Chesapeake Bay
National Estuarine Research Reserve in Virginia
Management Plan: 2008-2012

Special Report No. 402 in Applied Marine Science and Ocean Engineering

Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

October 2008

This management plan has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972, as amended, and the provisions of the Virginia Coastal Management Program.

Chesapeake Bay
National Estuarine Research Reserve in Virginia
Management Plan: 2008-2012

Special Report No. 402 in Applied Marine Science and Ocean Engineering

Chesapeake Bay National Estuarine Research Reserve in Virginia
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

October 2008

Principal Authors:

William Reay, Ph.D.[1]

Sandra Erdle[1]

Scott Lerberg[1]

Sarah McGuire[1]

Kenneth Moore, Ph.D.[1]

Cory Riley[2]

1. Virginia Institute of Marine Science, College of William and Mary.
   Gloucester Point, Virginia 23062

2. National Oceanic and Atmospheric Administration, Estuarine Reserve Division.
   1305 East-West Highway (N/ORM5), Silver Spring, Maryland 20910

This document can be cited as follows:

Reay, W., S. Erdle, S. McGuire, K. Moore, C. Riley and S. Lerberg. 2008. Chesapeake Bay National Estuarine Research Reserve in Virginia Management Plan: 2008-2012. Special Report No. 402 in Applied Marine Science and Ocean Engineering. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Virginia.***pp. plus appendices.

Table of Contents

List of Acronyms and Abbreviations

ADA	Americans with Disabilities Act
BWET	Bay Watershed Education and Training Program (NOAA)
CBLAD	Chesapeake Bay Local Assistance Division (VaDCR)
CBNERRVA	Chesapeake Bay National Estuarine Research Reserve - Virginia
CBOS	Chesapeake Bay Observing System
CBP	Chesapeake Bay Program
CCRM	VIMS Center for Coastal Resources Management (VIMS)
CDMO	Central Data Management Office (NERRS)
CELCP	Coastal and Estuarine Land Conservation Program
CICEET	Cooperative Institute for Coastal and Estuarine Environmental Technology
CMER	Cooperative Marine Education and Research Program (NOAA)
COOPS	Center for Operational Oceanographic Products (NOAA)
COSEE	Centers for Ocean Science Education Excellence
CSC	Coastal Services Center (NOAA)
CTP	Coastal Training Program (NERRS)
CZMA	Coastal Zone Management Act (of 1972, and subsequently amended)
CZMP	Coastal Zone Management Program (Federal)
ERD	Estuarine Reserves Division (NOAA)
ESL	Eastern Shore Laboratory
ETM	Estuarine Turbidity Maximum (Primary)
GIS	Geographical Information System
GPS	Global Positioning System
GRF	Graduate Research Fellow(ship) (NERRS)
HABs	Harmful Algal Blooms
HMC	Habitat Mapping and Change Project (NERRS)
HRPDC	Hampton Roads Planning District Commission
IOOS	Integrated Ocean Observing System
IDC	Indirect Costs
KEEP	K-12 Estuarine Education Program (NERRS)
K-12	Kindergarten through 12th Grade
LUHC	Land Use and Habitat Change (Strategy)
MACOORA	Mid-Atlantic Coastal Ocean Observing Regional Association
MACOSEE	Mid-Atlantic Center for Ocean Science Education Excellence
MAMEA	Mid-Atlantic Marine Education Association
MDN	Mercury Deposition Network
MOU	Memorandum of Understanding
MPPDC	Middle Peninsula Planning District Commission
NADP	National Atmospheric Deposition Program
NAIB	National Aquarium in Baltimore
NCBO	NOAA Chesapeake Bay Office

NCCOS	National Centers for Coastal Ocean Sciences (NOAA)
NCERT	National Coastal and Estuarine Research and Technology Program (NOAA)
NEMO	Nonpoint Education for Municipal Officials
NERRS	National Estuarine Research Reserve System
NFWF	National Fish and Wildlife Foundation
NGS	National Geodetic Survey (NOAA)
NMEA	National Marine Educators Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service (NOAA)
NSF	National Science Foundation
NTN	National Trends Network
NVPDC	Northern Virginia Planning District Commission
OCRM	Office of Ocean and Coastal Resource Management (NOAA)
PAH	Polycyclic Aromatic Hydrocarbon
PAR	Photosynthetic Active Radiation
PCB	Polychlorinated Biphenyl
pH	Hydrogen Power
PIBI	Phytoplankton Index of Biotic Integrity
PRC	Peoples Republic of China
RIM	River Input Monitoring Station
SAIC	Strategic Applications International Corporation
SAV	Submerged Aquatic Vegetation
SAMP	Special Area Management Plan
STM	Secondary Turbidity Maximum
SWMP	System-Wide Monitoring Program (NERRS)
TMDL	Total Daily Maximum Load
TPL	Trust for Public Land
TPWNR	Tianjin Palaeocoastal and Wetland National Nature Reserve
UNH	University of New Hampshire
US	Unites States
USCG	United States Coast Guard
USCOE	United States Corp of Engineers
USDI	United States Department of the Interior
USDOD	United States Department of Defense
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VCU	Virginia Commonwealth University
VECOS	Virginia Estuarine and Coastal Observing System
VECRRS	Virginia Estuarine and Coastal Research Reserve System
VaCZMP	Virginia Coastal Zone Management Program
VaDACS	Virginia Department of Agriculture and Consumer Services
VaDCR	Virginia Department of Conservation and Recreation
VaDEQ	Virginia Department of Environmental Quality
VaDGIF	Virginia Department of Game and Inland Fisheries
VaDHR	Virginia Department of Historic Resources
VaDOF	Virginia Department of Forestry
VaDH	Virginia Department of Health

VaDOT	Virginia Department of Transportation
VaEDP	Virginia Economic Development Partnership
VaMRC	Virginia Marine Resources Commission
VIMS	Virginia Institute of Marine Science
W&M	College of William and Mary
YRSP	York River State Park

List of Figures

List of Tables

List of Appendices

Acknowledgments

This Management Plan was prepared by the staff of the Chesapeake Bay National Estuarine Research Reserve in Virginia. In addition to principal authors, additional current and past Reserve staff aided in the planning and writing of this plan, they include: Robert Carroll (Education Coordinator), Alyson Craig (CTP Coordinator), Chris Clapp (Stewardship Coordinator) and Carolyn Gardner (Business Manager). The staff of the Estuarine Reserves Division of NOAA/NOS/OCRM provided helpful guidance and timely comments throughout the plan's development.

Financial support for the publication of this Management Plan was provided by grants NA04NOS4200071 and NA05NNOS4201104 under the Federal Coastal Zone Management Act, administered by the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration, Silver Spring, MD.

Certificate of Designation of the Reserve

UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

DESIGNATION OF THE CHESAPEAKE BAY
NATIONAL ESTUARINE RESEARCH RESERVE IN VIRGINIA
GOODWIN ISLANDS, CATLETT ISLANDS, TASKINAS CREEK
AND SWEET HALL MARSH COMPONENTS

Consistent with the provisions of section 315 of the Coastal Zone Management Act, 16 U.S.C. § 1461, the Commonwealth of Virginia has met the following conditions to establish Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as components of the Chesapeake Bay National Estuarine Research Reserve in Virginia.

1) Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh are representative ecosystems that are suitable for long-term research and contribute to the biogeographical and topological balance of the National Estuarine Reserve Research System.

2) Virginia state laws provide long-term protection for reserve resources to ensure a stable environment for research.

3) Designation of Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as reserve components will serve to enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation.

4) The Commonwealth of Virginia has complied with the requirements of the regulations relating to designation of a National Estuarine Research Reserve.

Accordingly, I hereby designate the areas of Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as components of the Chesapeake Bay National Estuarine Research Reserve in Virginia, the boundaries of which are specified in the final management plan.

Jean for Gary Matlock, Assistant Secretary (for)
John A. Knauss
Under Secretary for Oceans
and Atmosphere

xiii

THE ADMINISTRATOR

This page intentionally left blank.

Executive Summary

Background

The Virginia Institute of Marine Science, College of William and Mary (VIMS/W&M), is designated as the entity responsible for the overall operation and management of the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA or Reserve) in cooperation with the Estuarine Reserves Division of the National Oceanic and Atmospheric Administration (NOAA). Designated in 1991, the Reserve is one of 27 protected areas that make up the National Estuarine Research Reserve System (NERRS) established to promote informed management of the Nation's estuaries and coastal habitats. The mission of CBNERRVA is to preserve a network of reserves that represent the diversity of coastal ecosystems found within the York River estuary and manage these reserves to support informed management of coastal resources through estuarine research, education, stewardship and advisory service.

As the nation's largest estuary, Chesapeake Bay contains a diverse collection of habitats and salinity regimes. In order to incorporate the diversity of habitats in the southern Chesapeake Bay subregion, CBNERRVA established a multi-component system along the salinity gradient of the York River estuary. The Reserve's four components are: (1) Sweet Hall Marsh (443 ha; 1094 ac), an extensive tidal freshwater-oligohaline marsh ecosystem located in the Pamunkey River, one of two major tributaries of the York River; (2) Taskinas Creek (433 ha; 1070 ac), containing non-tidal feeder streams that drain oak-hickory forests, maple-gum-ash swamps and freshwater marshes which transition into tidal oligo and mesohaline salt marshes; (3) the Catlett Islands (220 ha; 542 ac), consisting of multiple parallel ridges of forested wetland hammocks, maritime-forest uplands, and emergent mesohaline salt marshes; and (4) the Goodwin Islands (148 ha; 366 ac), an archipelago of polyhaline salt-marsh islands surrounded by inter-tidal flats, extensive submerged aquatic vegetation beds, and shallow open estuarine waters near mouth of the York River.

With the approval of this management plan, CBNERRVA will reduce from a total of 1302 ha (3217 ac) to a total of 1244 ha (3072 ac). This change is attributable to boundary modifications at the Sweet Hall Marsh and Taskinas Creek components of the Reserve. At Sweet Hall Marsh, 76 ha (189 ac) of buffer are being removed from the reserve boundary due to a change in ownership of the Tick Hill parcel. At Taskinas Creek, the 18.0 ha (44.5 ac) Harrison tract is being incorporated as new acreage within the boundary as a buffer to the core reserve habitat.

Under federal regulation, all NERR's are required to have a NOAA approved management plan. Reserve management plans are to be updated on a routine basis and serve to provide a framework to direct and track progress of a reserve's programs, and to help guide federal evaluations of the reserve. This document is the second edition of the management plan for the CBNERRVA and covers the period 2008-2012. This plan is an addendum to the original management plan that was approved by NOAA and adopted by CBNERRVA in 1991.

2008-2012 Management Plan

The CBNERRVA has developed focus areas that address national, regional and local issues. Cutting across specific program boundaries, issue focus areas allow the Reserve to address key management concerns in a more integrated and comprehensive manner. Primary focus areas directing Reserve programs include:

- Functions and linkages of land-margin ecosystems;
- Ecosystem vulnerability to climate and human-induced stressors;

- Water quality and aquatic stressors; and

- Integrated ocean observing systems.

This management plan addresses specific goals within individual Reserve Programs and supporting operations in order to support the Reserve's mission over the next five years (2008-2012). The Reserve's goals and objectives outlined in this management plan align with the goals and objectives of the NOAA/NERRS 2005-2010 Strategic Plan (NOAA 2005b). Goals of the Reserve's 2008-2012 Management Plan are:

Goal 1. Increase recognition of CBNERRVA as a regional leader in applying science and education to support coastal resource management and literacy;

Goal 2. Enhance scientific understanding of coastal ecosystems, surrounding environments and the natural and human processes influencing such systems;

Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making;

Goal 4. Increase public awareness, understanding and appreciation of coastal environments;

Goal 5. Provide administrative leadership and resources necessary to fulfill the Reserve's mission; and

Goal 6. Strengthen the protection and management of Reserve coastal resources to ensure long-term integrity and diversity of its ecosystems and archaeological/cultural sites.

The Reserve's 2008-2012 Management Plan has been divided into six programmatic (i.e., Administration, Research and Monitoring, General Education and Public Outreach, Coastal Training, Stewardship, and Special Programs) and three operational (i.e., Public Access, Boundary and Acquisition, and Facilities and Site Infrastructure) sections that address Reserve goals and objectives, with specific strategies identified to provide focused guidance and allow Reserve performance to be monitored. Expected programmatic and operational efforts and outcomes are summarized below:

- Administration: Reserve administration will continue to seek funding and other resources to enhance all Reserve program sectors, foster productive relationships with current and new partners, support staff professional development, and explore increased State funding for critical core staff positions.

- Research and Monitoring: Reserve associated faculty and staff will focus on applied science and monitoring of land-margin ecosystems, watershed and airshed processes that directly relate to coastal water quality impacts, support local and regional Integrated Ocean Observing System (IOOS) efforts, and continue to participate in NERRS system-wide monitoring initiatives.

- General Education and Public Outreach: Reserve educators will continue to increase awareness and appreciation of coastal and ocean resources by grade school students (K-12), teachers and the general public through current and newly developed science-based classroom, laboratory and field experiences. Inclusion of Reserve and VIMS generated science and data into education programs, and development of new partnerships with local and regional environmental education providers will be a priority.

- Coastal Training Program: The Coastal Training Program (CTP) will increase education and training opportunities to targeted, coastal decision-maker audiences concentrating on the three major themes of riparian/wetland buffers, shoreline management, and water quality/quantity. Development of

partnerships, enhanced networking of coastal decision-makers and program improvement through an evaluation process will also be important outcomes of the CTP.

- Stewardship Program: Reserve stewards and scientists will further the Reserve's resource protection capacity through the implementation of component-specific natural resource management plans and enhancement of skills and knowledge that support stewardship activities through directed research and monitoring activities.

- Boundary and Acquisition: Efforts will be taken to develop a Boundary and Acquisition Plan and procure funds for land acquisition to protect key land and water areas and adjacent buffer areas essential for sustained Reserve operation and habitat protection. Desired identified tracts include core areas of the Catlett Islands Reserve component and adjacent core/buffer areas (Stieffen tract) to the Taskinas Creek Reserve component. Additional acquisition priorities include a yet to be determined "true" tidal freshwater Reserve component and aquatic buffers adjacent to both the Goodwin and Catlett Island components of the Reserve.

- Public Access Management: Managed access at Reserve components will maintain each site's integrity for research and education while permitting traditional uses which do not conflict with Reserve goals or agreements with private landowners and public lands managers.

- Facilities, Site Infrastructure and Equipment Support: Continued efforts will seek to identify and provide facilities, equipment and other infrastructure support that allow for attainment of program goals and objectives. Identified needs include additional laboratory space, improvements to education and interpretive space (including exhibit material), and enhancement of field support infrastructure.

