetland/upland habitat maps.

Action: Continue involvement in the NERRS System-Wide Monitoring Program

The DNERR will participate and assist in the implementation of any additional SWMP initiatives as set forth by the NERRS. If the DNERR staff have expert knowledge or experience in any SWMP initiative, their participation on the relevant committees will be encouraged.

Action: Establish DNERR as a Sentinel Site.

Collecting and building baseline databases for use in long-term and interdisciplinary studies, for monitoring differences over time, and for making comparisons to other areas to increase the knowledge of habitats and anthropogenic changes

Objective 4: Provide technical assistance and advisory services that contribute to efficient and effective management of estuaries and coastal resources in the State of Delaware and Mid-Atlantic Region.

Action: Transfer of Research Findings to Education Programs.

The research staff will assist the education staff in the development of materials based on DNERR research and monitoring findings to be used in the DNERR's education programs. Information gathered through the activities of the DNERR research and monitoring programs, including the management implications of this information, is made available to decision-makers and the public in understandable forms.

Action: Disseminating research results and other pertinent information to local/regional/national decision-makers and the community to foster proper management and protection of the estuarine ecosystem.

The DNERR encourages the dissemination of research results at the national level through journal articles in peer-reviewed literature, presentations at professional societies, and estuarine/coastal symposiums. In addition, the DNERR utilizes other avenues of information exchange, when appropriate, including workshops and conferences at the Reserve, articles in journals of local organizations, press releases to local media, direct mailings to State and local decision-makers, and participation in conferences about local estuarine/coastal issues.

Research and Monitoring Opportunities at Delaware NERR Components

St. Jones Reserve Component

The St. Jones River sub-component offers several attractive features for estuarine research, primarily because of its accessibility and the juxtaposition of an urbanized, developed upper watershed with an agrarian, relatively undisturbed downstream component.

Being adjacent to intensely managed State Wildlife Areas offers opportunities to develop and evaluate habitat enhancement or restoration methods. It is probable that most habitat management manipulations would occur on the proactively managed Wildlife Areas, with much of the St. Jones Reserve component serving a control function. However, carefully planned and sited habitat manipulations could still occur in the DNERR component on a limited scale for research purposes. It is anticipated that the primary habitat management research topics (on-site or off-site) would focus on restoration and management of impounded marshes for multiple resource objectives; on mosquito-abatement practices; on phragmites control; on management of waterfowl, migratory shorebirds, horseshoe crabs, and upland game species; on management for endangered or rare species; and on effects of sea-level rise on emergent wetlands.

Basic ecological studies on structure and function of mesohaline-polyhaline emergent wetlands could be an important component of the Research and Monitoring Program. Studies of commercial fisheries for blue crabs, oysters, shad, white perch, weakfish, striped bass, and eels could be conducted in the adjacent open waters of Delaware Bay and in the lower end of the St. Jones River, and results of these studies will enhance the understanding of DNERR ecosystem structure and function. Research opportunities in the Lower St. Jones River basin also exist to assess the impacts of farming practices on the estuary, particularly in terms of nonpoint source runoff of nutrients, sediments, and pesticides going either into the headwaters of tidal tributaries or into the upper wetlands fringes. New or innovative farm management practices designed to lessen these problems could be implemented and evaluated.

Because of the rich historical and cultural database already existing for the Lower St. Jones River, the component will lend itself to analyses of estuarine impacts or uses associated with many past activities by humans.

With the upper end of the St. Jones River watershed heavily developed by the growing city of Dover, there are excellent opportunities along an approximately 5-mile segment of the river, just upstream from the Reserve's western boundary, to examine the impacts of urbanization on the estuary. Research emphasis could be given to the impacts of commercial and residential development on nonpoint source pollution into the headwater tributaries and upper wetland fringes, particularly from stormwater runoff; on point-source discharge impacts from industry (a power plant and two manufacturers who conduct permitted discharging); and on groundwater and estuarine surface water pollution problems associated with vertical and lateral leaching from an abandoned landfill.

The Delaware Bay sub-component to the St. Jones River Component provides extensive intertidal and subtidal research opportunities in the Delaware Bay. This area is representative of much of the western Delaware Bay waterfront and nearshore. It is one of the preferred spawning areas for horseshoe crabs and the consequential foraging area of migratory shore birds. This portion of the reserve can be used for studies of tributary influx to the Delaware Bay. The Delaware Bay sub-component is to the east of the State owned Ted Harvey Wildlife area and as such there is minimal human activity along the beach face allowing for undisturbed research activity.

Blackbird Creek Reserve Component

The diversity of estuarine habitats found at Upper Blackbird Creek, and how they differ from those found at the Lower St. Jones River, is a major attribute of interest to environmental researchers. Some of the least-understood estuarine zones, in terms of ecological structure and function, are brackish and tidal freshwater marshes. The interconnection of upland and marine environments starts in these zones, so a better comprehension of oligohaline-limnetic systems should yield benefits to our overall understanding of estuarine ecosystems. The Blackbird Creek Reserve component provides outstanding examples of these transitional habitats.

Other research opportunities within or near the Blackbird Creek Reserve component include studies of agricultural practices in terms of effect on estuarine biota or processes, and studies in land-use planning in terms of contending with burgeoning residential development. In the most seaward portion of the Reserve, and then for several miles downstream of this area, are some of the State's most dense and extensive phragmites stands, providing substantial opportunities for basic and applied research studies of this problem species. The site's proximity to complexes of freshwater wetland swales, the Delmarva Bays, should be of interest to hydrologists, botanists, and herpetologists.

The Blackbird Creek Reserve component also provides opportunities for archaeological and historic research. The Blackbird Creek drainage is north of the prehistoric range of oysters and provides a significantly different environmental setting for human groups. Historical research for the Appoquinimink drainage, just north of the Blackbird Creek site, indicates significant impacts from cultivar-induced siltation within 20 years of the first European settlement.



COORDINATION AND PARTNERSHIPS

Coordination

A major benefit offered by the DNERR is the potential for coordination of research and monitoring efforts. The Reserve offers permanent places where various institutions can implement their projects and compare results to complement one another's work; through the DNERR, baseline data is compiled, assembled, analyzed, and made available for the use of other researchers, coastal managers, and the public. Research coordination also reduces unnecessary duplication and effectively decreases the cost of publicly supported research.

Coordination of Reserve Staff

To enhance the Reserve's abilities through collaboration, the research staff seeks to enhance communication and program consistency among Reserve sectors and sites to ensure research and monitoring results integrated Reserve education and stewardship programs. The Reserve Manager will encourage this enhanced integration among DNERR sectors through regular staff meetings and encouraging participation of other sector staff in research efforts. Research staff will assist with the development of displays and the distribution of education and outreach materials and provide input on stewardship efforts. These activities will encourage the sectors to work together more efficiently as well as create a more integrated education program throughout Delaware.

Coordination with other Reserves and NOAA

The DNERR works closely with NOAA staff, especially NOAA's Science Coordinator, to develop and assess National Research Priorities. The DNERR Research Coordinator communicates with estuarine Research Coordinators in other states, particularly other Mid-Atlantic States, on common issues.

Data from the DNERR contributes to the long-term national network study monitoring the status and trends of estuarine ecosystems. Data from the NERRS makes a substantial contribution to the understanding of long-term ecological effects on estuaries and is useful in predictive trend analysis of ecological stresses. This coordinated research network aids greatly in understanding the theoretical and practical aspects of conservation and coastal resource management.

Coordination with Other Coastal and Estuarine Research Programs

Research coordination with NOAA and other Federal and State agencies is undertaken to ensure that studies are not being unnecessarily replicated by the DNERR, and to see if any research is being performed elsewhere on those topics that are identified as high priority by the DNERR. Other Federal agency programs with which coordination is highly desirable include the U.S. Fish and Wildlife Service (USFWS), the U.S. Geological Survey (USGS), and the Marine Fishery Councils. It will be very important to coordinate DNERR research efforts with the U.S. EPA's two National Estuary Programs (NEPs) in Delaware (the Partnership for the Delaware Estuary and Center for the Inland Bays) due to the shared priority issues including wetlands, living shorelines, climate change and sea level rise, water quality and habitat restoration. Example collaborative research efforts working with the Partnership for the Delaware Estuary include the Mid-Atlantic Coastal Wetland Assessment (MACWA) and monitoring system which was developed to determine the status of tidal wetlands in the Delaware Estuary and New Jersey's Atlantic Coast and has incorporated data from the Reserve's sentinel site infrastructure such as Sediment Elevation Tables (SETs).

It is also critical to coordinate research interests and efforts with other state agencies. Within the DNREC, all Divisions have various interests in applied estuarine research. In particular, coordination of research and consistency of activities between the DNERR and the DCMP is emphasized. Coordination of research can involve other State agencies: the Department of Agriculture, the Division of Historical and Cultural Affairs, and the Department of Transportation.

Of primary importance for research coordination is the interaction between the DNERR and nearby academic research institutions. Research is coordinated between the DNERR and the University of Delaware (UD) College of Earth, Ocean and Environment, with special attention to the Sea Grant College Program. Other UD programs with research links include the Colleges of Agricultural and Natural Sciences, Engineering, and Urban Affairs. Research coordination between the DNERR and Delaware State University focuses on the School of Agriculture and Related Sciences and their newly developed Masters Program in Natural Resources as well as the Environmental Cooperative Science Center (ECSC). The ECSC is a collaborative program between minority serving institutions and NOAA. Interactions with Wesley College in Dover are through their undergraduate and graduate Environmental Sciences Program.

The last area of DNERR research coordination is with private environmental organizations that perform either independent or cooperative estuarine research. These are not-for-profit organizations like Delaware Nature Society (DNS), The Nature Conservancy (TNC), or the Delmarva Ornithological Society. Research is also coordinated with any private consulting or engineering firm whose interests concern the research priorities of the DNERR.