- Special Programs: The Reserve will continue efforts to identify funds to support special programs such as the Virginia Estuarine and Coastal Research Reserve System (VECRRS) and the International Sister Reserve Program (Tianjin Palaeocoastal and Wetland National Nature Reserve in the People's Republic of China- TPWNR).

The use of this Plan will allow CBNERRVA to work towards fulfilling its mission of protecting a network of Reserve components within the York River estuary and supporting informed management of coastal resources through estuarine research, education and stewardship.

I. Introduction

1.1 Introduction

The National Estuarine Research Reserve System (NERRS or reserve system) is a network of protected areas representing different biogeographic regions of the United States and territories that provide opportunities for long-term research, environmental monitoring, coastal and ocean education and informed coastal resource management. The Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA or the Reserve) is one of the 27 National Oceanic and Atmospheric Administration (NOAA) designated reserves, protecting over one million acres of estuarine lands and waters. The Reserve is managed on a daily basis by the Virginia Institute of Marine Science, College of William and Mary (VIMS/W&M). As part of a federal-state partnership program, reserves are periodically evaluated by NOAA and required to have an approved site-specific management plan.

1.2 Purpose and Scope of this Management Plan

Under Federal regulation, 15 C.F.R. 921.13, all NERR's are required to have a NOAA approved management plan. The purpose of a reserve management plan is: (1) to provide a framework for the direction and progress of a reserve's programs, (2) allow for evaluation of how successfully a reserve's goals have been met and to determine necessary changes to accomplish goals, and (3) help guide Coastal Zone Management Act (CZMA) Section 312 evaluations of the reserve. This document is the second edition of the management plan for the CBNERRVA and covers the period 2008- 2012. This plan is an addendum to the original management plan that was approved by NOAA and adopted by CBNERRVA in 1991.

The original management plan established the inclusion of CBNERRVA in the NERRS. This management plan included detailed information on the history of the Reserve's beginning, the multi-component site selection process and specific York River site information at each of the four Reserve components (CBNERRVA 1991). In addition, program goals, objectives and strategies as well as plans for management and operations, research and monitoring, education and interpretation, resource protection, and facilities development were established to guide the Reserve through its initial years of operation. Many of the original plan's objectives are ongoing as are new objectives that have been developed as the national program and CBNERRVA have grown and developed since 1991.

This second edition of the management plan describes the updated mission, goals, objectives and implementation strategies of NERRS and CBNERRVA, describes Reserve accomplishments since 1991, and provides current plans for Reserve administration, research and monitoring, general education and outreach, coastal training, stewardship, land acquisition, public access, facilities and construction, and special programs. This management plan will cover the Reserve's operation from 2008-2012. In light of external factors that may impact implementation of this plan, such as funding fluctuations and other unforeseen issues, CBNERRVA will continue to seek external funds from a variety of sources in order to enhance Reserve operations and continue to provide and support focused and integrated research, education and stewardship programs. This revised management plan has been developed by CBNERRVA in accordance with NOAA regulations and Section 315 of the CZMA. This plan is intended to guide the future direction and accomplishments of CBNERRVA, and its implementation will be subject to evaluation as required by Federal regulation 15 CFR 921.40.

II. National Oceanic and Atmospheric Administration

2.1 Introduction

NOAA, within the U.S. Department of Commerce, is focused on the role of oceans, coasts, and atmosphere in the global ecosystem and serves as the parent federal agency for the NERRS. NOAA's mission is to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs. Being within NOAA's organizational framework, it is essential that the NERRS and individual reserves support the overarching goals identified in NOAA's 2006-2011 Strategic Plan (NOAA 2005a). NOAA's four mission goals are:

Goal 1. Protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management;

Goal 2. Understand climate variability and change to enhance society's ability to plan and respond;

Goal 3. Serve society's needs for weather and water information; and

Goal 4. Support the nation's commerce with information for safe, efficient, and environmentally sound transportation.

NOAA's Office of Ocean and Coastal Resource Management (OCRM) provides national leadership, strategic direction, and assistance to state/territory coastal management programs, NERRS, and other partnership programs to sustain healthy coastal and ocean ecosystems. As stated in OCRMs 2007-2012 Strategic Plan, OCRM contributes to Goals 1, 3 and 4 of NOAA's principal goals outlined above (NOAA 2007). Through additional strategic planning processes, the NERRS further support NOAA's mission by development and implementation of NERRS Strategic Plans (NOAA 2005b) and individual reserve management plans; these efforts address all four of NOAA's mission goals.

2.2 The National Estuarine Research Reserve System

2.2.1 Introduction

NERRS was created by the CZMA, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management Program (CZMP). The CZMP is dedicated to comprehensive, sustainable management of the nation's coasts. The reserve system is a network of protected areas established to promote informed management of the Nation's estuaries and coastal habitats. The reserve system currently consists of 27 reserves in 22 states and territories, protecting over one million acres of estuarine lands and waters.

2.2.2 Federal Administrative Framework, Planning and Oversight

Administrative Framework

The Estuarine Reserves Division (ERD) of OCRM administers the reserve system (see Figure 6.1 for NOAA management structure). The Division establishes standards for designating and operating reserves, provides financial and technical 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. ERD also coordinates and includes reserve state partners

in the strategic planning and the decision-making process for the NERRS. A Memorandum of Understanding (MOU) between VIMS/W&M, the Commonwealth of Virginia and NOAA establishes the formal federal-state administrative framework for the CBNERRVA (see Appendix I.1 and Figure 6.1).

Reserve Planning and Oversight

The reserves are required by Federal regulation, 15 C.F.R. 921.13, to have a NOAA 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 and interpretation, stewardship, public access, construction and acquisition, and resource preservation, restoration and manipulation. Reserve staff roles in each of these areas must also be addressed. A new reserve's initial management plan and any major proposed changes to a revised plan are made available for public comment at national and local levels before receiving NOAA's final approval. Reflecting the purposes of a management plan (see Section 1.2), plans are required by Federal regulations,15 C.F.R. 921.40, to be updated at least every five years. This management plan has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the CZMA and the provisions of the Virginia Coastal Zone Management Program (VaCZMP). As required by Federal regulation, 15 C.F.R. 921.40, OCRM periodically evaluates reserves for compliance with federal requirements and with the individual reserve's approved management plan. The reserve's research and monitoring, education and natural resource management programs must be in compliance with NERRS objectives and with the reserve's management plan. The NOAA evaluation team may identify areas needing improvement or increased emphasis, or may make suggestions regarding any aspect of reserve management.

2.2.3 Mission, Goals and Objectives

NERRS Federal Regulations

As stated in the NERRS regulations, 15 C.F.R. 921.1(a), the reserve systems 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 (U.S.). Estuarine research reserves are established to provide opportunities for long-term research, education, and interpretation. Federal regulations, 15 C.F.R. 921.1(b), provide five specific goals for the NERRS. These overarching goals connect the individual reserves to a national program while still allowing each reserve to address relevant and local issues of importance. It is the intent of the CBNERRVA Research and Monitoring, General Education and Public Outreach, Coastal Training and Stewardship Programs to fulfill the NERRS regulation goals. Federal NERRS regulation goals and CBNERRVA programs addressing specific goals (shown parenthetically) are presented below:

Goal 1. Ensure a stable environment for research through long-term protection of NERR resources (Stewardship);

Goal 2. Address coastal management issues identified as significant through coordinated estuarine research within the system (Research and Stewardship);

Goal 3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation (Education and Coastal Training);

Goal 4. Promote federal, state, public and private use of one or more reserves within the system when such entities conduct estuarine research (Research and Stewardship); and

Goal 5. Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas (Research, Education, Coastal Training and Stewardship).

NERRS Strategic Plan (2005-2010)

The reserve system began a strategic planning process in 1994 in an effort to help NOAA achieve its environmental stewardship mission to "sustain healthy coasts." In conjunction with the strategic planning process, ERD and reserve staffs have conducted a multi-year action planning process on an annual basis since 1996. The resulting five-year action plan provides an overall vision and direction for the reserve system and articulates how the strengths of the reserve system will be applied to address the challenges facing coastal resource management, advancing estuarine research, and educating current and future generations. As part of this process, the reserve system developed a vision and mission statement.

Vision: ***Healthy estuaries and watersheds where coastal communities and ecosystems thrive.***

Mission*:* ***To practice and promote coastal and estuarine stewardship through innovative research and education, using a system of protected areas.***

Goals and objectives of the NERRS 2005-2010 Strategic Plan (NOAA 2005b) are:

Goal 1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research and education.

Objective 1. Biogeographically and typologically representative estuarine ecosystems are protected through the designation of new reserves;

Objective 2. Biological, chemical, physical, and community conditions of reserves are characterized and monitored to describe reference conditions and to quantify change; and

Objective 3. Reserve ecosystems are conserved through land acquisition, natural resources management and restoration.

Goal 2. Increase the use of reserve science and sites to address priority coastal management issues.

Objective 1. Scientists conduct estuarine research at reserves that is relevant to coastal management needs;

Objective 2. Scientists have access to NERRS datasets, science products and results; and

Objective 3. The scientific community uses data, tools and techniques generated at the NERRS.

Goal 3. Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

Objective 1. People are aware of the ecological, economic, historical, and cultural importance of estuarine resources;

Objective 2. People understand how human choices and natural disturbances impact social, economic, and estuarine ecological systems; and

Objective 3. People apply science-based information when making decisions that could impact coastal and estuarine resources.

CBNERRVA goals, objectives and strategies outlined in this management plan align with the above stated goals and objectives of the NERRS 2005-2010 Strategic Plan.

2.2.4 Reserve Representation and Designation

Biogeographic Region Representation

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. 921, Appendix I and II). When complete, the NERRS will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2008, the NERRS contained 27 approved reserves with several proposed (Figure 2.1). The CBNERRVA is representative of the Chesapeake Bay subregion of the Virginian biogeographic region.

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:

Condition 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;

Condition 2. The law of the coastal state provides long-term protection for the proposed reserve's resources to ensure a stable environment for research;

Condition 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

Condition 4. The coastal state has complied with the requirements of any regulations issued by the U.S. 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 an MOU. A reserve may apply to ERD for funds to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction and land acquisition.

2.2.5 System-Wide Programs

ERD currently provides support for three system-wide programs: (1) the System-Wide Monitoring Program (SWMP), (2) the Graduate Research Fellowship (GRF) Program, and (3) the Coastal Training Program (CTP). These programs are discussed in greater detail in other respective sections of this plan; see Research and Monitoring Plan for SWMP (Section 7.2.5) and GRF (Section 7.2.3), and the CTP Plan (Section 9). Additionally, ERD provides support for reserve initiatives on restoration science, invasive species, kindergarten through 12th grade (K-12) and community education, and reserve specific research, monitoring, education and resource stewardship initiatives and programs.

Figure 2.1. Individual designated and proposed NERR's.

III. CBNERRVA: Reserve Setting

3.1 Introduction and Historical Context

In 1988, the Chesapeake Executive Council, made up of the governors of Virginia, Maryland, and Pennsylvania, the mayor of the District of Columbia, the chair of the Chesapeake Bay Commission and the administrator for the Environmental Protection Agency (USEPA), called for the establishment of a system of research reserves that would provide the research community with sites for long-term, habitat focused research that would be protected as far as possible from immediate threats from development (Chesapeake Executive Council 1988). It is within this context that the Commonwealth of Virginia began its planning for the CBNERRVA. VIMS/W&M was designated by the Governor to take the lead role in establishing a suitable research reserve system for the Commonwealth.

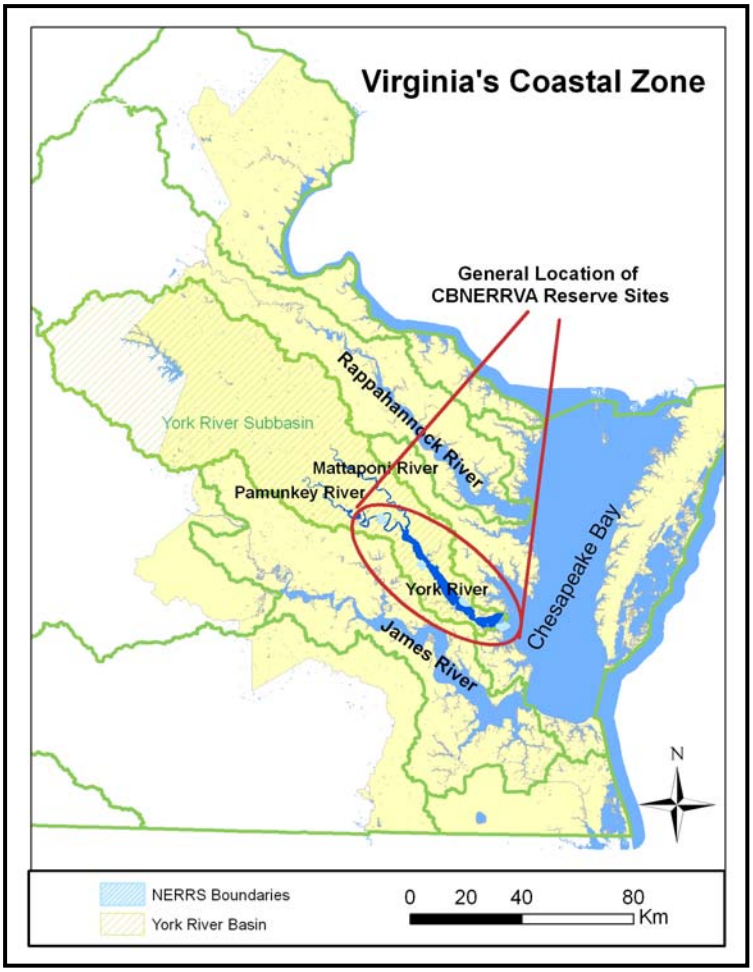

Figure 3.1. Coastal zone of Virginia highlighting the York River drainage basin.

Based on a salinity and tributary segmentation scheme, it was originally envisioned that CBNERRVA might eventually include more than 20 components. Because of the high number of potential components, designation of CBNERRVA sites was to occur in a phased manner. Phases were designated as (I) York River basin, (II) Rappahannock and Potomac River basins, (III) James River basin and western shore of Chesapeake Bay, and (IV) Bay-side Eastern Shore of Chesapeake Bay. The York River basin components were designated in 1991 and CBNERRVA became the 18th reserve within the national system. Based on a number of concerns, which include staff and resource limitations, both VIMS and ERD have decided not to proceed with the expansion of CBNERRVA outside the York River system at this time. It is anticipated that when fully implemented, the Virginia Estuarine and Coastal Research Reserve System (VECRRS; see Section 14.2) will achieve many of the goals originally envisioned with the proposed phased expansion of the CBNERRVA.

3.2 Chesapeake Bay Description and Strategic Focus Areas

3.2.1 Chesapeake Bay Description

Chesapeake Bay was first named “Chesepiooc” or “Great Shellfish Bay by Native Americans for its bounty of crabs, oysters and other shellfish. As the nation's largest estuary, it remains today as a national treasure and one of the most productive in the world. Formed from a drowned river valley by melting glaciers over 12,000 years ago, the Chesapeake Bay main-stem stretches approximately 305 km (190 mi) from Havre de Grace, Maryland to Norfolk, Virginia. The Bay and its tributaries have approximately 18,700 km (11,680 mi) of shoreline and a water area of 11,600 km^2 (4,480 mi^2)(Cronin 1971). Despite its vast size, Chesapeake Bay is relatively shallow with an average depth on the order of 6.4 m (21 ft)(Cronin 1971); 20 percent of the Bay exhibits water depths less than 2.1 m (7 ft) and 10 percent exhibits water depths less than 0.9 m (3 ft).

The Bay receives about half of its water volume from the Atlantic Ocean with the rest entering from surface waters (rivers and streams), ground water and direct precipitation. The Bay’s watershed, on the order of 165,700 km^2 (64,000 mi^2), incorporates parts of six states (i.e., New York, Pennsylvania, West Virginia, Delaware, Maryland, and Virginia) and the District of Columbia. Major river systems flowing into the Bay include the Susquehanna, Patuxent, Potomac, Rappahannock, York, and James River, with the Susquehanna providing about half of the freshwater input. The large extent of the Bay, its tributaries, and watershed, and the mixing of fresh and high salinity ocean water results in a large diversity of aquatic, intertidal, riparian and upland habitats. The Bay, its tributaries, and its watershed represents a complex ecosystem that supports over 3,600 species of plants and animals including approximately 350 species of finfish, 170 species of shellfish, 200 species of birds and waterfowl, and over 2,700 plant species (USEPA/CBP; http://www.chesapeakebay.net/status.cfm).

In addition to natural resources, the Bay watershed is home to more than 15 million people and is projected to grow to 18 million by 2020 (http://www.chesapeakebay.net/pop.htm). Approximately 70 and 90 percent of Virginia’s and Maryland’s population live within coastal counties, respectively (Crossett et al. 2004). Throughout modern history, the Chesapeake Bay and its tributaries have help sustain the regions economy through commercial and recreational fisheries and other opportunities, and served as a hub for shipping and commerce. The Bay annually produces 227 million kg (500 million lbs) of seafood and contains two (i.e., Baltimore and Hampton Roads) of the five major North Atlantic ports in the U.S. (USEPA/CBP; http://www.chesapeakebay.net/status.cfm). Agriculture and related activities continue to play a very important role with respect to land use and economics within the Bay watershed. On an aerial basis, agricultural lands represent approximately thirty percent of the Bay’s watershed. A growing tourism trade, service and high-technology jobs, and a strong military presence all continue to support the regions economy.

3.2.2 Chesapeake Bay Strategic Focus Areas

In addition to the national funding and programmatic priorities, NOAA recognizes that individual reserves develop, support, and implement site-specific research programs to address local and regional research, education and training, and natural resource management or stewardship needs. In 1983, Virginia, Maryland, Pennsylvania, the District of Columbia, the USEPA and the Chesapeake Bay Commission formally agreed to coordinate interstate planning and programs for the Chesapeake Bay and its tributaries and establish mechanisms to facilitate that coordination. Since 1983, this joint commitment has led to new levels of government cooperation, including a more comprehensive Chesapeake Bay Agreement by the Chesapeake Executive Council in 1987, which accelerated advances in the Bay’s restoration and protection. To address data and information gaps, the Chesapeake Executive Council developed a Comprehensive Research Plan for the Chesapeake Bay (Chesapeake Executive Council, 1988).

In June 2000, Chesapeake Bay Program partners adopted the Chesapeake 2000 Agreement, a strategic plan to achieve a vision for the future of the Bay (Chesapeake Bay Program 2000). A vision that includes abundant, diverse populations of living resources, fed by healthy streams and rivers, sustaining strong local and regional economies, and our unique quality of life. Chesapeake 2000 is one of the most aggressive and comprehensive watershed restoration plans ever developed. The agreement is the result of a comprehensive three-year stakeholder-driven process involving more than 300 scientists, resource managers, policymakers and citizens from all parts of the Bay watershed. Restoring ecosystems as

complex as the Chesapeake Bay requires work on many fronts. The agreement details nearly one hundred commitments important to Bay restoration, organized into five strategic focus areas, they are:

- Protecting and restoring living resources;
- Protecting and restoring vital habitats;
- Improving water quality;
- Managing lands soundly; and
- Engaging individuals and local communities.

3.2.3 Principal Chesapeake Bay and York River Estuary Management Issues

Degradation of marine and estuarine environments is of global concern and the Chesapeake Bay system is no exception. A growing population along with associated land use changes are primary factors causing water quality and habitat degradation in the Bay's watershed, its tributaries and the Bay proper. Key management issues and threats to the Bay system include:

- Excess sediments which result in degraded habitat, reduce water clarity, and serve to transport toxic materials, pathogens and nutrients to water resources;
- Excess nutrients, both nitrogen and phosphorus, that stimulate algal blooms and lead to oxygen deprived waters and reduced water clarity;
- Introduction of toxic chemicals (e.g., mercury, PCBs, pesticides) and associated health impacts on wildlife and humans;
- Loss and/or degradation of key habitats (e.g., submerged aquatic vegetation, wetlands, riparian forests, oyster reefs) that provide critical services to a wide variety of residential and migratory species; and
- Declining finfish and shellfish populations due to over-fishing and disease issues.

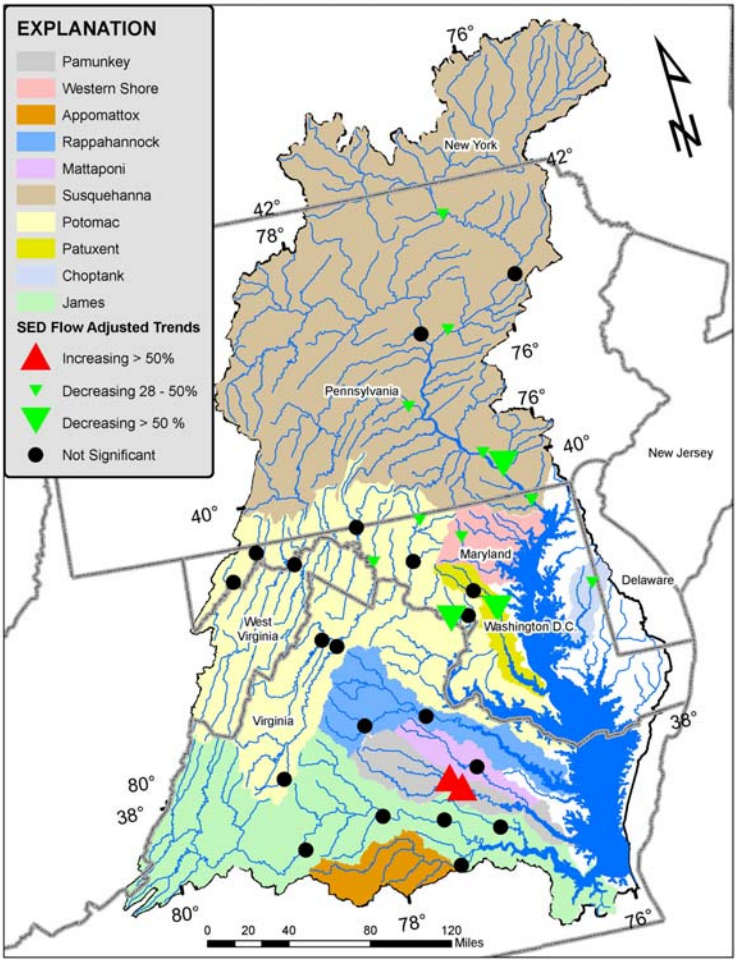

Figure 3.2. Long-term (1985-2006) selected RIM station flow adjusted sediment concentration trends. Image from the CBP.

Recent water quality status reports for the Chesapeake Bay and York River systems indicate continued degraded conditions. Temporal changes in sediment and nutrient loads from primary tributaries are primarily a function of streamflow variability and changes in land use and/or management strategies over the longer term. Long-term (1985-2006) sediment, nitrogen and phosphorus monitoring has occurred at primary Chesapeake Bay Program (CBP) River Input Monitoring Program (RIM) stations that are located at gaging stations above the point of tidal influence. Data from these monitoring stations generally show decreasing or no

significant trends in flow adjusted sediment concentrations. Exception occurred in the Pamunkey River, a tributary of the York River, where a significant increasing trend for sediment (reported percent change: 85%; 1989-2006) was observed (Langland et al. 2007)(Figure 3.2). As with sediment, long-term (1985-2006) nutrient concentration trends at RIM stations generally show decreasing or no significant trends in flow adjusted concentrations. Exceptions include increasing trends for nitrogen in the Pamunkey River (reported change: 20%) and for phosphorus in the Potomac, Pamunkey (reported change: 122%), Appomattox (a tributary of the James River) and the Choptank Rivers.

Poor water clarity is a persistent and widespread problem in the Bay and York River systems (Dauer et al. 2005) and a principal factor regulating the growth and distribution of submerged aquatic vegetation (SAV). Light attenuation is principally controlled by interactions between plankton and suspended sediments. Based on turbidity and total suspended solid SAV habitat requirement criteria, much of the York River system (e.g., transitional/oligohaline and middle mesohaline York) fail to meet SAV habitat requirements. High salinity regions in the lower York meet criteria and much of the tidal freshwater reaches are marginal (Dauer et al. 2005). With respect to phytoplankton primary productivity, a Phytoplankton Index of Biotic Integrity (PIBI) has been developed for Chesapeake Bay to assess phytoplankton health with respect to "reference communities" found in desirable water quality conditions (Buchanan et al. 2005). PIBI scores of CBP monitoring stations for the tidal freshwaters of the Pamunkey River indicate poor to fair status in the spring and fair to good status in the summer while the upper mesohaline reach of the York River indicates a poor-fair status in the spring and a poor status in the summer (Lacouture et al. 2006). Waters in the open Mobjack Bay complex, located at the mouth of the York River estuary, exhibit a poor-fair status for both spring and summer. Phytoplankton features in waters with a fair-poor status include frequent algal blooms and somewhat frequent harmful algal blooms (HABs), high variability in biomass and species composition, and exceedance of water quality criteria (Buchanan 2006). There have been a number of reported sporadic and reoccurring HABs within the York River estuary. The bloom producing dinoflagelletes, *Cochlodinium polykrikoides*, C. *heterolobatum* and *Prorocentrum minimum*, are associated with the "red tide" that generally occur on an annual basis in summer months in the lower York River (Marshall 1994)(Figure 3.3).

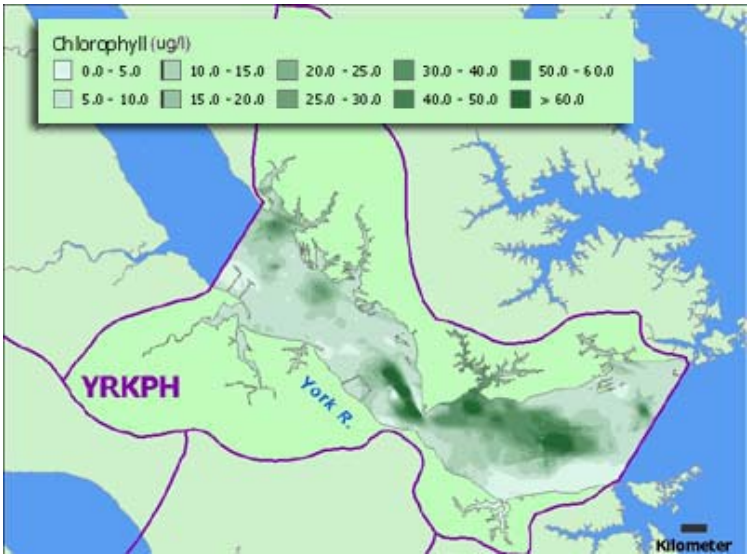

Figure 3.3. Surface chlorophyll *a* concentrations during a "red tide" event in the lower York River (Sept. 9, 2007). Data and map source: www.vecos.org.

Hypoxia, or depletion of oxygen to a defined lower limit, and anoxia, the complete lack of oxygen, has been a recurring condition within bottom waters of the Chesapeake Bay proper and some of its tidal tributaries. Within the York River estuary, hypoxia has been observed repeatedly in the bottom waters of its lower reaches when water temperatures exceed 20 °C (Kuo and Neilson 1987). In addition to depletion of oxygen in channel bottom waters, diel variations in dissolved oxygen concentration in shallow waters can be significant and result in low dissolved oxygen conditions. This phenomenon is often observed in temperate unstratified shallow habitats where night-time respiration temporarily deplete water oxygen levels which are subsequently replenished by photosynthesis during day-time conditions. Investigating dissolved oxygen dynamics at the national reserve-wide scale, Wenner et al. (2001) did report hypoxic water conditions, however at a very low percent level, for the Taskinas Creek component of the Reserve.

Chemical contaminants entering the Bay and its tidal tributaries come from a variety of natural processes, such as weathering of rocks, and human derived point and nonpoint sources. Priority toxic contaminants identified by the CBP include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), organochlorine and organophosphate pesticides, and "other" priority pollutants such as metals (USEPA 2006). While there appears to be areas of limited toxic chemical contamination and associated adverse effects, broad-scale degradation of the York River estuary due to toxicological stressors is not apparent. Contaminants listed in fish consumption advisories in Virginia coastal waters include PCBs, mercury and Kepone (VaDEQ/VaDCR 2006). Specific to the York River basin, PCB and mercury fish consumption advisories and restrictions were issued by the Virginia Department of Health (VaDH) in 2004 and are currently in effect (Figure 3.4). PCBs are a class of organic chemical compounds that were used extensively in industrial manufacturing (e.g., production of dielectric fluids for transformers and capacitors, synthetic resins and epoxy paints) and exhibit a high degree of resistance to degradation processes. Given that production of PCBs ceased in 1977, PCBs are currently released into the environment from hazardous waste sites, illegal/improper discarding of PCB containing wastes, atmospheric deposition or from failing PCB containing equipment. Large-scale soil PCB removal actions have occurred at federal (e.g., Yorktown Naval Weapons Station and Camp Peary immediately adjacent to the York River in James City County) and superfund (e.g., H&H burn pit site in Hanover County) facilities within the York River basin (VaDEQ 2005). In contrast to PCBs, mercury is released to the environment by both natural processes and human induced activities. Monitoring data and model simulations suggest that atmosphere deposition is a primary source of mercury to the Chesapeake Bay system (Mason et al. 1997). Dominant emission sources within the Bay region include coal fired electrical generation plants, such as that located at the mouth of the York River, and waste incineration plants.