Coordination with the Delaware Coastal Management Program

The DNERR coordinates with the Delaware Coastal Management Program on identifying priority coastal management issues and data gaps for the State of Delaware and Mid-Atlantic Region. It is anticipated that some research efforts that are relevant to DNERR Goals and Objectives will extend beyond the Reserve boundaries and into the associated watersheds. This research activity may occur outside the DNERR Watersheds, but this research will be directly tied to DNERR priorities. In particular, cooperative research associated within the inland bays (Rehoboth, Indian River, and Little Assawoman Bays) might occur. Although the extensive Delaware Bay system is an excellent representation of a drowned river, coastal plain estuary along the Mid-Atlantic coast, it is not characteristic of lagoon or bar-built estuaries, which are also common in the Middle Atlantic region. Delaware's inland bays are representative of these lagoon or bar-built estuaries, and research attention paid to these systems would give the DNERR an active role in examining all of the Middle Atlantic region's major estuarine habitat types. Off-Reserve projects will be conducted in partnership with the Delaware Coastal Management Program (DCMP). The DNERR may either function as the lead investigator or provide logistical and technical support to the DCMP. Each project will be evaluated for staffing and technical expertise requirements and for relevance to DNERR research priorities and objectives to determine which program to assign as lead investigator.

Partnerships

Delaware Environmental Observing System

The Delaware NERR has partnered with the University of Delaware, Delaware Emergency Management Agency (DEMA), Delaware Department of Transportation (DelDOT), Delaware Department of Natural Resources and Environmental Control (DNREC) to provide data along with the National Weather Service – Mt. Holly, NJ (NWS), National Data Buoy Center (NDBC), Delaware Geological Survey (DGS), U.S. Geological Survey (USGS), Delaware Solid Waste Authority (DSWA), U.S. Army Engineer Research and Development Center, Mid-Atlantic Regional Coastal Ocean Observing System, and the Integrated Ocean Observing System for the Delaware Environmental Observing System (DEOS).

DEOS is a support tool for decision makers involved with emergency management, natural resource monitoring, transportation, and other activities through the State of Delaware. The primary goal is to provide state agencies and the citizens of Delaware with immediate information about environmental conditions in and around the State. DEOS also archives data for historical environmental studies and research.

USFWS Cooperative Agreement

The Delaware Coastal Programs/Delaware NERR have undertaken a 5 year cooperative agreement with the U.S. Department of Interior, Fish and Wildlife Service with the goal to assess the vulnerability of Delaware's coastal impoundments and adjoining tidal marshlands to climate change and sea-level rise using a combination of field observations and predictive modeling, and to support Region 5 – Coastal Wetland Impoundment and Sea-Level Rise Structured Decision Making (SDM) Case Study by providing the technical and scientific data needed for a refuge SDM-monitoring program on the Coastal Delaware NWR Complex.

PROTECTING AND RESTORING COASTAL AND ESTUARINE LANDS: stewardship plan





STEWARDSHIP PROGRAM OVERVIEW

Per its authorizing legislation, the Coastal Zone Management Act (CZMA), the 28 National Estuarine Research Reserves are to be managed to ensure that Reserve ecosystems continue to be available for long-term estuarine research, education, and interpretation. The Delaware National Estuarine Research Reserve (DNERR) seeks to maintain, protect, and preserve the designated components for National Estuarine Research Reserve System (NERRS) purposes, while providing public access and allowing compatible traditional uses consistent with primary Reserve objectives. Implementation of the stewardship plan maintains the DNERR as a scientific and educational resource and information base, designated to foster more informed management of estuaries.

The overall goal of stewardship in the DNERR is to protect or restore the land and water resources of the Reserve while promoting biodiversity and conserving sensitive species and their habitats through resource protection, habitat management, public outreach and ensure a suitable environment for coastal research and education. The DNERR stewardship plan provides a coordinated, proactive framework to address Reserve management responsibilities and federal/state obligations. This plan also constitutes the resource protection plan.

Stewardship of the DNERR involves direct protection of existing resources within the Reserve as well as the acquisition and/or protection of additional land within the two Reserve components. Stewardship efforts are designed to preserve existing resources within the Reserve and are vital to all other goals and objectives of the DNERR.

Resource Protection and Management

Along with research and education, resource protection is a major emphasis of the DNERR. Estuaries are among the most biologically productive systems on Earth. The productivity and integrity of the Reserve's resources must be protected in order to provide a stable environment for research and education programs, which are used to address coastal management issues.

It is important to note that both DNERR components are home to Federally protected species. The St. Jones Reserve component habitats include Bald Eagles (*Haliaeetus leucocephalus*) and Swamp Pink (*Helonias bullata*). The Blackbird Creek Reserve component habitats support Bald Eagles (*Haliaeetus leucocephalus*), Swamp Pink (*Helonias bullata*), and Small Whorled Pogonia (*Isotria medeoloides*).

Resource protection relies on the coordinated efforts of all the DNERR programs. It also relies on a number of existing Federal, State, and local laws and regulations, plus the efforts of Reserve staff and property owners. It is the responsibility of the Reserve staff to be knowledgeable of and involved with land-use issues, and not only in the vicinity of the Reserve components—a larger watershed-protection policy will be advanced as opportunities present themselves. Estuarine areas do not operate in isolated clusters. The Reserve's estuaries are the benefactors of all activities occurring within the surrounding watersheds. Their health reflects a community's efforts to protect water quality and wildlife habitat.

Any activity conducted on State-owned land or private land under cooperative agreements will adhere to a conservation plan acceptable to all cooperators. Resource protection will typically be addressed by restricting certain land-use activities; for example, sand and gravel operations will not be permitted on DNREC-controlled lands within the Reserve. Erosion and sediment control and stormwater management plans will be carried out to enhance water quality and quantity by limiting sediment, toxic, chemical, and waste-oil runoff. The use of insecticides, herbicides, and other toxic substances when necessary will be carefully planned and their application will follow all required or appropriate procedures. Pesticides with rapid breakdown and negligible effects on the environment can be used when necessary through prior coordination with or approval of the Reserve Manager.

DNERR staff will encourage any activities outside of and adjacent to the Reserve to be compatible with resource protection and conservation. Activities such as development, infrastructure concerns, and any land-disturbing action that occurs upstream from the Reserve or any of its tributaries may be monitored.

Research proposals and education programs will undergo a review for impacts on resource protection by the appropriate agency, Advisory committee, or Reserve staff. The type and scope of any project will be weighed against the need to maintain critical natural and cultural resources.

Research is a key use of the Reserve and is given a high priority in the management plan. Interference with research activities can disrupt the DNERR's efforts to achieve effective long-term management of the estuarine systems. Reserve staff will monitor research sites and will post signs identifying these sites. With the exception of samples taken for approved research and education programs, and fish and game taken from designated fishing, hunting, or trapping areas, nothing may be removed without prior approval of the Reserve Manager. Plants, animals, minerals, cultural resources, or any parts of these must remain to protect the integrity of these key areas.

Because the DNERR boundaries fall under a number of different and sometimes overlapping jurisdictions of local and State agencies, coordination and cooperation among all authorities is essential. Some of the State and local regulations directly affecting the Reserve are listed in the next section. The Reserve staff coordinates resource protection activities with the appropriate regulatory and other agencies' efforts to ensure that all State and local permits are completed and approved as necessary. Existing surveillance and enforcement is primarily handled directly by the DNERR during business hours, as well as through the DNREC Natural Resources Police. Local police units patrol the St. Jones Reserve component's access lane and respond to security alarms at the St. Jones and Blackbird Creek Reserves.

Laws and Regulations – Legal Authorities

The State exercises direct management control of the designated lands through ownership, conservation easement or legislative authority including the State Wetlands Act (7 Del. C. Chapter 66), Delaware Coastal Zone Act of 1971 (7 Del. C. Chapter 70), Subaqueous Lands Act, (7 Del. C. Chapter 72), Delaware Antiquities Act (7 Del. C. Chapter 53), The 1978 Natural Areas Preservation System Act (7 Del. C. Chapter 73), Conservation easement (7 Del. C. Chapter 69), Erosion and Sedimentation Control and Stormwater Management (7 Del. C. Chapter 40), Sediment and Stormwater Regulations, Endangered Species Act, (7 Del. C. Chapter 6), Wildlife and Fish Management (7 Del. C. Chapters 1-27), Hunting and Fishing Regulations, Environmental Protection Act (7 Del. C. Chapter 60), Land Use and Zoning Restrictions – New Castle County, Kent County, Public Lands, and State Parks (9 Del. C. Chapter 26, Chapter 30, Chapter 48, Chapter 49) (7 Del. C. Chapter 45, Chapter 47) and Surface Water Quality Standards (7 Del. C. Chapter 60). (Appendix E)