The Chesapeake Bay and its tidal rivers encompass a diverse range of habitats with each being important to the general health of the Bay ecosystem. Critical Bay estuarine habitats include riparian forests, emergent tidal wetlands, seagrass beds, aquatic or oyster reefs, shallow waters (depth to 3 m or 10 ft) and open waters beyond the nearshore region. Ecological services provided by these habitats include shoreline stabilization, hydrologic functions (e.g., flood protection, streamflow regulation), water quality remediation, airborne pollutant removal and habitat community functions (e.g., biodiversity, productivity/carbon sequestration, detritus export/storage, refuge and forage). Due to regional growth and development, direct harvesting and natural causes, there has been a continued degradation, fragmentation and loss of critical estuarine habitats. Along with the degradation or loss of these habitats, the natural interactions, or connectivity, between these ecosystems may be diminished, or in some cases, entirely eliminated (Reay and Lerberg 2008).

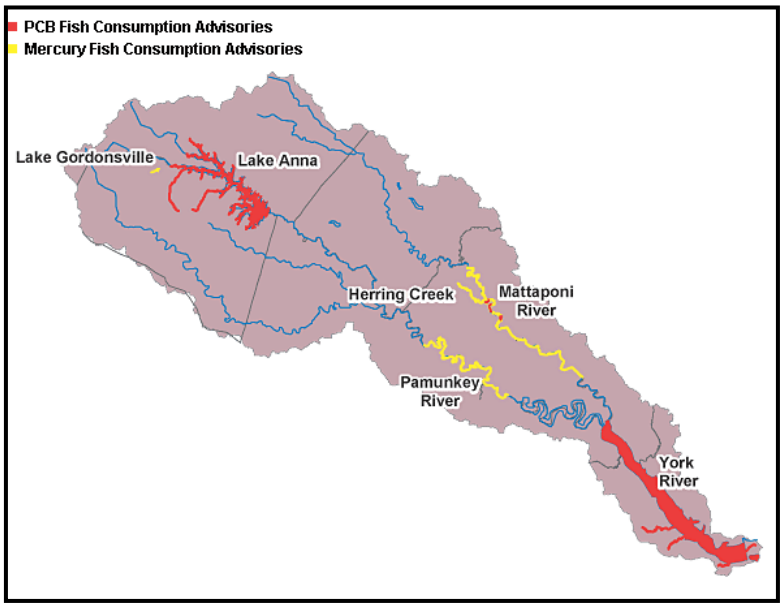

Figure 3.4. Current PCB and mercury fish consumption advisories within the York River watershed and estuary. Image source: VaDH.

The current (mid-eighties to early 2000) loss of forest cover is estimated at approximately 5 percent within Virginia and Maryland with about one-half of the Bay's streamside and shoreline forests being in a disturbed or degraded state (Sprague et al. 2006). Tidal emergent wetlands are particularly vulnerable to the effects of relatively high rates of sea level rise (3 mm yr^{-1} in the northern Bay region to 7 mm yr^{-1} near the Bay's mouth; Zervas 2001), increased erosion and shoreline development, and the potential for saltwater intrusion. It is

estimated that more than half of the Chesapeake Bay's tidal marsh area currently show signs of degradation (Stevenson et al. 2002). Additionally, the permitted hardening of over 730 km (450 mi) of shoreline in Maryland and Virginia since 1993 further illustrates the magnitude of impacts on fringing wetlands within Chesapeake Bay watershed through conventional shoreline protection measures. Oyster reefs, which serve as the largest hard surface on the Bay's bottom, are dependent on oyster survival and reproduction for long-term sustenance. The interaction of over-harvesting, disease (e.g., MSX and Dermo), sedimentation and poor water quality have caused a severe decline in oyster abundance over the past century which is currently estimated at 2 percent of historic levels (http://www.chesapeakebay.net/oysterharvest.aspx). The shallow waters of the Chesapeake Bay and its tributaries are home to at least 16 species of underwater grasses, also termed SAV, which serve as critical habitat to commercially and ecologically important nekton. As with other important cited estuarine habitats, underwater grasses have declined precipitously from historical abundances (Orth and Moore 1983). Current 2007 underwater grass distribution is estimated at 26,270 ha (64912 ac) and approximately one-third of the Bay programs restoration target of approximately 74,870 ha (185,000 ac) (http://www.chesapeakebay.net/status_baygrasses.aspx). Reduced water clarity, and for some species elevated summer temperatures, remain as current threats to underwater grasses.

A final key management issue and threat to the Bay system is the declining finfish and shellfish populations of major species which include the blue crab, American oyster, American shad populations, Atlantic menhaden, and striped bass. The blue crab, the Bay's signature species and highest valued commercial fishery, remains vulnerable to overexploitation. As a result of increased fishing effort and habitat loss, blue crab catches have dropped to levels lower than recorded in previous decades. 2007 population estimates were approximately 78 percent of the 200 million blue crab interim initial rebuilding target (http://www.chesapeakebay.net/crabs.aspx). Threats to shad, herring and menhaden populations include over-fishing and habitat degradation particularly due to water quality changes associated with nutrient and sediment loadings and shoreline alteration. Additionally, restricted access to essential spawning habitats by dams is of concern for several anadromous species including the American and Hickory shad and a variety of herring species. Currently, the Bay-wide and York River American shad abundance index is 22 and 28 percent, respectively, of the restored goal level (ASMFC 2007). While striped bass populations have rebounded since a fishing moratorium was lifted in 1990 (enacted 1985-1989), there is increased concern regarding the current health status of the Bay's striped bass population due to the high prevalence of a disease called mycobacteriosis and reduced abundance of principal prey species (e.g., Atlantic menhaden).

3.3 Reserve Setting

3.3.1 York River Geographic and Physical Description

As the nation's largest estuary, Chesapeake Bay contains a diverse collection of habitats and salinity regimes. In order to incorporate the diversity of habitats in the southern Chesapeake Bay subregion, CBNERRVA established a multi-component system along the salinity gradient of the York River estuary. The York River estuary is the Bay's fifth largest tributary in terms of flow and watershed area on the order of 6900 km^2 (2662 mi^2). The York River basin is located within Virginia's Coastal Plain and Piedmont physiographic provinces and includes all of the land draining into the Mattaponi, Pamunkey and York Rivers (Figure 3.1). Land use is predominantly rural in nature with forest cover accounting for 61 percent of the basin's cover, agricultural lands accounting for 21 percent, developed lands 2 percent, wetlands 7 percent, barren lands 1 percent and water accounting for the remaining 8 percent (Chesapeake Bay Program watershed profiles: http://www.chesapeakebay.net)(Figure 3.5). Percentage of impervious surfaces, a component of developed lands, is on the order of 1 percent. Starting from the headwater regions, the York River basin includes all or portions of the following counties: Albemarle, Orange, Louisa, Fluvanna, Spotsylvania, Goochland, Hanover, Caroline, Essex, King William, King and Queen, New Kent, James City, Gloucester and York. Year 2000 population estimates for the York River watershed was 372,500 (EPA/CBP Watershed Profiles; www.chesapeakebay.net) and is projected to reach 452,000 in the next twenty years. Population centers within the watershed include Poquoson, Gloucester Point, Ashland, West Point and Spotsylvania Courthouse. While there are currently no major metropolitan

areas contained within the watershed, growth from Fredericksburg, Richmond and Hampton Roads is impacting the region.

The York River receives freshwater from its two major tributaries whose confluence is at West Point located approximately 55 km (34 mi) from the rivers mouth near the Goodwin Islands component of the Reserve. Long-term daily mean streamflow is 1.41×10^6 m^3 (4.98×10^7 ft^3) for the Mattaponi (USGS Station: 01674500; 1942-2007) and 2.66×10^6 m^3 (9.39×10^7 ft^3) for the Pamunkey (USGS Station: 01673000; 1972-2007) Rivers. The York River estuary also receives freshwater input from a large number of smaller ungaged subbasins and direct groundwater discharge to tidal waters; approximately 35% of the York River basin is below US Geological Survey (USGS) gaging stations (Seitz 1971).

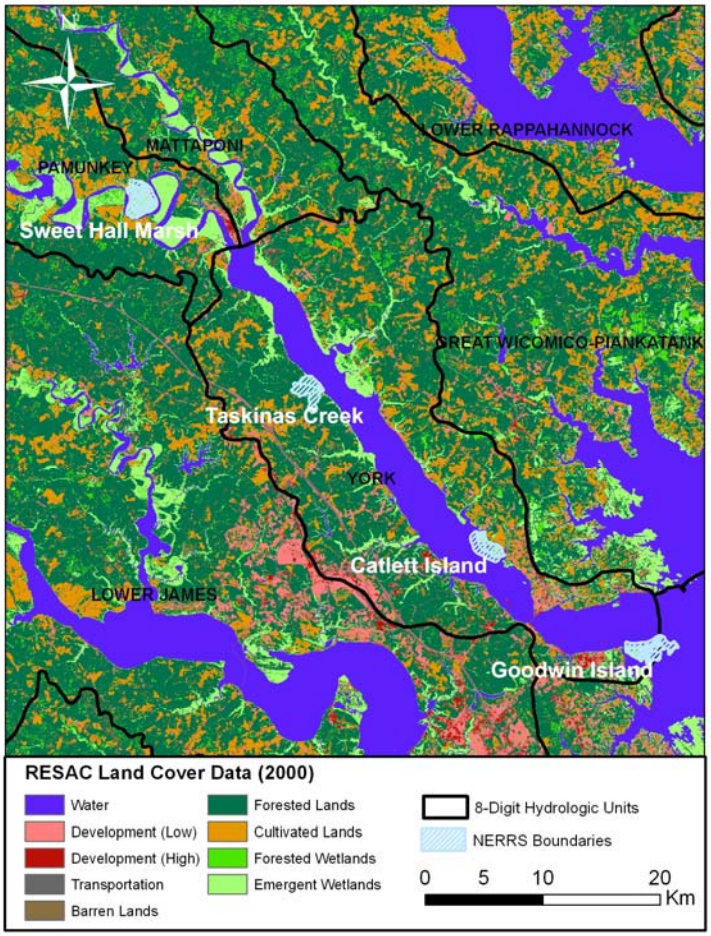

Figure 3.5. Reserve component locations and land-use within the York River basin and surrounding lands.

The York River system is classified as a microtidal, partially mixed estuary. The mean tidal range is 0.7 m (2.3 ft) at its mouth, 0.9 m (1.0 ft) at West Point and increases to over 1 m (3.3 ft) in the upper tidal freshwater regions of the Mattaponi and Pamunkey Rivers (Sisson et al. 1997). The tidal prism has been estimated at 110 million m^3 (3.9×10^9 ft^3) at the mouth and 35 million m^3 (1.2×10^9 ft^3) at West Point (Sturm and Neilson 1977). Principal bathymetric features of the York River consist of an axial channel flanked by broad, shallow shoals of less than 2 m (4.6 ft) in depth (Nichols et al. 1991); main channel depths are on the order of 14 m (46 ft) near Gloucester Point to 6 m (20 ft) near West Point. Because the Mattaponi and Pamunkey Rivers do not exhibit a prominent fall-line as delineated by other major western shore Bay tributaries, the uppermost extent of tidal propagation is somewhat variable and on the order of 120 km (75 mi) upriver on the Mattaponi and as far as 150 km (93 mi) upriver on the Pamunkey (Lin and Kuo 2001). Residence time, defined as the time taken for an element to be discharged from the estuary, is dependent on freshwater discharges rates. Shen and Haas (2004) have estimated residence times are the order of 45 and 90 days for material discharged at the headwaters of the Mattaponi and Pamunkey Rivers during high (upper 90th percentile) and mean flows, respectively.

Salinity distribution along the York River estuary ranges from tidal freshwater to polyhaline regimes (Figure 3.6). Seasonal salinity (2003-2006) patterns specific to the Reserve components indicate tidal freshwater to oligohaline (0.5 to 5 ppt) conditions at Sweet Hall Marsh, mesohaline (5 to 18 ppt) conditions at Taskinas Creek and Catlett Island, and a meso to polyhaline (18 to 30 ppt) salinity regime at Goodwin Islands. Interannual variations in hydrologic budgets and large-scale episodic events (e.g., tropical cyclones) can have a significant impact on the short and long-term salinity patterns within the estuary (Reay and Moore 2005). The York River estuary can exhibit both a primary (ETM) and a more localized secondary estuarine turbidity maximum (STM) where suspended sediments occur at greater

concentrations than observed either upriver or seaward (Figure 3.6)(Lin and Kuo 2001). The ETM is situated near the confluence of the Mattaponi and Pamunkey Rivers at the town of West Point, VA and the STM occurs within the region about 20 to 40 km (12 to 25 mi) from the mouth of the York River estuary. Resuspension of the bottom mud layer in the mid-region of the York River is believed to be a primary sediment contributor to the STM. The turbidity maximums may shift seasonally, migrating upriver during periods of low freshwater discharge.

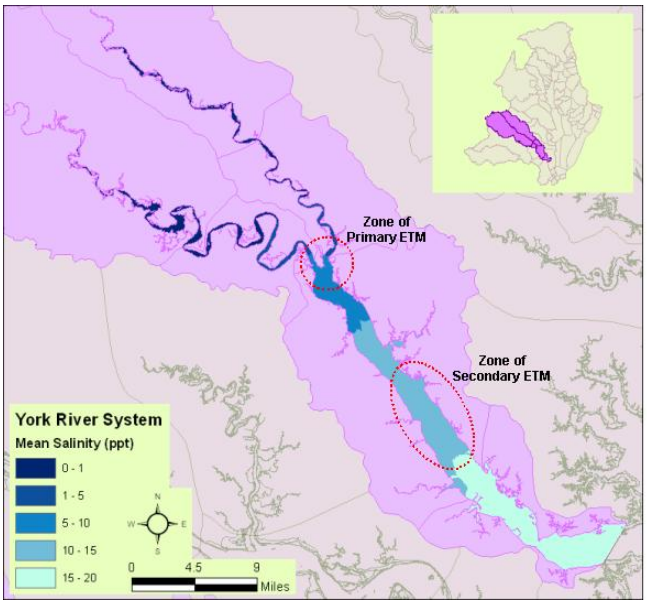

Figure 3.6. Mean salinity map of York River estuary based on monthly (April-October) Dataflow cruises of 2003, 2004 and 2005 and general locations of primary and secondary ETM.