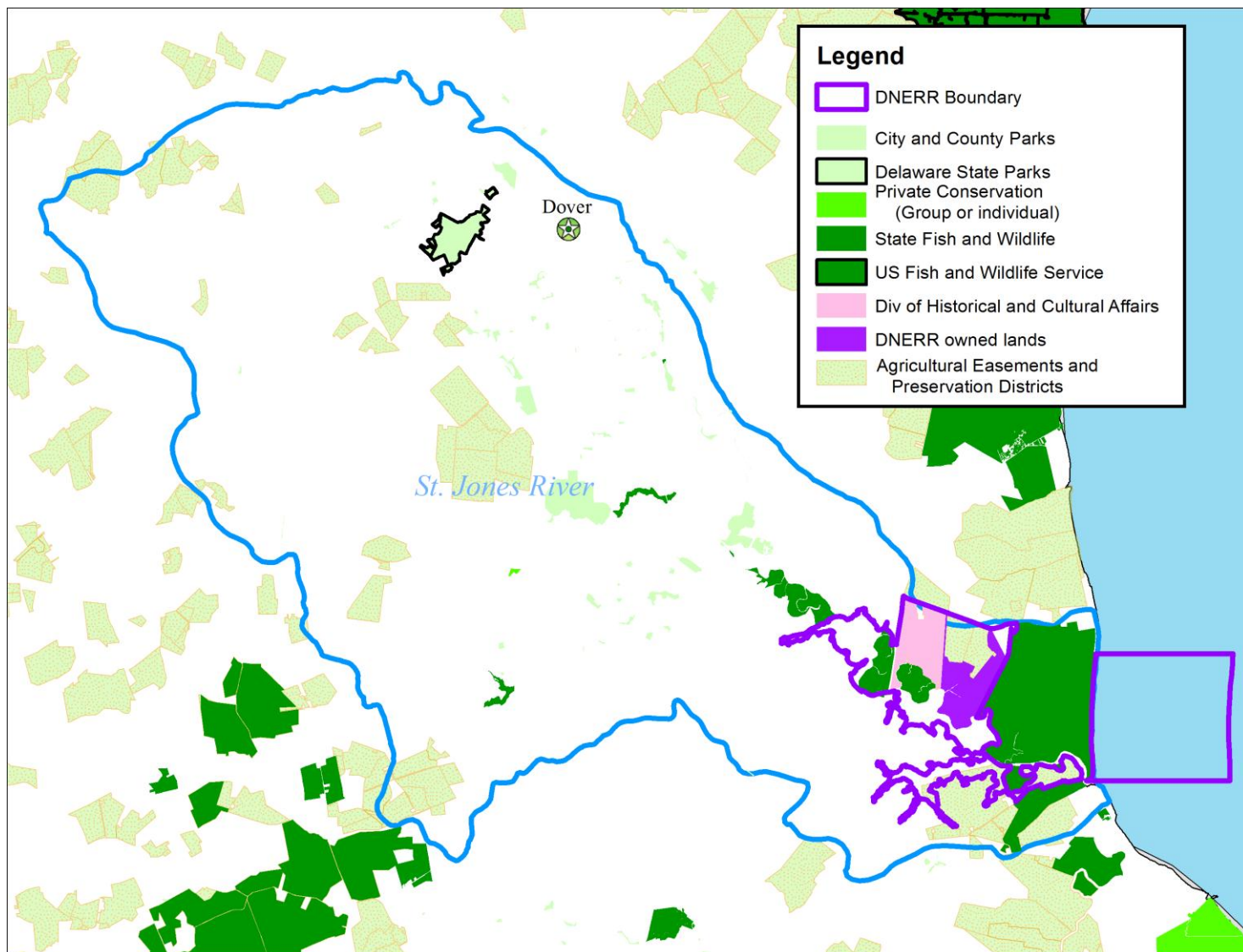
At the time of Reserve designation all private landowners were informed that a portion of their property was to be included in the Reserve buffer boundaries. The State Wetlands Act is the primary protection mechanism of private property within Reserve boundaries. The Reserve must receive permission from any private landowners to conduct research or education on their property.

Land Protection

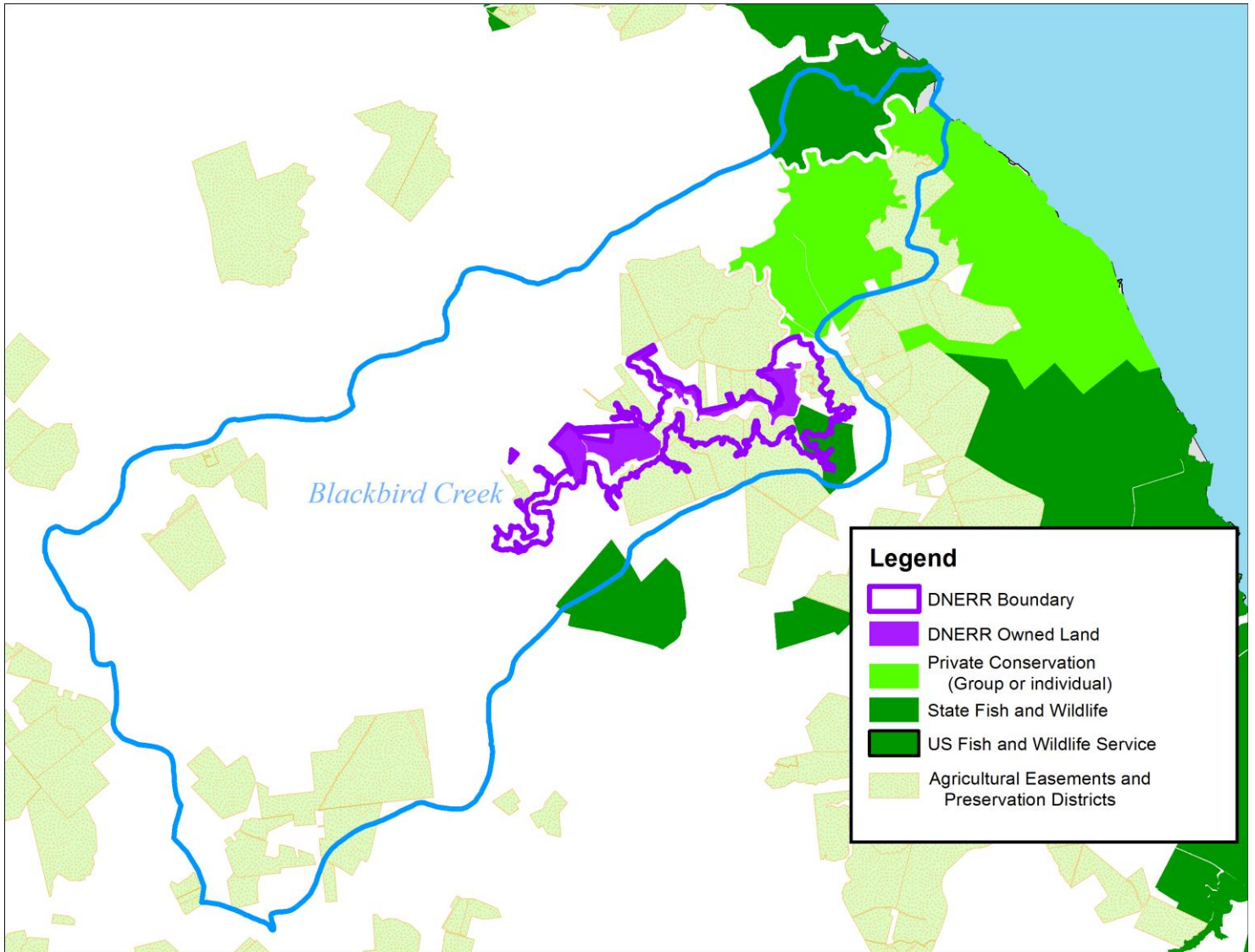
The DNERR encourages the protection of essential habitat and water-quality areas in the watersheds that contain each Reserve component. The main objective of the acquisition strategy is to promote protection of sensitive areas in and around the Reserve.

With the approval of this management plan, the DNERR will actively manage approximately 3,219 acres, divided between both Reserve components (Maps 10 and 11). Current staffing and funding are at sufficient levels to manage and maintain the Reserve property. The Reserve Manager is responsible for all land acquisition issues and plans. The Planning, Preservation, and Development Section of the DNREC’s Division of Parks and Recreation has responsibility for reviewing and handling DNREC land acquisition and protection programs.

Private ownership comprises a large portion of land. It is protected in one of two ways; a) the land is governed by the State Wetlands Act, whereby all property below the limit of the high tide line cannot be developed and, b) the property has a permanent conservation easement on it. The DNERR owns easements for land at its St. Jones component and the State Farmland Preservation Program has easements at the Blackbird Creek component. Both of these methods provide sufficient levels of protection for the Reserve.



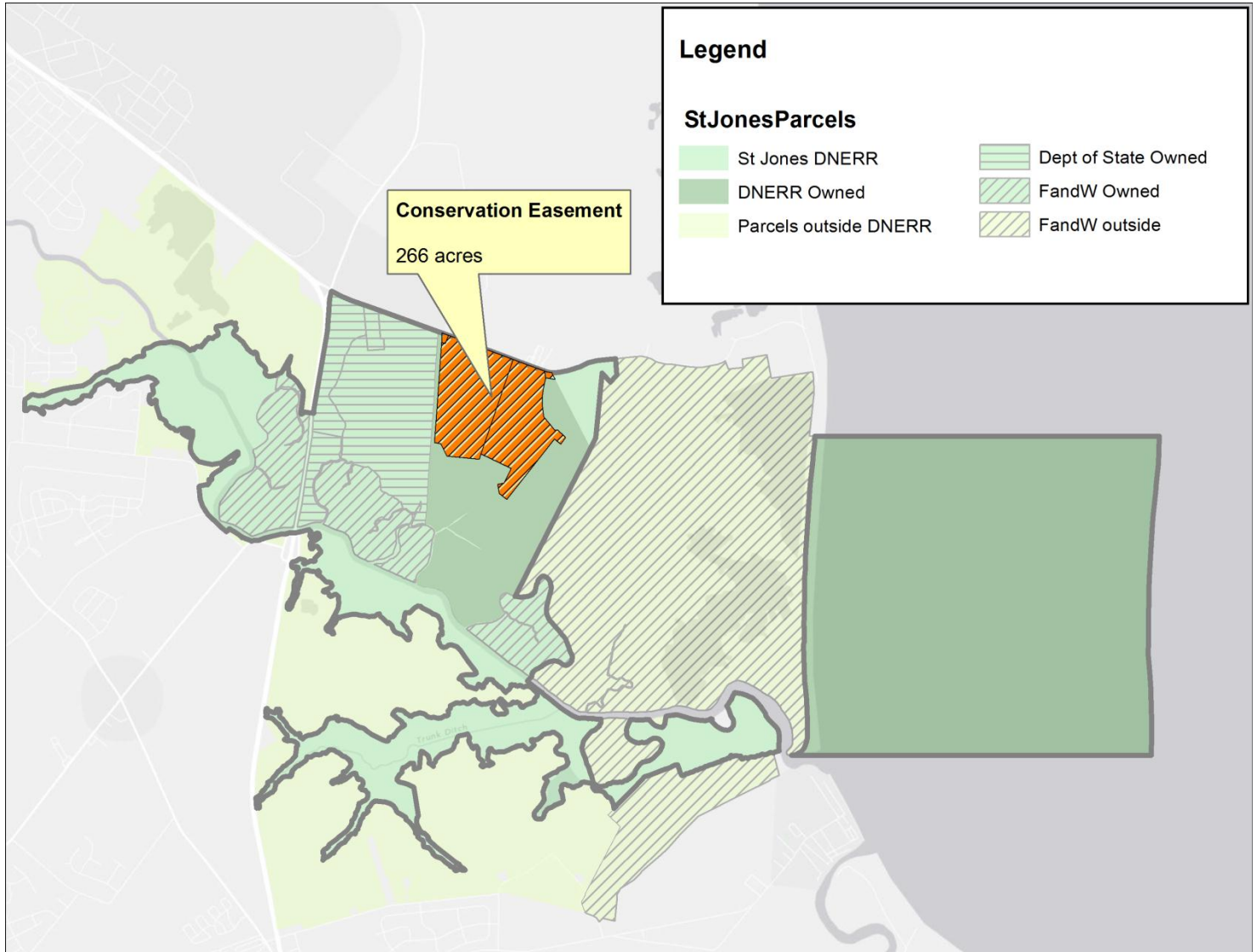
Map 6: Land Protection within the St. Jones River Watershed