Vertical salinity stratification and homogeneity has been shown to regularly oscillate with the spring-neap tidal cycle in the lower and upper York River estuary (Haas 1977; Sharples et al. 1994). Stability of the water column is controlled by processes that support stratification (e.g., freshwater induced density gradient, decreased turbulent mixing during neap tides and local surface heating) and processes that induce vertical mixing (e.g., elevated tidal action during spring tides and wind driven shear stresses). With respect to water quality, periodic and episodic vertical homogeneity and stratification of the water column is significant. Mixing of the water column can result in the reintroduction of nutrients to surface waters and subsequent enhanced phytoplankton growth (Webb and D'Elia 1980; Haas et al. 1981) and replenishment of oxygen to deeper waters (Kuo et al. 1991). Conversely, stratification can lead to low dissolved oxygen conditions in bottom waters and influence the development of secondary turbidity maximums (Lin and Kuo 2001).

3.3.2 Climate

Due to Virginia's varied landscape and close association with large water masses, the state's climate is diverse and can be classified into five different regions: the Tidewater, Piedmont, Northern Virginia, Western Mountain and Southwestern Mountain regions (www. Climate.Virginia.edu/description.htm). The York River watershed is located within the Tidewater and Piedmont climate regions. Climate within the York River basin is moderate with an average annual temperature of 14 °C (57 °F). Average winter season temperatures range from 2-5 °C (36-41 °F), with average daily minimum values of -5 to -1 °C (23-30 °F). Colder winter temperatures are associated with the more northwestern portions of the watershed. Average summer daily maximum temperatures vary from 23-24 °C (73-75 °F) with average daily maximum values ranging from 29-31 °C (84-88 °F). Warmer summer temperatures are associated with the lower, southern portions of the watershed.

Average annual precipitation rates within the watershed varies from 111 cm (44 in) in the upper reaches of tidal waters (Walkerton; 1932-2007) to 121 cm (48 in) in lower reaches (Williamsburg; 1948-2007). Precipitation is generally well distributed throughout the year. Much of this rainfall is associated with storms resulting from warm and cold frontal systems that generally track from west to east. In the vicinity of the Virginia coast, storm movement is typically northeastward paralleling the coast and Gulf Stream (www. Climate.Virginia.edu/description.htm). Excessive rainfall can result from hurricanes and tropical storms that cross Virginia. These large-scale events generally occur in early August and September. During September, anywhere from 10-40 percent of Virginia's rainfall comes from tropical cyclones. Average annual seasonal snowfall varies from approximately 51 cm (20 in) in the Piedmont region to less

than 25 cm (10 in) in the lower southern Coastal Plain regions (USDA County Soil Surveys). Average relative humidity in the mid-afternoon is on the order of 50 percent throughout the watershed.

3.3.3 Reserve Components

CBNERRVA consists of four components, Sweet Hall Marsh, Taskinas Creek, Catlett Islands and the Goodwin Islands, which represent a diversity of coastal ecosystems found within the York River estuary and its principle tidal tributaries (Figure 3.5). Sweet Hall Marsh, 443 ha (1094 ac) in area, represents an extensive tidal fresh water-oligohaline marsh ecosystem located in the Pamunkey River, one of two major tributaries of the York River (Figure 3.7). Taskinas Creek encompasses 433 ha (1070 ac) within the boundaries of York River State Park (YRSP) (Figure 3.8). The non-tidal portion of Taskinas Creek contains feeder streams that drain oak-hickory forests, maple-gum-ash swamps and freshwater marshes which transition into tidal oligo and mesohaline salt marshes. The Catlett Islands, 220 ha (542 acres) in area, consist of multiple parallel ridges of forested wetland hammocks, forested upland hammocks, emergent mesohaline salt marshes and tidal creeks surrounded by shallow subtidal areas that once supported beds of submerged aquatic vegetation (Figure 3.9). The Goodwin Islands, located near the mouth of the York River, are a 148 ha (366 acres) archipelago of polyhaline salt-marsh islands surrounded by inter-tidal flats, extensive submerged aquatic vegetation beds, and shallow open estuarine waters (Figure 3.10). The reader is directed to the Reserves Site Profile for an in depth description of the York River watershed, its coastal ecosystems and associated diverse flora and fauna (Moore and Reay 2008). Details regarding general location, ownership, management, physical conditions, representative habitats, rare and endangered flora and fauna, cultural/historical resources, and identified management issues are provided below for each Reserve component.

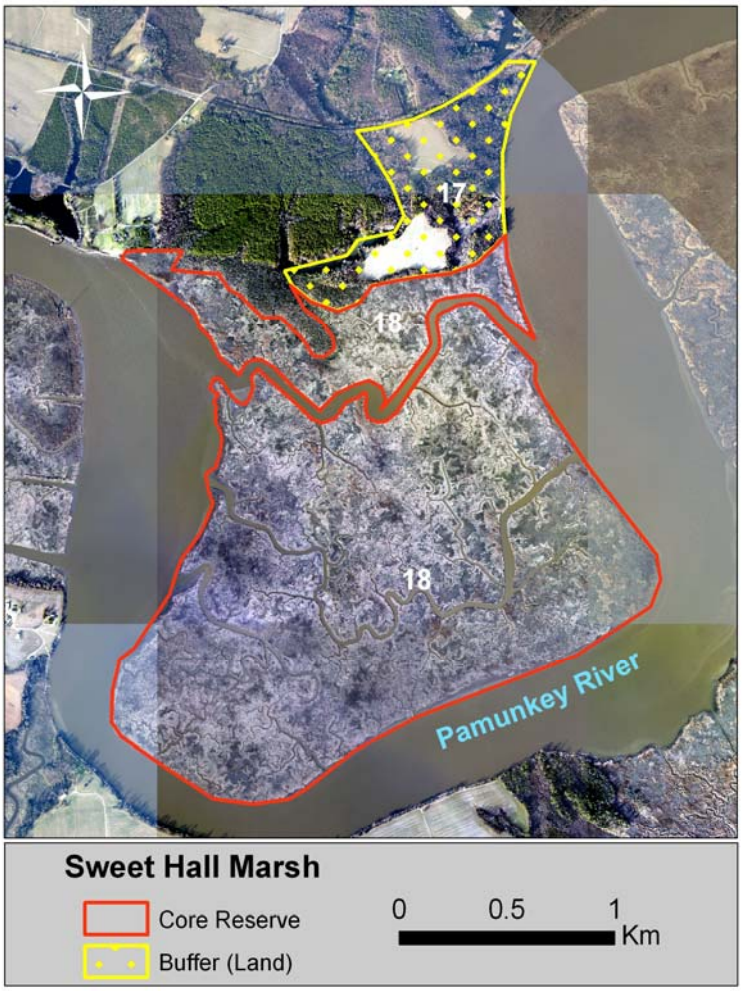

Figure 3.7. Aerial photo of Sweet Hall Marsh Reserve component delineating core and buffer areas.

Sweet Hall Marsh

Location: Sweet Hall Marsh (37° 34' N; 76° 50' W) is located in the tidal freshwater-oligohaline transitional zone of the Pamunkey River, one of two major tributaries of the York River, and has historically represented the lower-most extensive tidal fresh water marsh located in this riverine system. Sweet Hall Marsh is approximately 35 km (22 mi) from West Point, where the Pamunkey and Mattaponi converge to form the York River. The site is 63 km (39 mi) upriver from VIMS and 83 km (52 mi) from the mouth of the York River.

Ownership and Management: Sweet Hall Marsh is privately owned by the Tacoma Hunting and Fishing Club; parcel identification is provided in Figure 3.7. Parcel size is 384 ha (949 ac) for tract 18 and 59 ha (145 ac) for the buffer tract 17. The Tick Hill tract, identified as parcel 12 (76 ha; 189 ac) in the 1991 Reserve Management Plan, was sold in 2000 by the Chesapeake Corporation to a private citizen. An updated MOU between VIMS/W&M and the new owner does not currently exist and therefore the Tick Hill tract is no longer included in the Reserve; see Section 11.3.3 for further details. VIMS serves as the on-site manager of the Sweet Hall Marsh component of the Reserve and assures consistency with the Sweet Hall National Estuarine Research Reserve in Virginia Management Agreement dated May 1, 2008 (Appendix I.2).

Physical Conditions: Tides at Sweet Hall Marsh are semi-diurnal and display an average range of 1.0 m (3.3 ft). Mean seasonal water temperature values range from 14.7-16.7 °C (58.5-62.1 °F) for spring, 26.7-27.9 °C (80.1-82.2 °F) for summer, 18.6-19.1 °C (65.5-66.4 °F) for fall, and 4.7-6.3 °C (40.5-43.3 °F) for winter. Located within the oligohaline, lower freshwater reaches of the Pamunkey River, mean seasonal salinity values range from 0.1-3.4 psu for spring, 0.1-8.4 psu for summer, 0.3-8.4 psu for fall, and 0.1-3.2 psu for winter. Summary water quality statistics were derived from SWMP 15-minute interval data for the years 2002-2004.

Representative Coastal Habitats: The Sweet Hall Marsh component consists of a 384 ha (949 ac) core region that encompasses emergent, fresh and low salinity marsh, seasonally flooded forested wetlands and scrub-shrub wetlands (Figure 3.7). A 59 ha (145 ac) buffer consists primarily of uplands forests and open agricultural fields. The emergent marsh community is classified as freshwater mixed and includes arrow arum (*Peltandra virginica*), big cordgrass (*Spartina cynosuroides*), smartweeds (*Polygonum spp.*) species, rice cutgrass (*Leersia oryzoides*), wild rice (*Zizania aquatica*), sedges (Carex spp.) and rushes (*Scirpus* spp.), cattail (*Typha* spp.) and panic grass (*Panicum virgatum*). The dominant canopy species in the flooded forested wetlands include green ash (*Fraxinus pennsylvanica*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*) and ironwood (*Carpinus caroliniana*). Scrub-shrub species include wax myrtle (*Myrica cerifera L.*), mountain laurel (*Kalmia latifolia*) and arrow wood viburnum (*Viburnum dentatum*). The uplands in the buffer zone consist of agricultural fields and mixed hardwoods and pine.

Rare Plant and Animal Species: The sensitive joint vetch (*Aeschenomene virginica*), a candidate for federal listing as an endangered species, has historically been found at Sweet Hall Marsh but has not been found in recent surveys. Fauna surveys conducted to date have found the butterfly species *Problema bulenta*, a “Rare Skipper” species that has both a global and state rare ranking (Myers et al. 2008b). Several Bald Eagles nesting locations are located near, but not within the boundaries of Sweet Hall Marsh. Eagles use both the water and upland resources within the Reserve boundary for fishing and resting and should be considered in management plans.

Cultural and Historic Resources: Sweet Hall Marsh has not been surveyed for archaeological resources. Due to its long history of human use, it is expected that Sweet Hall Marsh and adjacent uplands would yield significant prehistoric and historic resources.

Identified Management Issues: Identified resource management issues at Sweet Hall Marsh and immediate surrounding region include: (1) assessment and control of problem invasive plant species which may include the non-native common reed (*Phragmites australis*), (2) assessment of relative sea level rise impacts (includes subsidence due to ground water withdrawal and other factors) on plant communities, (3) assessment of long-term reductions in stream flow on salinity patterns and the impacts on plant communities and fish spawning grounds, (4) source identification of mercury inputs and impacts upon the ecosystem, (5) assessment of introduced Blue catfish populations and impact on local fish populations (6) assessment of increased development and public access pressures on natural resources, and (7) survey of archaeological resources and development of archaeological resource management plan.

Taskinas Creek

Location: The Taskinas Creek component (37° 24' N; 76° 42' W) is located within the boundaries of YRSP near the town of Croaker, in James City County, Virginia. The small subestuary of the York River is located on the southern side of the river, approximately 22 km (14 mi) upriver from VIMS and 44 km (27 mi) from the mouth of the York River.

Ownership and Management: YRSP contains 1034 ha (2554 ac; includes 44.5 ac Harrison tract acquired in 2003). All lands within the boundaries of YRSP are owned by the Commonwealth of Virginia. Lands within the Taskinas Creek Reserve component of YRSP, identified as the Taskinas Creek Management Unit in the YRSP Resource Management Plan (VaDCR 2000b), are co-managed by the Virginia Department of Conservation and Recreation (VaDCR) and VIMS in a manner consistent with the MOU between VIMS/W&M and the VaDCR dated August 19, 2008 (Appendix I.3).

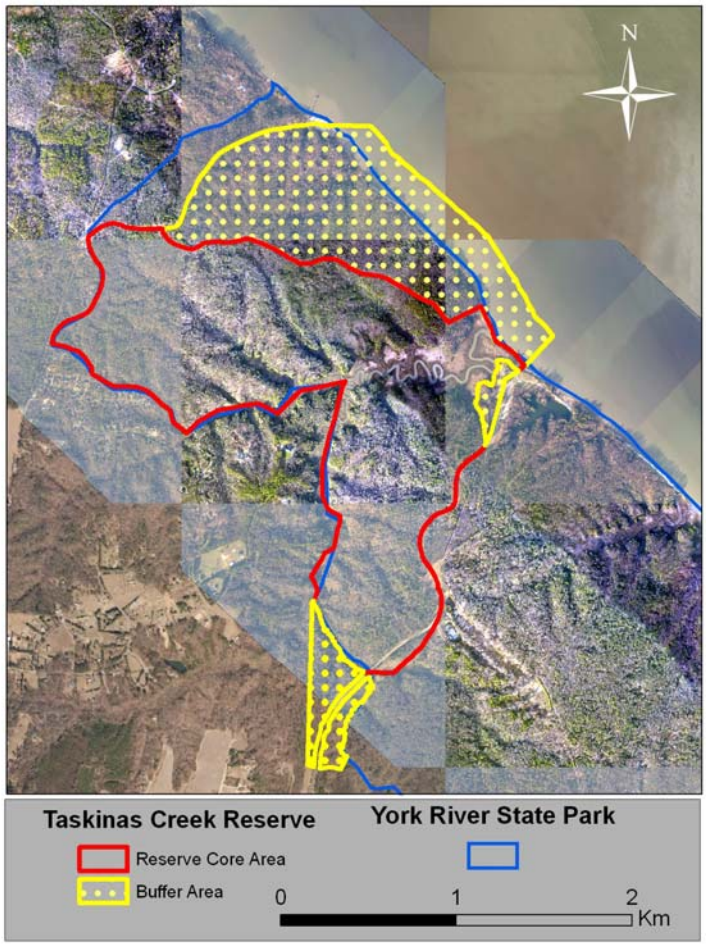

Figure 3.8. Aerial photo of Taskinas Creek reserve component delineating core and buffer areas and YRSP boundaries.