Map 7: Land Protection within the Blackbird Creek Watershed

Conservation Easements

The Reserve holds one conservation easement on its buffer property in the St. Jones Component. The easement ensures permanent protection of the property by placing the following major restrictions: no more than five residences can be placed on the property, and only agricultural operations are allowed. Traditional uses are preserved and development is severely limited. (Map 8)



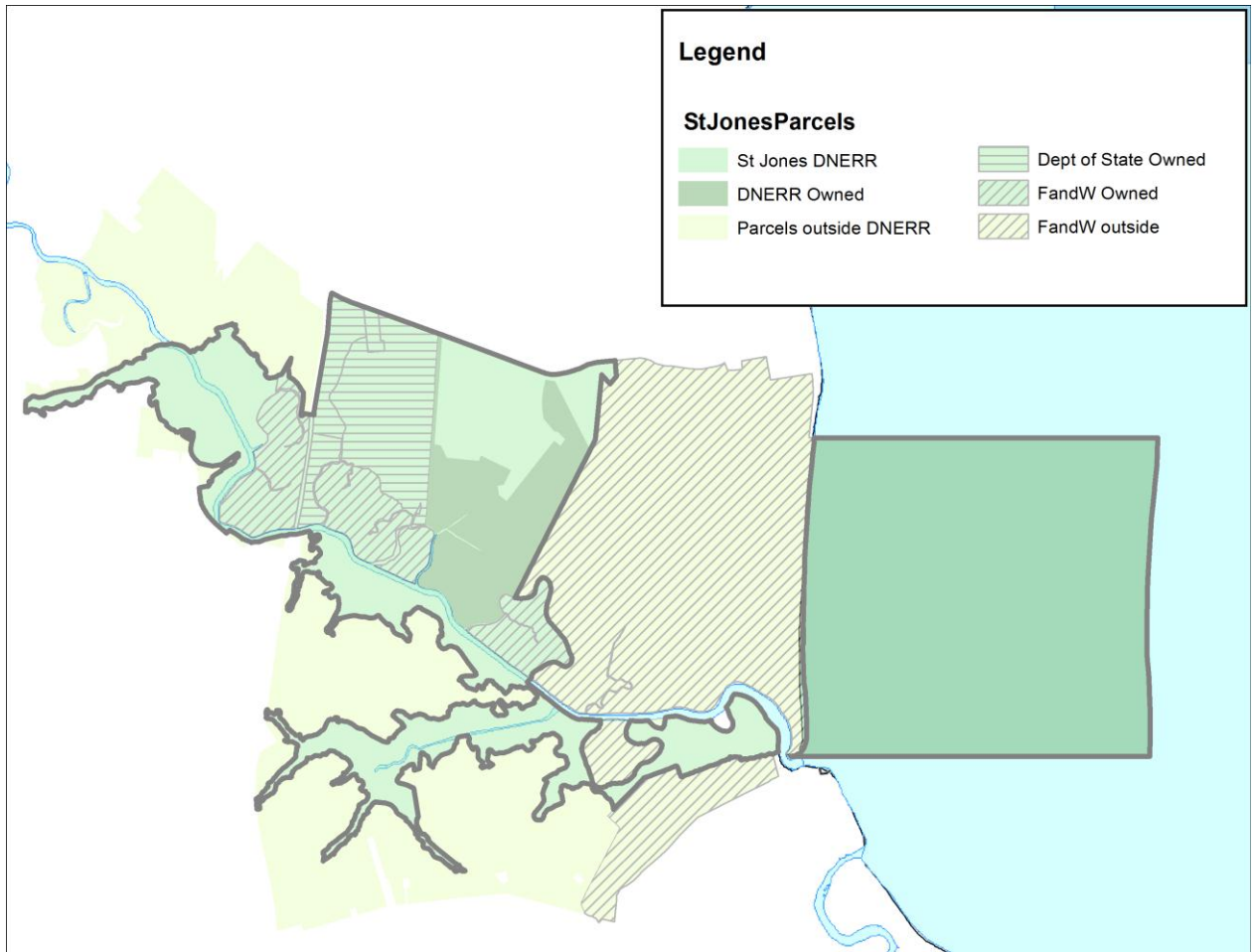
Map 8: Conservation Easement at St. Jones Reserve component

Land Acquisition

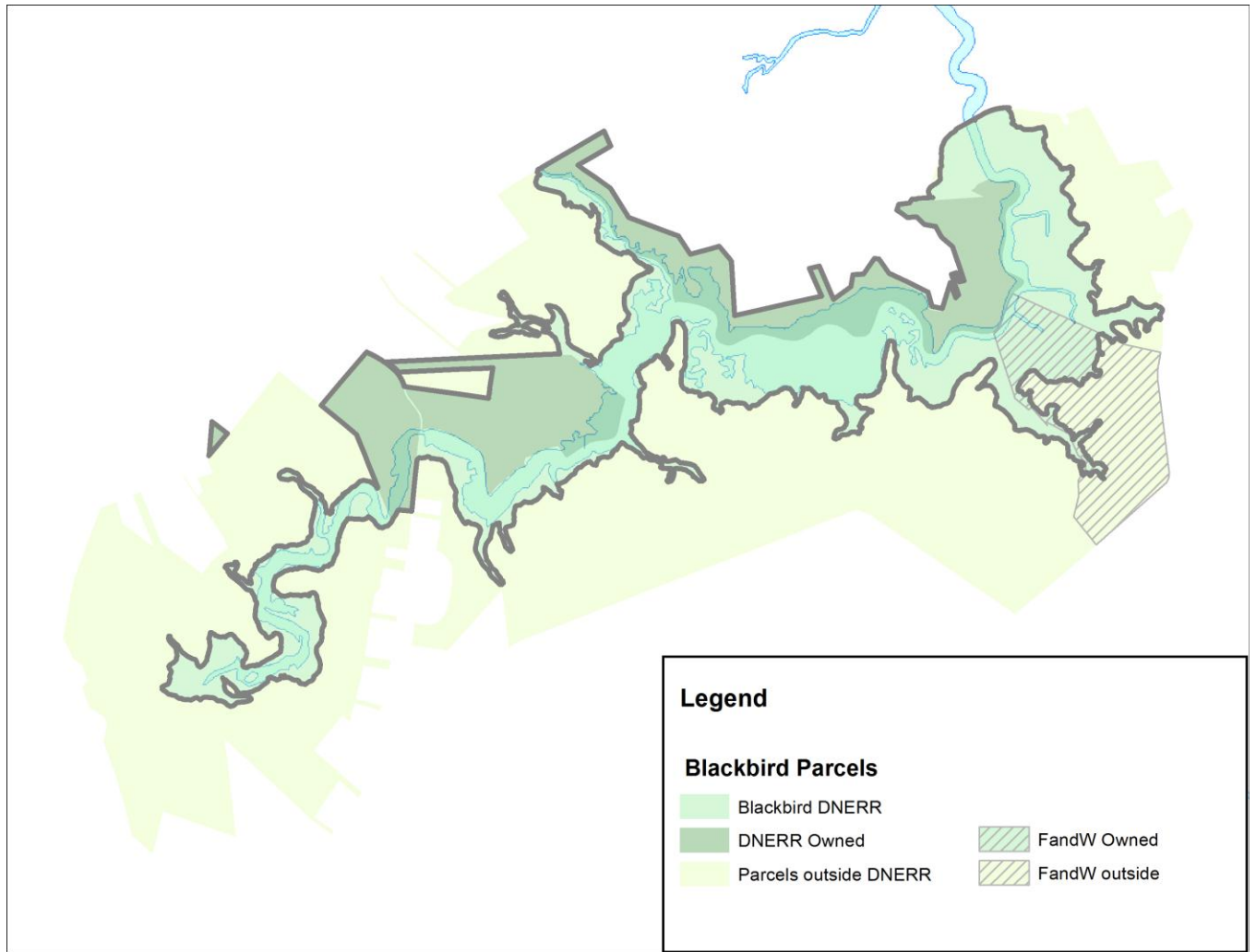
Watershed Protection

Reserve watershed protection is a significant consideration when acquisition priorities are being established. Secondary to that consideration is the protection of fragile estuarine communities around the State. It was suggested by the Advisory Committee that the DNERR take a keen interest in its “own backyard” prior to acquiring land in other areas. This opinion rang true and has been adopted as a guiding principle. There are significant issues of pollution, encroachment, habitat degradation, and invasive species within DNERR watersheds that can be addressed through local land purchases or conservation easements, whether by the DNERR, state agencies or other conservation groups such as The Nature Conservancy, Delaware Wild Lands, Delaware Nature Society, The Conservation Fund, etc. All coastal and watershed protection benefits State resources, including those of significance to the DNERR. Therefore, partnerships with other land conservation organizations, both public and private, are important. These partnerships generate mutual benefits within and outside DNERR core and buffer areas.

The Reserve benefits from environmentally active neighbors along the boundaries of both components. In the last five years the DNERR has attempted to raise awareness of environmental issues and activities. Maps 9 and 10 Show the level and types of land protection that are currently in place around both components. There are two distinct types of protection, State owned and conservation easements. The State owns property adjacent to both components, specifically DNREC’s Division of Fish and Wildlife and the Department of State Division Historical and Cultural Affairs. The DNERR enjoys an excellent working relationship with both agencies.



Map 9: Land Protection within the designated boundary of the St. Jones Reserve component



Map 10: Land Protection within the designated boundary of the Blackbird Creek Reserve component

“Core” and “Buffer” Areas

Key land and water areas are identified as that core area within the Reserve that is so vital to the proper functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the Reserve for research on natural processes. (15 C.F.R. Sec. 921.13) Key land and water areas are those ecological units that preserve for research a range of physical, chemical and biological factors contributing to the diversity of natural processes occurring within the estuary. The establishment of which specific areas are to be identified as “core” within the Reserve is determined by scientific knowledge of that area and the degree of scientific research occurring within that area.

Buffer areas of the Reserve are identified as those areas that are adjacent to, or surround, the key land and water (core) areas and are essential to maintaining their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species.

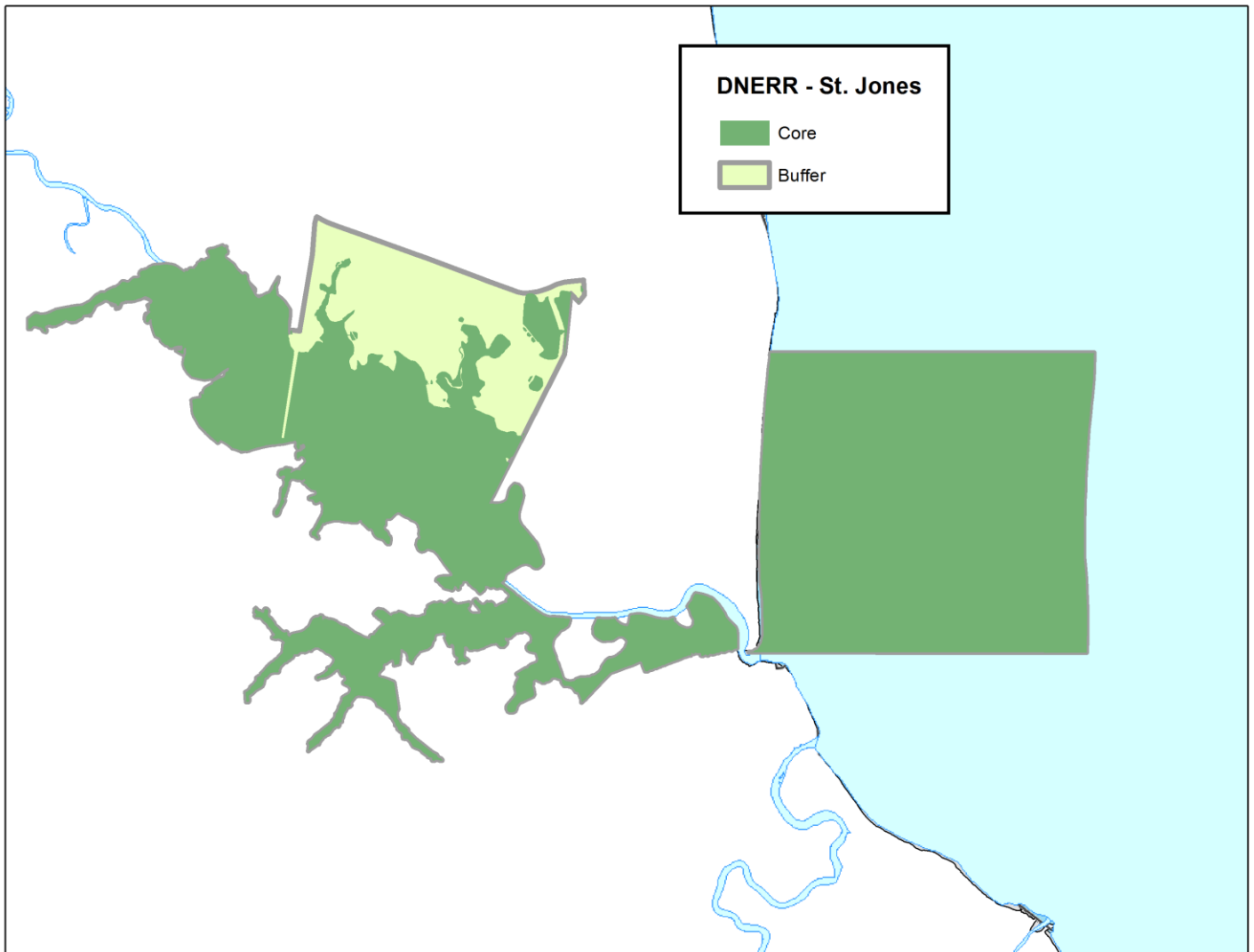
DNERR Core and Buffer Areas: Designation and Rationale

Core Area of the Delaware NERR

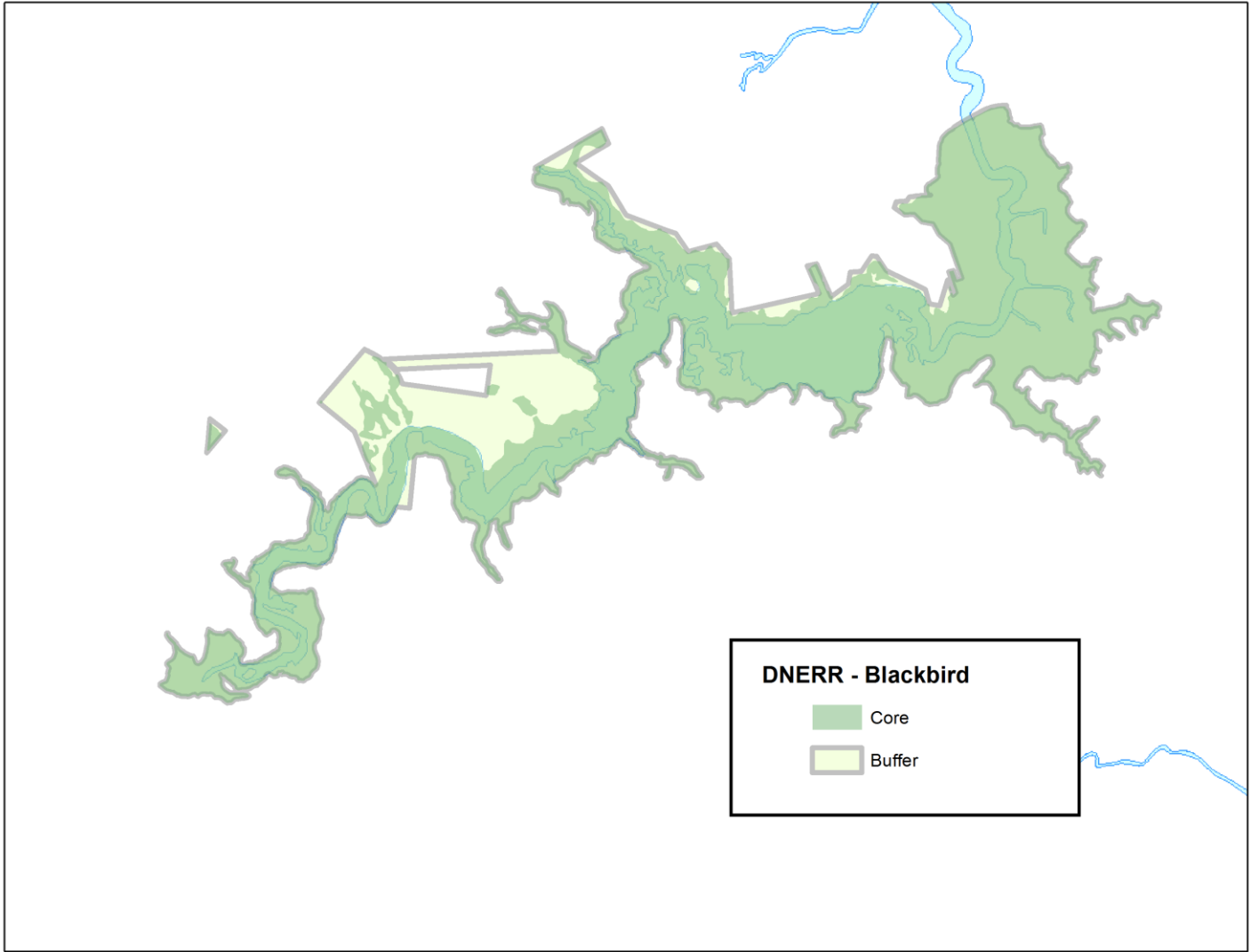
The core areas of the Reserve are the estuarine waters and associated tidal marshes within the designated boundary for the Reserve associated with the St. Jones River, Blackbird Creek and their tributaries. These core components ensure adequate, and direct, applications of state and federal control and management, providing sufficient protection to ensure the integrity of a stable platform for the continuation of ongoing scientific investigation.

Buffer Area of the Delaware NERR

The agricultural and wooded land within the Reserve boundary immediately adjacent to the core area defines the buffer area of the Delaware NERR.



Map 11: Core and buffer areas of the St. Jones Reserve component.



Map 12: Core and buffer areas of the Blackbird Creek Reserve component.

Acquisition Areas

Each Reserve component has a defined acquisition area. Maps 13 and 14 reflect the priority areas for land acquisition over the next five years. The acquisition maps reflect the areas that the Reserve is interested in acquiring properties, easements or facilitating protection by other public and private groups. The maps reflect distinctions between properties that are already protected. Any designated areas that are not held in State ownership are also included as priority acquisition areas. The identified areas allow the Reserve to focus on properties that border the current boundaries, but also on properties that will ensure the continued environmental quality of the surrounding watersheds. The priority for land acquisition is the fee-simple purchase or conservation easement purchase of any remaining properties held in private ownership that are in the designated boundaries. Secondary priority will be given to any properties that are contiguous to the Reserve boundaries.

St. Jones Component

Land acquisition/protection in the designated areas of the St. Jones Reserve component has been very successful with the efforts of the DNREC Division of Fish and Wildlife and the Division of Historic and Cultural Affairs. The property acquisitions by these Divisions have established a large corridor of protected land in which the DNERR is a significant component. Future land acquisition strategies by the DNERR will focus on the remaining unprotected areas.

Core area acquisition is the primary focus in the St. Jones Reserve component. Within the core area, special emphasis is placed on any land that adjoins the current DNERR boundaries or borders the St. Jones River. Over time, it is hoped that funds and willing sellers will be identified so that the remaining farmland adjacent to the Reserve will be purchased through fee-simple acquisition.