Physical Conditions: Taskinas Creek water quality is influenced to a large degree by watershed drainage at low tide and mainstem York River during high tide conditions. Tides are semi-diurnal and display an average range of 1.0 m (3.3 ft). Mean seasonal water temperature values range from 15.2-19.0 °C (59.4-66.2 °F) for spring, 26.8-28.2 °C (80.2-82.8 °F) for summer, 15.7-18.3 °C (60.3-64.9 °F) for fall, and 3.6-9.0 °C (38.5-48.2 °F) for winter. Located within the meso-polyhaline region of the York River estuary, mean seasonal salinity values range from 4.0-14.0 psu for spring, 7.0-18.2 psu for summer, 6.9-17.0 for fall, and 5.8-15.3 psu for winter. Summary water quality statistics were derived from SWMP 15-minute interval data for the years 1998-2004.

Representative Coastal Habitats: The Taskinas Creek component consists of a 285 ha (704 ac) core and 148 ha (366 ac) buffer region within the boundaries of YRSP (Figure 3.8). The upper, most inland boundary of the core area coincides with the 30.5 m (100 ft) contour and the seaward boundary of the core and buffer is defined by the 0.3 m (1 ft) water depth contour which delineates the seaward limit of the intertidal zone. The non-tidal portion of Taskinas Creek contains feeder streams that drain oak-hickory forests, maple-gum-ash swamps and freshwater marshes. Freshwater mixed wetlands are found in the upstream reaches of Taskinas Creek. Three-square (*Scirpus americanus* and *S. olneyi*) and big cordgrass (*Spartina cynosuroides*) characterize the middle marsh reaches. Salt marsh vegetation dominated by smooth cordgrass (*Spartina alterniflora*) is found in the lower reaches of the creek, near the outlet to the York River.

Rare Plant and Animal Species: A population of mountain camellia (*Stewartia ovata)* (G4/S2), first discovered in 1990, was rediscovered at the Reserve in 2006. Thirty two plants were located in six

subpopulation areas (Meyers et al. 2008a). One Bald Eagle nesting location is known just outside the boundary of YRSP and the Taskinas Creek Reserve. Eagles use both the water and upland resources within the Reserve boundary for fishing and nesting and are therefore considered in this management plan.

Cultural and Historic Resources: Archaeological studies have been conducted within YRSP. Two sites of interest have been dated to between 1000 B.C. to 1500 A.D. (Egloff, 1988). Of significance is a previously undefined type of ceramic ware (Croaker Landing) and type of projectile point (Potts Side-Notched). Additional information and archaeological/historical sites and areas of archaeological resource potential within YRSP are provided in the YRSP Resource Management Plan (VaDCR 2000b).

Identified Management Issues: Identified resource management issues for the Taskinas Creek component of the Reserve and its immediate surrounding region include: (1) control of known problem invasive plant species which include the common reed (*Phragmites australis*), (2) assessment of sea level rise and shoreline erosion on critical habitats and geomorphic features, (3) source tracking of tidal creek fecal coliform contamination and development of remediation strategies, (4) assessment of increased development and public access pressures on natural resources, (5) enhanced survey of archaeological resources and development of an archaeological resource management plan, (6) determination of Reserve and YRSP carrying capacity to accommodate public use, research and education, (7) assessment of foot, bike and horse traffic on trail system, and (8) unauthorized public use of the Reserve which includes non-permitted collection of plants and animals, artifact collection, and unleashed dogs and cats.

Catlett Islands

Location: The Catlett Islands (37° 18' N; 76° 33' W) are located approximately 35 km (22 mi) from the mouth of the York River and 7 km (4 mi) from VIMS, on the North side of the York River in Gloucester County, Virginia. Timberneck Creek flows into the York River on the eastern side of the Catlett Islands and Cedarbush Creek enters the river on the western side. Poplar Creek bisects the two large areas of the Catlett Islands.

Ownership and Management: The Reserve core encompasses the entire Catlett Island ecological unit except for a small portion (Owner: D. and M. Ablowich; Size: 32 ha or 79 ac; Parcel ID: 88) located on the most northwest portion of the Islands (Figure 3.9). The majority of land comprising the Catlett Islands component is owned by Timberneck LLC (Parcels 64, 87, 89, 90 and 91). Parcel size is 47 ha (115 ac) for tract 64, 63 ha (155 ac) for tract 87/89, and 45 ha each (112 ac) for tracts 90 and 91. VIMS/W&M holds deed to a small portion (20 ha; 48 ac) of the most southeast portion (Parcel 65) of the island complex. VIMS serves as the on-site manager of the Catlett Island component of the Reserve and assures consistency with the Catlett Island National Estuarine Research Reserve in Virginia Conservation Easements dated September 5, 1990 and November 14, 1990 (Appendices I.4 and I.5).

Physical Conditions: Tides at the Catlett Islands are semi-diurnal and display an average range of 0.8 m (2.6 ft). Mean seasonal water temperature values range from 15.2-18.7 °C (59.4-65.7 °F) for spring, 25.2-28.5 °C (77.4-83.3 °F) for summer, 14.9-20.9 °C (58.8-69.6 °F) for fall, and 4.5-12.1 °C (40.1-53.8 °F) for winter. Mean seasonal salinity values range from 10.7-22.6 psu for spring, 15.1-23.1 psu for summer, 13.2-25.2 psu for fall, and 10.3-23.1 psu for winter. Summary water quality statistics were derived from weekly interval data from the Alliance for the Chesapeake Bay for the years 1995-2004.

Representative Coastal Habitats: The Catlett Islands component consists of approximately 220 ha (542 ac) core area consisting of multiple parallel ridges of forested hammocks and emergent wetlands (Figure 3.9). Primary ecological community groups occurring at Catlett Islands include tidal meso and polyhaline marshes, forested wetlands and maritime upland forests (Erdle and Heffernan 2005b). Smooth cordgrass (*Spartina alterniflora*) prevails over much of the marsh area along with saltgrass (*Distichlis spicata*), saltmeadow hay (*Spartina patens*), black needlerush (*Juncus roemerianus*) and various halophytic forbs. Estuarine scrub/shrub vegetation including saltbush or high-watershrub (*Iva frutescens*), groundsel tree (*Baccharis halimifolia*), southern bayberry (*Myrica cerifera*) and northern bayberry (*Myrica pennsylvanica*),

occurs in transitional areas from salt marsh to forested wetlands and hammock regions. Maritime upland forests, dominated by oak species (*Quercus phellos, Q. falcata, Q. pagoda*), loblolly pine (*Pinus taeda*) and to a lesser degree black cherry (*Prunus serotina*), red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*) and other tree species dominate the higher terrain.

Rare Plant and Animal Species: Flora surveys conducted to date do not indicate the presence of rare plant species. Bald Eagles have been documented on Catlett Island in years past and currently continue to utilize the Island. While there has been no successful breeding activity in recent years (2004-2005), a nest was rebuilt in 2005 and breeding activity is currently being evaluated (B. Watts, pers. comm.).

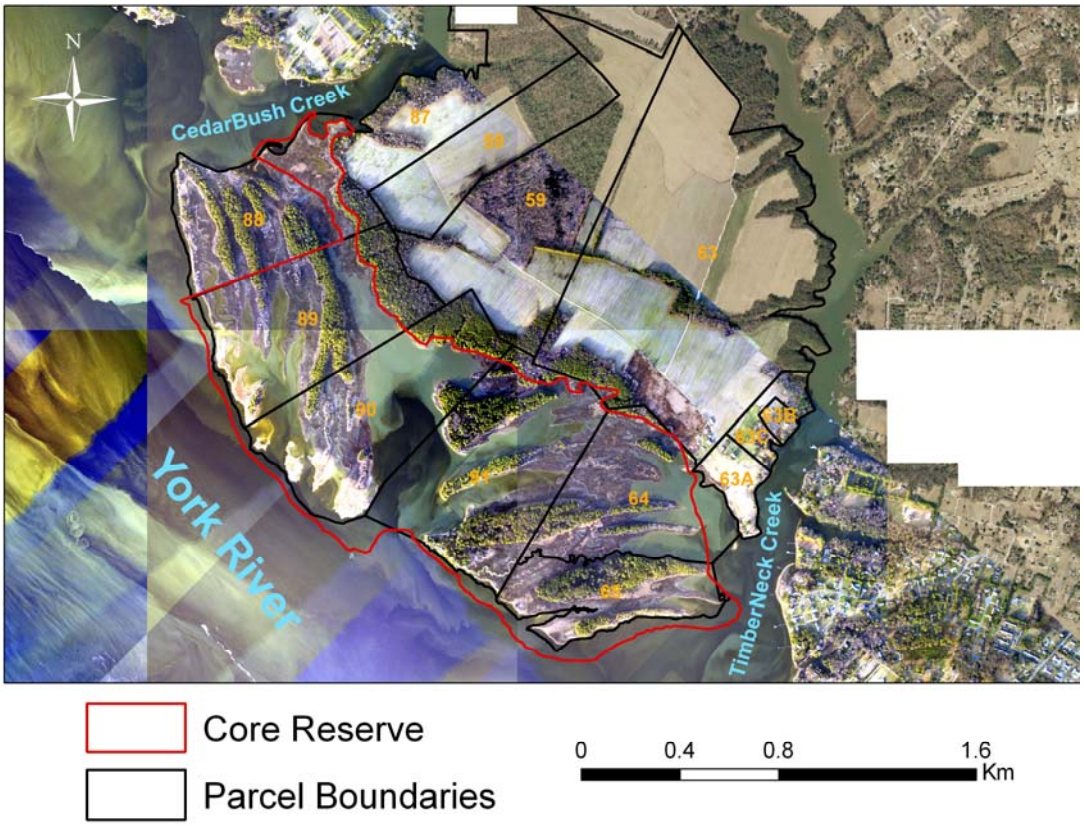

Figure 3.9. Aerial photo of Catlett Islands Reserve component delineating core area and land ownership information.

Cultural and Historic Resources: A cultural resource overview has been conducted for the Timberneck Farm and adjacent Catlett Islands (Blanton et al. 1993). The overview documented relatively few Archaic (10,000-2,500 yrs B.P.) sites, and on the order of ten each of Middle Woodland (2,500-1,000 yrs B.P.) and Late Woodland (1,000-400 yrs. B.P.) sites. With respect to historic sites, numerous site occupations from the seventeenth through twentieth centuries have been identified.

Identified Management Issues: Identified resource management issues on Catlett Islands and immediate surrounding region include: (1) control of known problem invasive plant species which include common reed (*Phragmites australis*), japanese honeysuckle (*Lonicera japonica*), and blunt-leaved privet (*Ligustrum obtusifolium*), (2) impact assessment and potential control of the southern pine bark beetle, (3) control of native animal problem species which include raccoon (*Procyon lotor*), fox species and white-tailed deer (*Odocoileus virginicus*), (4) assessment, protection and restoration of critical colonial bird nesting habitat with specific emphasis on the great blue heron (*Ardea herodias*), (5) assessment, protection and restoration of critical breeding and nesting areas for shorebirds including American

oystercatchers (*Haematopus palliates),* (6) assessment of sea level rise and shoreline erosion on critical habitats and geomorphic features, (7) development and implementation of a hunting management plan, (8) development of a petroleum/toxic material spill contingency and response plans, (9) development of a fire contingency plan, (10) assessment of increased development and public access pressures on natural resources, (11) source tracking of tidal creek fecal coliform contamination and development of remediation strategies, (12) determination of water quality status for surrounding waters and assess the potential for submerged aquatic vegetation and oyster restoration, (13) enhanced survey of archaeological resources and development of a archaeological resource management plan, and (14) unauthorized public use of the Reserve which includes non-permitted collection of plants and animals, artifact collection, hunting and camping.

Goodwin Islands

Location: The Goodwin Islands (37° 13' N; 76° 23' W) component of the CBNERRVA is located on the southern side of the mouth of the York River. The islands are at the northeastern tip of York County approximately 22 km (14 mi) down the York River from VIMS.

Ownership and Management: Goodwin Islands are owned by the College of William and Mary. VIMS serves as the on-site manager of the Goodwin Islands component of the Reserve and assures consistency with the MOU between VIMS/College of William and Mary and NOAA dated February 6, 1991 (Appendix I.1).

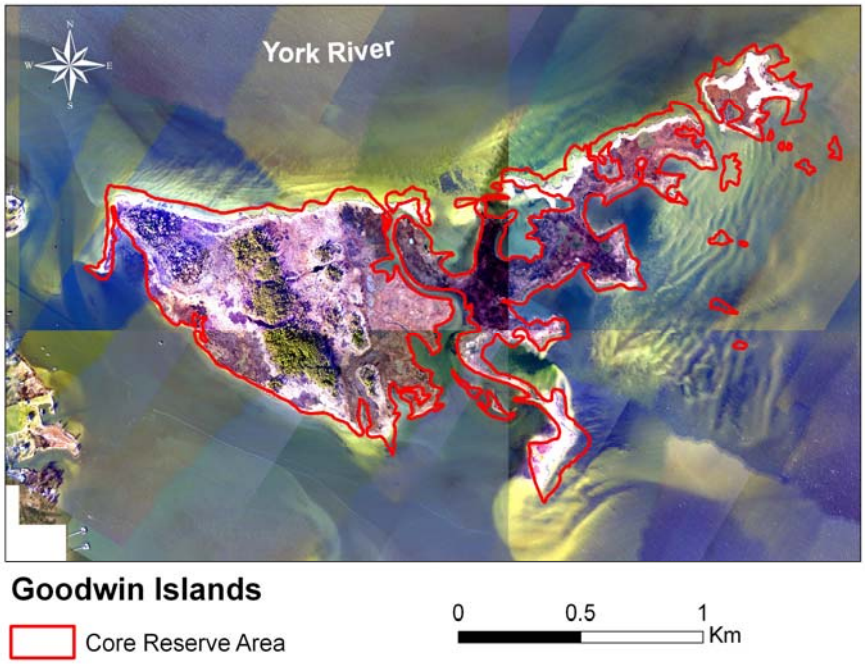

Figure 3.10. Aerial photo of Goodwin Islands reserve component delineating core boundary.

Physical Conditions: Water circulation patterns around the island are influenced by York River discharge and wind patterns of the Chesapeake Bay. Tides at the Goodwin Islands are semi-diurnal and display an average range of 0.7 m (2.3 ft). Mean seasonal water temperature values range from 13.7-15.6 °C (56.7-60.1 °F) for spring (March-May), 25.7-27.2 °C (78.3-81.0 °F) for summer (June-August), 18.0-19.2 °C (64.4-66.6 °F) for fall (September-November), and 4.7-8.2 °C (40.5-46.8 °F) for winter (January-February, and December). Located within the polyhaline region of the York River estuary, mean seasonal salinity values range from 13.9-23.0 psu for spring, 17.2-23.0 psu for summer, 16.5-24.0 for fall, and 15.9-23.3 psu for winter. Summary water quality statistics were derived from SWMP 15-minute interval data for the years 1998-2004.

Representative Coastal Habitats: Consisting of an archipelago of salt-marsh islands, the Goodwin Islands component core area is approximately 148 ha (366 ac) in area (Figure 3.10). Primary ecological community groups occurring at Goodwin Islands include tidal meso-polyhaline marshes, maritime dune grasslands, salt scrub, and maritime upland forest (Erdle and Heffernan 2005a). Salt marsh vegetation is dominated by smooth cordgrass (*Spartina alterniflora*) and saltgrass (*Distichlis spicata*). Other marsh associates include salt meadow hay (*Spartina patens*), glasswort (*Salicornia virginica*), sea-lavender

(*Limonium carolinianum*), and stands of black needlerush (*Juncus roemerianus*). Characteristic species of the narrow stands of maritime dune grasslands include saltmeadow hay (*Spartina patens*), beach panic grass (*Panicum amarum*), seaside goldenrod (*Solidago sempervirens*) seaside spurge (*Chamaesyce polygonifolia*) and searocket (*Cakile edentula*). Salt shrubland community, consisting primarily of groundsel tree (*Baccharis halimifolia*) and saltbush (*Iva frutescens*), is irregularly scattered along low dunes and the island perimeter. The higher, interior western portions of the Goodwin Islands support a large stand of loblolly pine (*Pinus taeda*) with some mixed oak. The understory is dominated by southern wax myrtle (*Myrica cerifera*) and to a lesser degree red bay (*Persea palustris*). The northwestern corner of the island contains a fringe forest of sugarberry (*Celtis laevigata*), slippery elm (*Ulmus rubra*) and cottonwood (*Populus deltoides*); understory consists of Chinese privet (*Ligustrum obtusifolium*) and other shrub species. The surrounding aquatic zone includes extensive submerged aquatic vegetation (SAV) beds of eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) approximately 183 ha (453 ac) in area (Orth et al. 2005), large expanses of unvegetated bottoms, and shallow open estuarine waters.

Rare Plant and Animal Species: Flora and fauna surveys conducted to date do not indicate the presence of rare plant and animal species. Breeding Bald Eagles have been documented in recent years, although Tropical Cyclone Isabel damaged nesting habitat in the fall of 2003 (Watts, pers. comm., 2004).

Cultural and Historic Resources: An archaeological survey has not been conducted at Goodwin Islands. Based on observations and personal communications, Goodwin Islands contains prehistoric and historic resources.

Identified Management Issues: Identified resource management issues on Goodwin Islands and the immediate surrounding region include: (1) control of known problem invasive plant species which include common reed (*Phragmites australis*), japanese honeysuckle (*Lonicera japonica*), japanese stilt grass (*Microstegium vimineum*), and border privet (*Ligustrum obtusifolium*), (2) control of native animal problem species which include raccoon (*Procyon lotor*), fox species and white-tailed deer (*Odocoileus virginicus*), (3) assessment, protection and restoration of critical spawning, nesting and nursery habitat with specific emphasis on colonial nesting birds such as the great blue heron (*Ardea herodias*), horseshoe crab (*Limulus polyphemus*) spawning grounds, breeding and nesting areas for shorebirds including American oystercatchers (*Haematopus palliates*), and diamondback terrapins (*Malaclemys terrapin*), (4) assessment of sea level rise and shoreline erosion on critical habitats and geomorphic features, (5) restoration of submerged aquatic vegetation beds to past aerial coverage, (6) continued implementation of hunting management plan, (7) assessment of direct and indirect impacts of fishing activity on natural resources, (8) development of petroleum/toxic material spill contingency and response plans, (9) development of a fire contingency plan, (10) assessment of increased development and public access pressures on natural, cultural and historic resources, (11) survey of archaeological resources and development of a archaeological resource management plan, and (12) unauthorized public use of the Reserve which includes non-permitted collection of plants and animals, artifact collection, unleashed dogs and cats, and camping.

IV. CBNERRVA: Programmatic Accomplishments, Evaluations and Changes: 1991-2008.

4.1 Summary of Reserve Accomplishments

Since the Reserve's designation in 1991, significant accomplishments have been recognized. Following are selected Reserve accomplishments by program category.

4.1.1 Administration and Staffing

- Since its inception, CBNERRVA has been managed by VIMS/W&M. This consistency in program administration has produced relative stability in Reserve staff, and allowed for fulfillment of program commitments and ability to conduct long-range planning. As part of an internal organizational realignment in the mid-1990's, CBNERRVA was designated as a Research Center and moved from academic departmental oversight to reporting directly to the Institute's Dean and Director. This reorganization allowed for greater visibility, more direct budgetary control of Reserve funds, increased input regarding staff evaluation, and direct involvement in planning and policy development at the Institute level. In addition, the Reserve maintains strong academic ties to VIMS/W&M through faculty appointments of the Reserve Director and Research Coordinator.

- CBNERRVA has continued to maintain a relatively stable level of state-support throughout its history. State funds have traditionally been adequate to support a large-fraction of two core Reserve staff positions; these are the Reserve's Director (85%) and Business Manager (100%). In 2005, state funds were appropriated to VIMS to support CBNERRVA facility maintenance and upkeep.

- With a combination of NERRS operational funds, state CBNERRVA operational funds, and external sponsored program funds derived from both competitive and noncompetitive grants, the staff and scope of CBNERRVA has grown significantly within the past few years. Currently, there are seventeen CBNERRVA associated staff that directly support NERRS initiatives or closely related activities. Increased staff capabilities and expertise has allowed CBNERRVA to make greater contributions in research and environmental monitoring, education and resource stewardship at local, regional and national levels.

4.1.2 Research and Monitoring Program

CBNERRVA has promoted research and monitoring activities within and outside its Reserve boundaries to support both basic and applied science that address a wide variety of coastal issues. Through the establishment and implementation of environmental monitoring programs, research programs of Reserve associated faculty, and assisting external sponsored research projects through coordination and logistical support, the Reserve's Research and Monitoring Program is recognized at the state and Bay-wide regional level. Following are some accomplishments of the program.

- Since its initiation in 1995, CBNERRVA has fully participated in the NERRS SWMP. Within the York River system, CBNERRVA maintains a network of long-term, year-round continuous water quality stations located at White House (2003-current), Sweet Hall Marsh (2000-current), Taskinas Creek (1995-current), Clay Bank (2001-current), Gloucester Point (2003-current) and Goodwin Island (1997-current). In 2002 and 2004, CBNERRVA implemented the NERRS nutrient/plant pigment monitoring program and SAV Tier II Biological Monitoring Program, respectively. Beginning in 2000, CBNERRVA established a weather station at Taskinas Creek to support meteorological monitoring aspects of

SWMP. In addition, CBNERRVA maintains additional weather stations at Sweet Hall Marsh and Goodwin Islands to support York River watershed level studies and site-specific research projects.

- Initiated in 2004, CBNERRVA played a critical role in the development and implementation of the NERRS SAV biomonitoring program. Fixed transects located within SAV beds at Goodwin Islands and Gloucester Point are monitored in order to quantify SAV inter-annual variability in shoot density and distribution and identify any relationship to water quality. Results from this effort have shown that eelgrass at the Reserve are growing near their physiological tolerances and the combined effects of short-term exposures to very high summer temperatures, compounded by reduced oxygen and light conditions, may lead to long-term declines of this species from this system (Moore and Jarvis 2008).

- Since 2003, CBNERRVA associated faculty and staff administer and operate the USEPA Chesapeake Bay's Shallow Water Monitoring Program within the southern portion of the Bay. This program established the use of surface water quality mapping (Dataflow) and augmented the spatial scale of the continuous, fixed water quality stations within Virginia's tidal waters. Surface water quality mapping current efforts include the lower York River (2003-ongoing), the upper York (including the Mattaponi and Pamunkey Rivers; 2003-2006), the Piankatank River (2003-2006), the James River (2006-ongoing) and other smaller coastal embayments. With respect to continuous, fixed water quality stations, CBNERRVA maintained numerous stations within the York (6 stations), Piankatank (3 stations; 2003-2006) and James River (7 stations; 2006-ongoing) systems. In 2007, through a state initiative,this program was expanded to address other river systems (e.g., Potomac and Rappahannock) on a three-year rotational basis.

- The Reserve has played a leading role in the local Virginia Estuarine and Coastal Observing System (VECOS) and the sub-regional Chesapeake Bay Observing System (CBOS). As part of this effort, CBNERRVA and the VIMS Department of Physical Sciences have enhanced telemetry capabilities at selected weather (4 stations) and water quality (3 stations) monitoring stations, and buoy platforms (2 buoys) using radio, cellular and satellite technology. In addition to being a primary data provider, CBNERRVA staff have been instrumental in the development of the VECOS data web portal and serving on strategic regional planning committees.

- CBNERRVA actively participates in national atmospheric monitoring programs such as the USEPA sponsored National Atmospheric Deposition Program (NADP). In 2004, CBNERRVA established and began maintaining site operations at the southern Chesapeake Bay station VA98 for the NADP's National Trends Network (NTN) and Mercury Deposition Network (MDN).

- Reserve associated faculty have developed externally funded research programs that focus on basic and applied science of shallow water, shoreline and riparian habitats, and watershed processes that directly relate to coastal water quality impacts. Results from these research programs have directly supported Bay-wide SAV restoration initiatives and tributary nutrient management strategies.

- CBNERRVA continues to promote the Reserve components as value added platforms in which basic and applied research can be conducted within a secure and long-term marine protected area. On an annual basis, CBNERRVA typically permits 30 research projects occurring within Reserve boundaries.

- Since its initiation in 1997, CBNERRVA has fully participated in the NERRS GRF Program. To date, this program has supported ten students pursuing advanced degrees and resulted in the granting of three doctoral and three masters degrees from the School of Marine Science, College of William and Mary.

4.1.3 General Education and Public Outreach

The CBNERRVA General Education and Public Outreach Program works to provide in-class and meaningful Bay experiences for student (K-12, college), educator and public audiences. Programs are

designed to enhance awareness and understanding of the estuary and emphasize the interrelationships of coastal habitats and human activities.

- Since 1991, CBNERRVA has actively participated in K-12 marine science education programs. A hallmark of the Reserve's K-12 education program is delivering a meaningful Bay experience to each participant through in-class pre field-trip preparation, a hands-on field experience and a post field trip follow up. Offerings are varied and in some cases tailored to meet individual teacher/school needs, and include 'Discovering Shallow Water Habitats', 'Oyster Restoration', and 'Fisheries Restoration' field-trips. With support of NOAA's Bay Watershed Education and Training Program (BWET), CBNERRVA provides every 7th grade student in Gloucester and Mathews Counties a meaningful Chesapeake Bay experience. On an annual basis, approximately 1000-2000 students, teachers and chaperones participate in CBNERRVA K-12 education programs.

- CBNERRVA has developed and offered multi-day summer programs to elementary, middle and high school students. Summer programs include classroom instruction, facility tours, experimentation and hands-on field activities. Beginning in 2002, high school offerings have included 'Investigating Current Chesapeake Bay Fisheries Issues' and the 'Chesapeake Bay Conference', a partnership program with Gloucester County Rotary Club. Beginning in 2007 and in partnership with NOAA's Chesapeake Bay Office (NCBO), elementary and middle school offerings have included 'Bay Exploration' and 'Ocean Technology' Camps. Summer programs have met with great success and typically serve 100 or more students per annum from throughout the Commonwealth.

- CBNERRVA has been involved in estuarine science curriculum development at the local, regional and national level. Locally, Reserve education staff have developed the York River Water Quality Curriculum that utilizes York River SWMP data to answer applied marine science questions and an environmental education program for children with visual and hearing special needs. Regionally, CBNERRVA has been active in development of the Chesapeake Bay module of the NERRS Estuaries 101. At the national level, the Reserve continues to support development and testing of the Estuaries 101 curriculum and in 2007, hosted the National Geographic Society's Jason Project focused on estuaries and embayments.

- Since its inception, CBNERRVA has participated in college and intern training programs. CBNERRVA has participated in VIMS National Science Foundation (NSF) funded Research Experience for Undergraduates, supported the National Aquarium in Baltimore (NAIB) with their Conservation Work Studies Program for under-represented and minority students, and supported the Rappahannock Community College's Technical Preparatory Program. In addition, through the Rouse-Bottom Endowment, CBNERRVA has been able to fund extended undergraduate research opportunities within the Reserve. Through these programs, Reserve staff mentor, on average, five undergraduate students per year.

- CBNERRVA has developed a series of public outreach offerings to increase public awareness and understanding of coastal and ocean resources. Adult programs include the canoe based 'Tour of the Reserves' and the VIMS 'After Hours Seminar Series'. Beginning in 2006, CBNERRVA has offered a monthly series of family oriented 'Discovery Labs' which link scientific presentations, relevant research and management information, and children activities on specific coastal topics and organisms. CBNERRVA is also an active participant in Marine Science Day, the Institute's open house, and the nationally celebrated Estuaries Day, both of which are yearly festival oriented events for audiences of all ages.

- CBNERRVA has singly and/or in conjunction with other key education partners, developed and conducted a variety of teacher professional development programs. Workshop topics include water quality, aquatic habitat restoration, oyster restoration, estuarine aquarium keeping, and schoolyard habitats. On an annual basis, approximately 75-100 teachers participate in CBNERRVA Teacher Professional Development Programs.

4.1.4 Coastal Training Program (CTP)

The CTP aims to provide timely scientific information, training, and resources to individuals that play a direct role in making decisions that affect coastal and estuarine resources. Following are some accomplishments of the Reserve's CTP.

- In 2005, CBNERRVA's CTP became fully implemented and received ERD program approval. Program approval required development, submission and approval of CTP planning documents. Reserve target audiences include local and regional land use planners, regulatory and management personnel, elected officials, developers, and other coastal businesses. CTP focus areas include riparian and shoreline management, water quality and management issues, and the Integrated Ocean Observation System (IOOS).

- In 2003, CBNERRVA in partnership with VIMS's Center for Coastal Resource Management (CCRM) and Public Relations Department developed and implemented the VIMS After Hours Seminar Series. This monthly naturalists' seminar series focuses on key Chesapeake Bay topics of interest to adult audiences and coastal decision-makers. Monthly seminar attendance varies from 40 to 180 persons.