Expanding into these areas will allow for greater research, educational, and stewardship opportunities as well as provide space for future building expansions if they become necessary.

The Reserve will be focusing on land located on the southern side as well as upstream portions of the St. Jones River. Both fee-simple and conservation easements will be options exercised to permanently protect these areas.

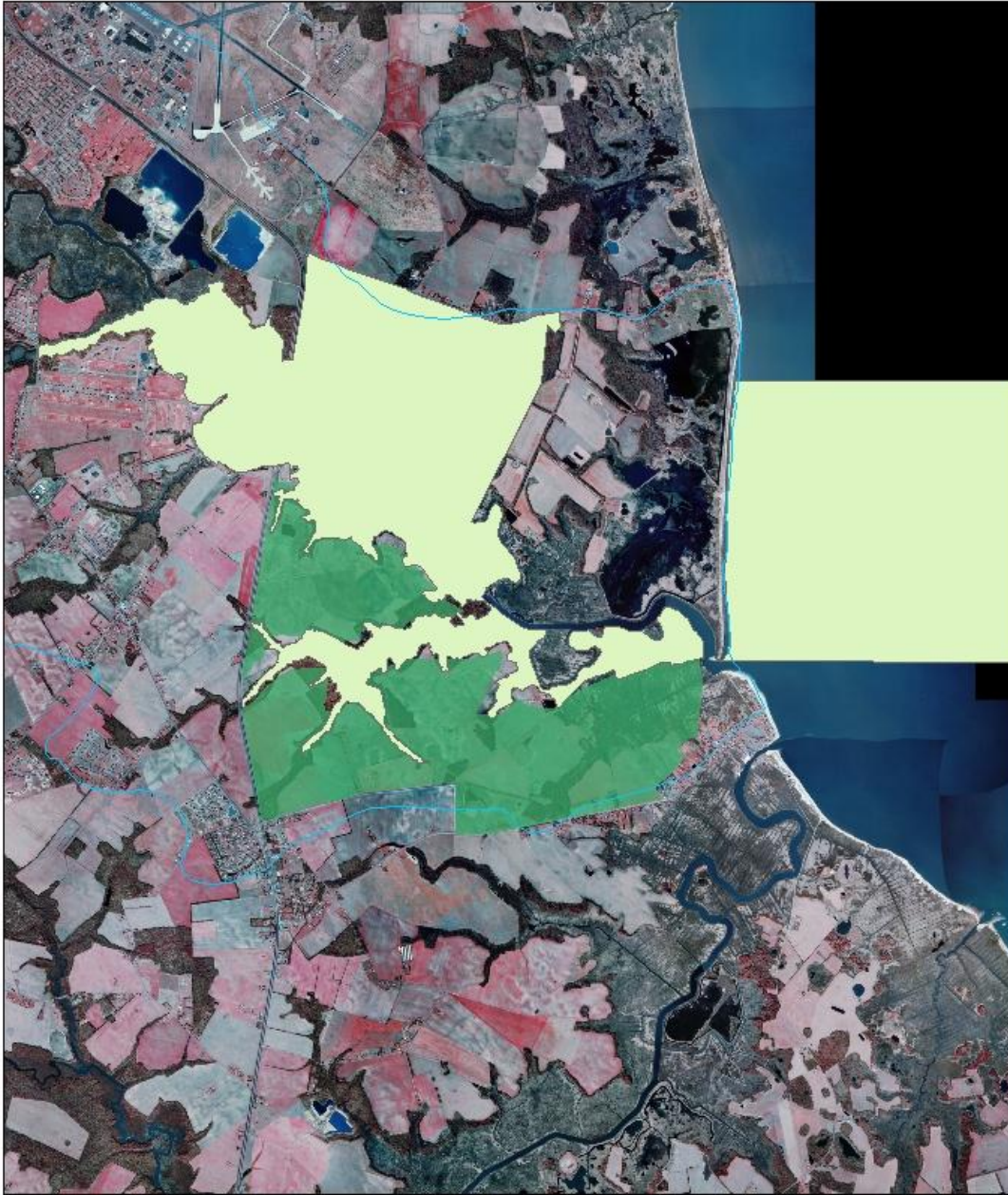
Acquisition priorities for the St. Jones Reserve component are:

- properties located within Reserve core and buffer areas
- farmland adjoining current core boundaries
- properties that lie along the St. Jones River
- properties that will enhance resiliency, preserve, or restore ecological function

Blackbird Creek Component

The Blackbird Creek designated areas are mostly comprised of properties that are privately owned but protected through easement or state regulation. State ownership of land in this area is significantly less than that around the St. Jones component. The location of the Reserve in relation to the growing development pressure in the area demands that land protection activities by the Reserve focus largely on the Blackbird Creek component. Local landowners have had remarkable success with conservation programs. The local community recognizes the ecological importance of the area and actively works to reduce development pressure. In particular, large portions of the privately held sections of core and buffer areas of the Blackbird Creek Reserve component are protected under Delaware's Farmland Preservation Program. Landowners who place their lands into Farmland Preservation agree to not develop their lands for at least 10 years, devoting the land only to agriculture and related uses. In return, the owners receive tax benefits, right-to-farm protection, and an opportunity to sell a preservation easement to the state that keeps the land free from development. The farming community in the Blackbird Watershed was a driving force in establishing this State administered program, and strong support still exists.

St. Jones Reserve Acquisition Priority Areas



This map was prepared by the Delaware National Estuarine Research Reserve for the Revised Management Plan. The information in this map is subject to change. The information provided is only an approximate geographical representation.

Delaware NERR/St. Jones Component

Acquisition Area
Watershed Boundary



Map 13: Acquisition priorities for St. Jones Reserve component

Fee-simple acquisition will be utilized when a willing seller has been identified and the property is of significant value. Conservation easements will also play a critical role. It is anticipated that a large portion of land that lies within the designated areas will remain in private ownership. Conservation easements, purchase of development rights, and promotion of farmland preservation have the potential to protect large portions of land while remaining cost effective and minimally increasing management responsibility for DNERR staff.

The DNERR places a priority on protecting core and buffer areas. Watershed protection, while extremely important and a component of the overall acquisition strategy, is secondary, unless properties of significant ecological importance become available.

Acquisition priorities for the Blackbird Creek Reserve component are:

- core and buffer area parcels
- property that will grant access to Blackbird Creek
- property that will enhance resiliency, preserve, or restore ecological function

Fee-simple versus Conservation Easements

When a property is identified for protection, based on the owner's willingness to sell and available funding sources, the DNERR will choose the appropriate method of protection. Determining factors will include the properties' management requirements, location, ecological value, and cost.

Fee-simple acquisition will be used to:

- acquire property in the Reserve's core and buffer areas
- expand Reserve boundaries into areas of high value to the research, education, and stewardship programs
- acquire property that helps allow wetlands to migrate with sea level rise, protects water quality and biodiversity within the St. Jones and Blackbird Creek Watersheds

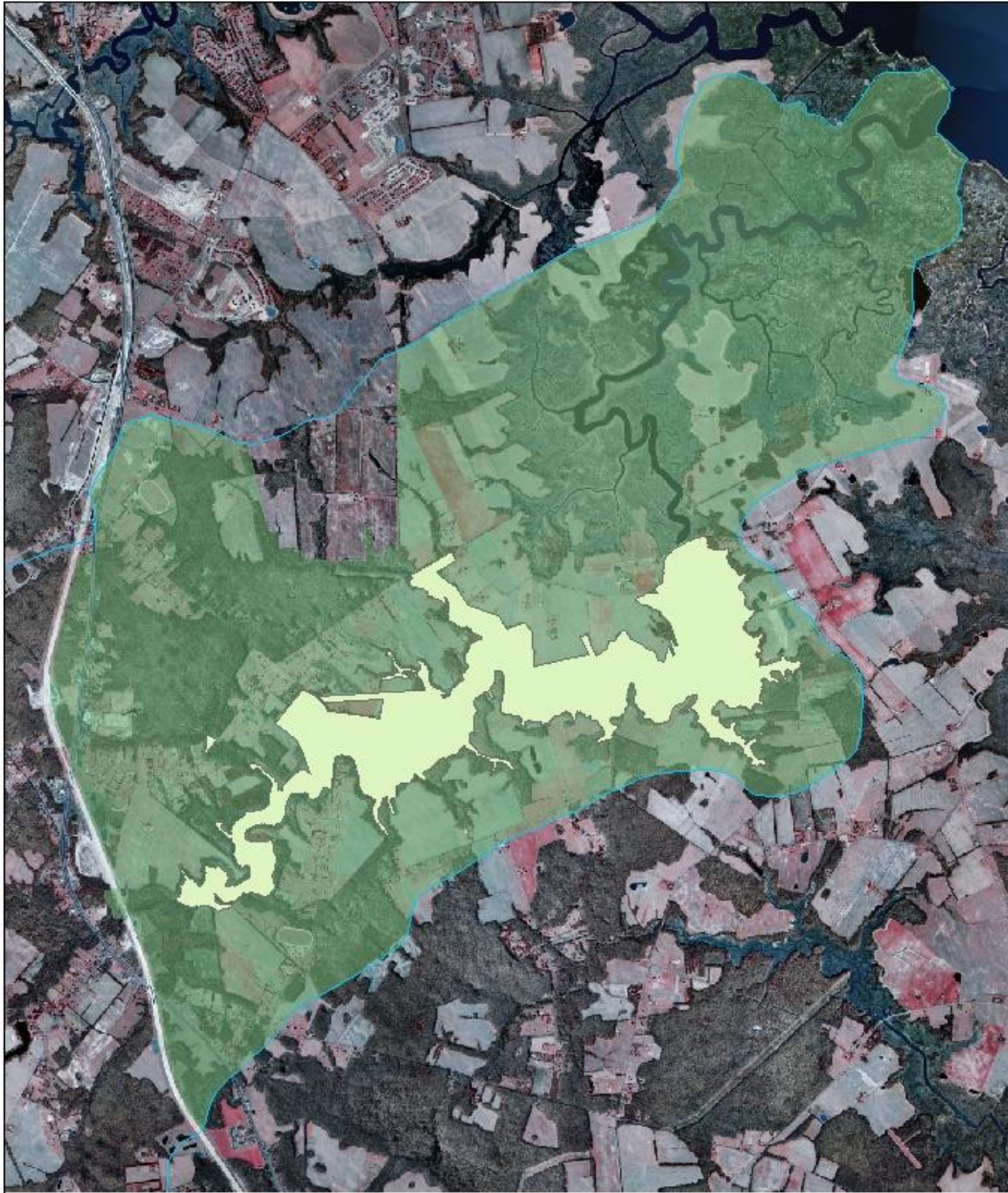
Conservation easements are valuable tools that will be used to leverage funding with acquisition/protection needs. Easements allow property to be protected while reducing costs and management responsibility, and ensuring permanent protected status.

Conservation easements will be used to:

- purchase development rights
- protect water quality and biodiversity within the St. Jones and Blackbird Creek Watersheds
- provide access for research and education programming
- protect property that holds significant ecological value



The decision to choose fee-simple acquisition over the purchase of a conservation easement rests on several factors. If a property offers adequate public access and will provide additional areas for research and education activities, fee-simple acquisition will be favored. If a property contains habitat typical of other Reserve holdings, has limited public access, or has owners that are unwilling to consider fee-simple acquisition, purchase of a conservation easement will be favored.

Blackbird Creek Reserve Acquisition Priority Areas



Delaware NERR/Blackbird Creek Component

This map was prepared by the Delaware National Estuarine Research Reserve for the Revised Management Plan. The information in this map is subject to change. The information provided is only an approximate geographical representation.

 Acquisition Area
 Watershed Boundary



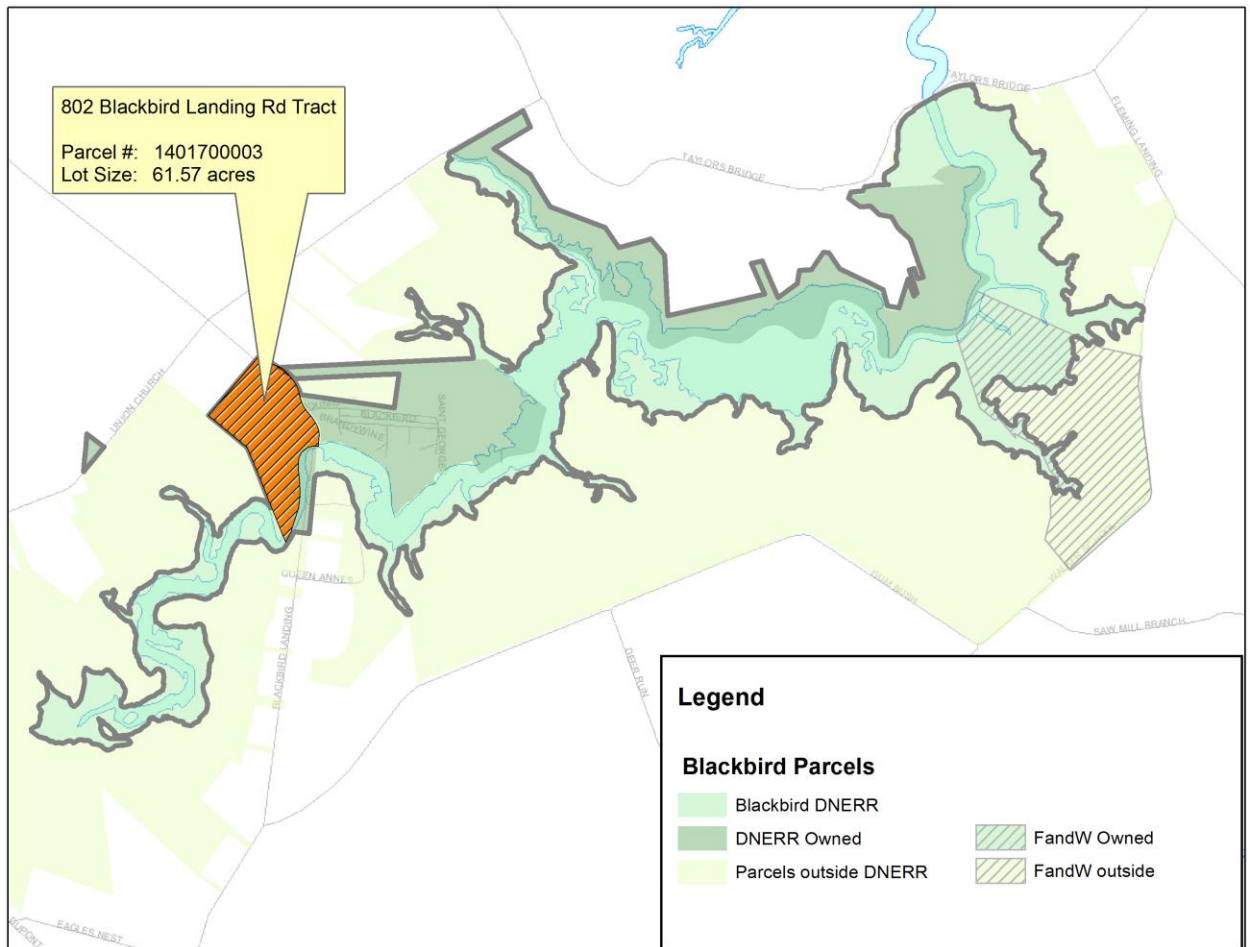
Map 14: Acquisition priorities for Blackbird Creek Reserve component

Boundary Amendment

In December of 2005 and December of 2011 the DNERR acquired new property totaling approximately 64 acres. The parcels include the following habitats: forested uplands, wetlands, marsh and farmland. The Reserve acquired the properties for their high ecological value. All marsh wetlands, or forested uplands acquired will be managed to preserve environmental quality, minimize detrimental impacts and control invasive species. Each parcel provides increased opportunities for research, education, and restoration. Both properties will be managed in accordance with this management plan. Upon approval of this updated management plan the DNERR will expand its boundaries to include the 802 Blackbird Landing Road Tract and 515 Union Church Road Tract (Maps 15 and 16). Sufficient public notice and comment period will be provided as part of the plan approval process.

802 Blackbird Landing Road Tract

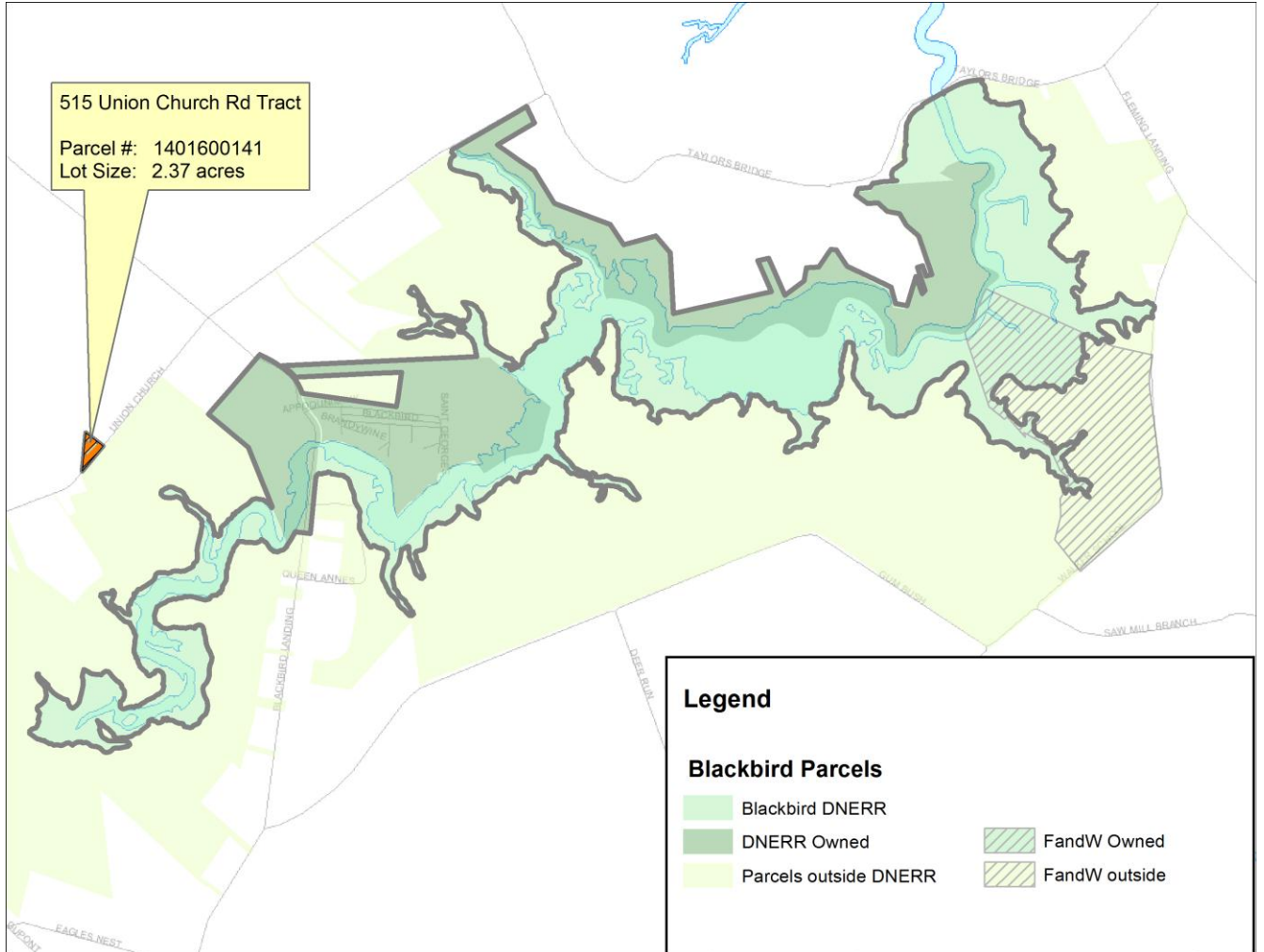
This property was residential located immediately across the street from the December 2004 purchase of the 801 Blackbird Landing Road, was formerly known as the Odessa Campground. The DNERR purchased approximately 62 acres in December 2005 including lands within the core and upland buffer area. The parcel included a residential house, forest, wetlands and agricultural fields. Resource manipulation (agriculture lease) will continue as an existing land use on this parcel until resources for the restoration of the property is obtained. At the end of the lease period for this parcel, resource availability for the restoration of the parcel will be considered and reviewed if the lease is to be stopped, modified or renewed.



Map 15: 802 Blackbird Landing Road Tract of the Blackbird Creek Reserve component.

515 Union Church Road Tract

This property, found within the Reserve’s acquisition area was purchased in December 2011 with funding from the Federal Emergency Management Agency to address a property with repeated flooding damage. This 2.3 acre site offers riparian protection along a tributary that leads directly into the Blackbird Creek. All infrastructure will be removed as part of the FEMA funding. The DNERR intends to manage this parcel for conservation.



Map 16: 515 Union Church Road Tract of the Blackbird Creek Reserve component

Resource Management

The DNERR provides long-term protection of natural resources associated with the Reserve and serves to model responsible resource management practices to other organizations and individuals in nearby coastal communities. This involves a wide range of activities including habitat mapping through geographic information systems (GIS), ecological restoration, invasive species management, resource inventories, demonstration areas, and more.

Restoration

As living laboratories, the Reserve is an ideal setting to investigate the restoration and protection of estuarine and coastal habitat. The reserve system offers the habitat, diversity, on-site human and physical infrastructure, educational programming, and, at many sites, experience in restoration science.

The DNERR has several restoration and demonstration sites at both the St. Jones and Blackbird Creek Reserves. In 2007 a comprehensive Master Ecological Restoration Plan (Appendix K) was developed for the Blackbird Creek Reserve identifying a phased approach to restoring the parcels. The DNERR will seek resources to continue implementing restoration projects including headwater stream restoration, wetlands restoration, invasive species management, riparian reforestation and upland meadow management.

Guiding Principles for Restoration

- Protect and maintain existing high quality habitat patches, and restore habitat to provide larger contiguous areas and increase the connectivity of habitat corridors
- Maintain existing high quality habitat conditions and improve degraded habitat conditions by removing threats or threatening processes
- Improve the condition of relic habitats in fragmented landscapes to ensure their persistence
- Emphasize supporting and regenerating natural processes for system recovery
- Support ecosystem conservation practices in all related activities
- Use applied monitoring and research to test ecological theories
- Consider human needs and compatibility with the needs of biotic systems
- Active restoration of specific degraded or impacted existing ecological resources including; non-tidal wetlands, streams and riparian buffers
- Creation of additional habitats that are fragmented, reduced or eliminated from the landscape (including; wetlands, upland reforestation and native meadows)
- Use varying degrees of non-native invasive species management to protect existing natural communities, and as a part of restoring degraded habitat areas
- Identify compatible ideas for sustainable facilities, best management practices (e.g. stormwater), and stewardship opportunities to support restoration
- Adaptive management in the form of restoration implementation, monitoring and informed decision making based on the analysis of the monitoring results.

Resource Manipulation

The DNERR currently has two parcels that undergo resource manipulation. These parcels of the Reserve have long term pre-existing manipulation, specifically agriculture, occurring for reasons not related to research or restoration.

There are two agriculture leases on Reserve parcels that may be used for producing agricultural commodities, including, corn, soybeans, wheat, and/or sorghum, etc. The leases include clauses to follow good farm management practices including: taking reasonable precautions to avoid the establishment of any noxious weeds as specified under Delaware State Law; ensure all agricultural pesticides, herbicides meet Federal and State standards; and prohibit any excavation and dumping.

- The parcel at the St. Jones Reserve that was acquired in 1991 included a 5 year renewable agricultural lease for 29 years from the original agreement.
- The parcel at the Blackbird Creek Reserve was acquired with 19 tillable acres which has been reduced over the years to 9 acres as resources have become available to restore the land or use it as part of a research project.

At the end of the lease period for a parcel, resource availability for the restoration of the parcel will be considered and reviewed if the lease is to be stopped, modified or renewed.



DELAWARE NERR STEWARDSHIP OBJECTIVES AND ACTIONS

Goal: Protect, manage and restore the natural functions, diversity and cultural integrity of estuarine and coastal ecosystems within the Reserve to serve as a model site for sustainable community stewardship in the Region.

Objective 1: Effectively manage Reserve lands with an emphasis on conservation and sustainable uses of ecological and cultural resources while balancing the needs of research and education.

Action: Develop and implement land management plans for newly acquired parcels.

Action: Monitor conditions of sites based on season and use.

To adequately address protection of the DNERR, the Conservation Technician will monitor each site on a regular basis as deemed appropriate based on season and use. Each site has a characteristic suite of communities and species, as well as a unique list of traditional uses and local threats associated with it, requiring that the monitoring schedule and protocols be site-specific.

Monitoring may include assessment of any or all of the following: invasive species presence and condition, endangered species presence and condition, visitor use impacts, habitat change as a result of natural or anthropogenic disturbance, and condition of Reserve-owned equipment and structures. All of these monitoring activities will assist in maintaining the Reserves for use by researchers and educators.

Action: Manage invasive species through identification, monitoring and removal.

The DNERR is host to both invasive plants and animals. Some of these may have the ability to affect ecological functions in the Reserve. To address these possible changes, invasive plant identification and removal efforts are continuous. The DNERR will create a database of existing terrestrial and aquatic invasive species within the Reserve and surrounding areas. The spread of invasives in the Reserve will be controlled through chemical and physical eradication. Populations will be monitored by the Conservationist and Reserve Manager.

Objective 2: Provide for a diversity of high quality estuarine and coastal habitats representative of the Mid-Atlantic region.

Action: Conserve lands necessary to protect Reserve resources, ensure a stable environment for research and education, and broaden the Reserve's ecological diversity.

Action: Utilize fee-simple acquisition and conservation easements to protect essential habitats within the Reserve's watersheds. Boundary expansion and acquisition will be completed to effectively protect Reserve core and buffer areas.

The DNERR will, as funding and willing sellers allow, acquire properties that enhance, preserve, or restore water quality and biodiversity and allow expanded research, education, and stewardship activities.

Action: Identify significant unprotected estuarine and coastal areas within the State of Delaware.

Promote land preservation within the Reserve's watersheds
Core and buffer area boundaries will be reevaluated and correlated to habitat, water-quality, and critical-area protection within the watersheds of both Reserve components.
The DNERR will identify and compile a list of priority land-acquisition areas within these watersheds. Education and outreach programs and materials (e.g., workshops, brochures, and signs) will be developed for local landowners in order to identify options for, and to promote the use of, conservation easements, agricultural districts, and other land-preservation options within the Reserve's watersheds. The DNERR will also assist other land-preservation groups and agencies as needed to protect land within the Reserve's watersheds.

Action: Increase local awareness of land preservation options.

Objective 3: Manage and restore habitats and ecosystem processes associated with the NERR using and adaptive management approach.

Action: Identify habitats for restoration
Using the Master Ecological Restoration Plan for the Blackbird Creek Reserve as a guide, evaluate current site conditions to identify habitats in need of restoration within the Reserve.

Action: Develop and implement science-based restoration plans
Following the identification of areas suitable for restoration, the DNERR will develop science-based restoration plans in collaboration with partners and other sectors. These plans will be completed in accordance with federal regulation 921.13. This effort may entail working with the NERRS Restoration Science Workgroup and state partners to determine the best approach for restoration. Implementation of restoration projects contingent upon available staffing and funding resources.

Objective 4: Collaborate with local, regional, national agencies and organizations to address natural resource management issues affecting estuaries and coastal watersheds.

Action: Monitor activities, policies, review reports, regulations, etc that affect the Reserve.

Action: Use resource management practices as a demonstration and teaching resource for similar coastal habitats in the Region.

Sponsor resource-protection projects at the St. Jones Reserve and Blackbird Creek Reserve. By working closely with partners the DNERR will maintain and promote the Conservation Demonstration Areas, stream and wetland restoration areas for educating decision maker audiences and develop signage and literature for visitors to the site. The DNERR will also continue to support the efforts of the Delaware Native Plant Society by providing space and labor to maintain the Native Plant Nursery at the St. Jones Reserve.



COORDINATION AND PARTNERSHIPS

Coordination

Coordination of Reserve Staff

Conservation Technician will provide regular updates to the Reserve Manager. This communication will specifically focus on site management issues in order to create an ongoing record of issues and how they are addressed. This will lead to the development of management policies and procedures.

Coordination with other Reserves and NOAA

The DNERR stewardship program is consistently reported to the National Oceanic and Atmospheric Administration's Estuarine Reserves Division through biannual progress reports. Additionally, upcoming stewardship activities are outlined in the annual DNERR 315 grant application.

Coordination with the Delaware Coastal Management Program

Coastal and estuarine land protection in Delaware is of critical importance. The DNERR works with the DCMP on specific collaborations for acquisition and site management guidance including the Coastal and Estuarine Land Conservation Program (CELCP). CELCP was established in 2002 to protect coastal and estuarine lands considered important for their ecological, conservation, recreational, historical or aesthetic value. The program provides funding for projects that ensure conservation of these areas for the benefit of future generations, and that can be effectively managed and protected.

Partnerships

Land Protection and Acquisition

Partnerships with other land conservation organizations, both public and private, are important. These partnerships generate mutual benefits within and outside DNERR for land protection and restoration.

The DNERR is a member of the Interagency Acquisition Working Group, chaired by DNREC, Division of Parks and Recreation whose members include staff from DNREC, Delaware Department of Agriculture (DDA), Delaware Economic Development Office (DEDO), New Castle County, Kent County, and Sussex County.

Restoration

The DNERR works collaboratively with several state, federal and conservation organizations on restoration projects, education, outreach and training including: DNREC, USDA, USFWS, DDA, Conservation Districts, University of Delaware, Delaware State University, Appoquinimink River Association, The Nature Conservancy, Ducks Unlimited, Delaware Wild Lands, Delaware Native Plant Society, Partnership for the Delaware Estuary, and Center for the Inland Bays.