- Since the inception of the Reserve's CTP, Reserve staff have played a leading role in the development and implementation of several technical training offerings focusing on shoreline management. Workshops included 'Perennial Stream Identification Methods', 'Wetland Identification and Delineation', 'Winter Wetland Botany', 'Introduction to Riparian Buffers', 'Living Shoreline: Erosion Control Alternatives', and 'Natural Heritage Geographical Information System (GIS) Data Exploration'. Program support was also provided to partner workshops whose subject matter was storm tide emergency management and non-tidal wetlands and resource protection area features.

- CBNERRVA has been a key sponsor to two regional Bay-wide conferences. The 2004 Hurricane Isabel in Perspective Conference, held in Linthicum, MD, focused on the many factors that exacerbated Isabel's impact on the Chesapeake Bay ecosystems and its coastal communities. The 2006 Living Shorelines Summit brought together groups interested in this technique of shoreline protection in order to present our current understanding of living shorelines and identify research, management, decision-making, design methods, and site suitability priorities which need to be addressed further. Reserve staff served as the primary editor for the Summit proceedings. Both conferences involved multiple partnerships and reached diverse audiences including government staff and officials, coastal managers, marine contractors, scientists, consultants and private citizens.

4.1.5 Stewardship Program

CBNERRVA maintains research reserves at Goodwin Islands, Catlett Islands, Taskinas Creek and Sweet Hall Marsh within the York River basin. In addition, CBNERRVA administers the Virginia Estuarine and Coastal Research Reserve System (VECRRS). Resource stewardship activities are designed to ensure that the integrity of the natural system is protected to preserve the representative ecosystem and support long-term research, monitoring and education programs. Following are some accomplishments of the program.

- Since the 2001-2002 hunting season, CBNERRVA has implemented a waterfowl hunting management plan at Goodwin Island. CBNERRVA maintains and permits licensed blinds surrounding the island in order to address the needs of the research and education community, minimize user conflict, and address natural resource protection and management issues.

- Inaugurated in 2001, the Virginia Coastal Birding and Wildlife Trail was the first phase of a state-wide driving trail with walking, biking and canoeing loop trails linking some of the Commonwealth's best wildlife watching areas. Taskinas Creek and Goodwin Islands components of the Reserve have been incorporated into the Lower Peninsula Loop of the Virginia Coastal Birding and Wildlife Trail. It is hoped that the Virginia trail system will be part of a larger Mid-Atlantic Birding and Wildlife Trail system.

- In 2003, the Taskinas Creek component of the Reserve was incorporated into the Mataponi, Pamunkey and York Rivers section of the Captain John Smith Chesapeake National Historic Trail. This water trail is a locally sustained trail that fulfills regional recreation needs, stimulates heritage tourism and enhances natural resource protection efforts.

- Beginning in 2004, CBNERRVA began committing resources for the development of comprehensive resource management and stewardship plans for each component of the Reserve. Resource management and stewardship plans for the Goodwin Islands (Erdle and Heffernan 2005a) and Catlett Islands (Erdle and Heffernan 2005b) components were completed in 2005. Plans for the Taskinas Creek (Myers et al. 2008a) and Sweet Hall Marsh (Myers et al. 2008b) components were completed in 2008. Task items identified within natural resource plans, such as invasive plant control strategies, are being implemented at specific Reserve components.

- In partnership with NOAAs Restoration Center, CBNERRVA was selected in 2007 as one of five NERRS to establish their Reserves as restoration reference sites by collecting both marsh structural and functional information. The data collected from Reserve reference sites will be used to evaluate restoration success on nearby Restoration Projects funded with Estuarine Restoration Act Funds.

4.1.6 Special Programs

- The Virginia Estuarine and Coastal Research Reserve System (VECRRS) was created in 1999 by the General Assembly of Virginia (Code of Virginia 28.2-1103 and 28.1-1104; see Appendix VII.1). VIMS is responsible for administration of the state reserve system, and to the extent possible, VECCRS initiatives are to be coordinated with CBNERRVA. Reserve efforts to date have focused on two geographic areas, the Dragon Run Swamp watershed and the tidal freshwater region of the James River. Accomplishments have included the acquisition of a key land tract within the Dragon Run Swamp and strategic planning discussions the Virginia Commonwealth University who owns and manages the Rice land tract on the James River. It is anticipated that both sites will be incorporated into the VECRRS.

- The Chesapeake Bay Virginia and Maryland NERRs have developed a formal relationship with the Tianjin Palaeocoastal and Wetland National Nature Reserve (TPWNR) in the People's Republic of China (PRC) as part of a US-PRC agreement. A General Cooperation Intention between CBNERRVA and TPWNR was signed in November 2001 and updated in 2005. Cooperation between CBNERRVA and the TPWNR includes but is not limited to 1) exchange of data, documentation, and research materials in fields of mutual interest, 2) exchange of scholars, researchers, administrators, and students and 3) coordination of such activities as joint research, lectures, seminars, workshops and symposia. Delegation exchange visits have occurred and are expected to continue in the future.

4.1.7 Advisory and Other Service

Faculty and staff associated with the Reserve provide a high level of advisory service to NOAA and other federal agencies, the Commonwealth, local governments and a variety of non-governmental organizations.

- With respect to advisory service to NERRS and ERD, Reserve associated faculty and staff have played an active role in committee and workgroup service in key areas including reserve-wide strategic planning (e.g., Strategic Committee, Performance Guidance Measures Workgroup, NERRS-CICEET Workgroup, NERRA Executive Board), research and SWMP support/build-out (e.g., Data Management Committee, Nutrient Workgroup, SAV/Emergent Mapping Workgroup, GRF Committee, IOOS Workgroup, Telemetry Workgroup), general education (e.g., Estuaries 101 and Teachers on the Estuary Workgroups) and coastal training (e.g., CTP Performance Monitoring Workgroup), and stewardship and habitat restoration (e.g., Restoration Committee, Stewardship Coordinating Committee). In addition, Reserve staff has actively participated in CZMA Section 312 reserve program

evaluations (Hudson River NERR, 1998; Great Bay NERR, 2005 and Kachemak Bay NERR 2003 and 2006)

- Advisory service support to the Commonwealth and regional Chesapeake Bay-wide programs include an appointment to Virginia's Coastal Policy Team, membership on a variety of state water quality committees and workgroups (e.g., Virginia Water Monitoring Council, Surface Water Quality Standards Workgroup, Nonpoint Source Advisory Committee), participation in a variety of CBP water quality and habitat committees and workshops (e.g., Shallow Water Data Management and Acquisition Workgroup, SAV Research, Monitoring and Restoration Workgroup), membership on the Chesapeake Bay Observing System (CBOS) steering board, and county appointment to the Dragon Run Steering Committee.

- CBNERRVA hosted the NERRS/NERRA Annual Meeting in 1999 and the Research Coordinator Sector Meeting in 2000.

4.1.8 Land Acquisition and Boundary Expansion

In order to protect the natural integrity of the ecosystems within the Reserve components and to manage these lands and waters for long-term research, monitoring and education activities, additional land and water conservation efforts may be required. Following are some Reserve accomplishments in land acquisition.

- Through NOAA Acquisition and Development Award NA16OR2512, derived from 2002 Coastal and Estuarine Land Conservation Program (CELCP) funds, CBNERRVA reimbursed the Trust for Public Land (TPL), on behalf of VaDCR, for purchase of the 18.0 ha (44.5 ac) Harrison Tract. The tract is located at YRSP, which encompasses the Taskinas Creek component of the Reserve. The property was transferred from TPL to the Commonwealth of Virginia on February 28, 2003. The title of the property is vested with VaDCR and subject to NOAA grants requirements. This tract has been incorporated, as a buffer region, into the Taskinas Creek component of the Reserve. This land tract was deemed critical to Park and Reserve operations from both a natural resource protection and security perspective. Plant communities or habitats within the Harrison Tract include temporarily flooded, palustrine deciduous forests along the ravine bottomlands and mesic hardwood forests along the ridges and slopes. A naturally maintained impoundment is also present on the property.

- In 2003, using funds derived from NOAA Acquisition and Development Award NA16OR1293, CBNERRVA was able to purchase a 19.5 ha (48.1 ac) tract of property on the Catlett Island component of the Reserve. Title to the property title was transferred from the Foodbank of the Virginia Peninsula, Inc., and the Boys and Girls Club of Greater Hampton Roads, Inc. to the VIMS/W&M on June 24, 2003. Because the said property was already incorporated into the core region of the Catlett Island component through a previous MOU, no additional boundary amendments were needed. This land tract was deemed critical to Reserve operations from a land protection and management perspective. Primary ecological community groups occurring at this tract include tidal meso and polyhaline marshes, forested wetlands and maritime upland forests.

- Through efforts such as Reserve component specific, comprehensive natural resource management plans and the National Strategy for NERRS Land Acquisition (Wellenberger 2002a), CBNERRVA has made significant progress in developing a Reserve boundary and acquisition plan and has participated in the development of the State's CELCP Plan.

4.1.9 Enhancement of Facilities, Site Infrastructure and Large Equipment

Adequate facilities, vehicles, and vessels are necessary in order to implement the Reserve's research and monitoring, education, and resource stewardship management plans and to fully participate in NERRS national priorities. Through support from ERD and other sources, CBNERRVA has made significant progress with respect to facilities construction and in large equipment purchases. All

CBNERRVA staff offices, laboratories and education facilities are located on the Gloucester Point campus of VIMS/W&M. Following are some accomplishments with respect to Reserve facilities, site infrastructure and large equipment.

- In 1995, CBNERRVA took possession of a modular unit that was designed to temporarily house the Research and Monitoring Program of the Reserve; life expectancy of unit was ten years. The unit was replaced with the Catlett-Burruss Research and Education Laboratory in 2005 but still provides secondary facility support for research, monitoring, education and stewardship activities.

- In 1996, educational trails and boardwalks were repaired/constructed along the edge of Taskinas Creek and within adjacent uplands. The trail and boardwalk are a component of the YRSP trail system that regularly draws a wide variety of users. Portions of the trail are handicap accessible. Also located at this site is a native plants arboretum constructed by CBNERRVA staff.

- In 2002, CBNERRVA purchased a residential housing unit from W&M at the VIMS Gloucester Point campus. After significant remodeling and some new construction, CBNERRVA was able to use the facility as its primary headquarters building in 2003. In addition to office space, this facility also provides the Reserve and the VIMS campus with variable meeting room space.

- The Catlett-Burruss Research and Education Laboratory was completed in 2005 and is sited immediately adjacent to CBNERRVA headquarters. This facility houses the Reserve's primary research, monitoring, and education laboratories.

- The Reserve has made significant recent investments to support the field efforts of the research, monitoring, education, and stewardship programs. The Reserve currently has three dedicated trailerable vessels, a 22' C-Hawk 222 Sport Cabin (2003), a 25' C-Hawk 25 Sport Cabin (2004) and a 20' Maritime Center Console. The Reserve also purchased an eight canoe trailer rig to support the education program. Field support vehicles include three standard-sized trucks; model years are 2003 (1 vehicle) and 2005 (2 vehicles).

4.2 CZMA Section 312 Evaluations

Section 312 of the CZMA of 1972, as amended, requires NOAA to conduct periodic evaluations of federally designated NERRs (see 16 U.S.C. 1458). The purpose of the evaluations is to ensure that reserves are following stated objectives in approved site specific management plans as well as showing satisfactory performance on annual operations award deliverables. The 312 evaluations are intended to support the reserve by identifying areas where progress has been accomplished as well as offering suggestions for areas that require more attention. Review team suggestions take the form of either Necessary Actions or Program Suggestions. Necessary Actions address programmatic requirements of the CZMA implementing regulations and of the reserve's approved management plan. Program Suggestions denote actions that NOAA believes would improve the management and operation of the reserve. Since designation and submittal of the original management plan, CBNERRVA has undergone Section 312 evaluations in June 1994 (period of evaluation: October 1990 – May 1994), September 1998 (period of evaluation: June 1994 – August 1998), April-May 2003 (period of evaluation: October 1998 – March 2003), and March 2007 (period of evaluation: April 2003 – March 2007). Copies of all previous section 312 evaluations are available upon request from CBNERRVA.

Based on the CBNERRVA evaluations, accomplishments included: (1) effective administration of the Reserve and retention of professional, well respected staff, (2) continued and effective working relationship between the Reserve and VIMS, (3) development and maintenance of strong partnerships with federal, state and local coastal management decision-makers, (4) increased level of research activities at the four component sites, (5) continued development of a regionally important research and monitoring programs and integration into local, regional and national observing systems, (6) development of an effective general K-12 education and public outreach program, (7) significant progress towards development and implementation of an approved CTP, (8) development of a adaptive resource

management oriented stewardship program, (9) continued mentorship by Reserve associated faculty for undergraduate and graduate students, and (10) successful completion of several facility construction and land acquisition projects critical for Reserve operations.

Program Suggestions have included: (1) review and resolution of the long-term expansion goals of the Reserve, (2) development of strategies to increase Reserve visibility within the NERRS, (3) set clear expectations for collaborative activities that involve CBNERRVA support of partnership staff positions, and (4) increasing state funding provided to CBNERRVA. In 1998, the Commonwealth was urged to revisit and resolve its commitment for the long-term expansion of the Reserve into other tributaries as envisioned at the time of the Reserve's nomination. However in 2003, after considering both state and federal resource constraints, both NOAA and VIMS have decided to postpone the expansion of CBNERRVA into the Potomac, Rappahannock, James and lower tributaries of the Chesapeake Bay. Since nomination, the Reserve has continued to explore and implement new strategies for increasing the visibility of its participation in the NERRS and within the regional Bay-wide research, education, and resource management communities. Given the level of quality and maturity of its research, monitoring and education programs, the Reserve is identified as a leader within the Bay region for these program areas. Advisory service to local, state and federal entities by Reserve staff have resulted in significant contributions to coastal resource management efforts by the state and the Chesapeake Bay Program. In 2007, the Commonwealth and VIMS were encouraged to consider increasing funds provided to CBNERRVA, potentially through the support of a reserve stewardship support position. VIMS and the Reserve are currently identifying both long and short-term strategies to ensure adequate state support of CBNERRVA.

Of the four program evaluations, only two Necessary Actions were identified. In 2003, CBNERRVA was asked to develop a schedule for completing the Reserve management plan. Since the April-May 2003 evaluation, the Reserve was in communication with ERD, developed a schedule for completion, and submitted for formal approval by NOAA, a management plan that will direct Reserve activities through 2012. In 2007, the Reserve was asked to complete its site profile and submit a final draft to ERD by September 2007. CBNERRVA has made significant progress with respect to its updated Management Plan and Site Profile, completing both documents in 2008.

4.3 Major Changes in Reserve Operations from the 1991 Management Plan

4.3.1 Proposed Multiphase Expansion of CBNERRVA

Based on a salinity and tributary segmentation scheme, it was originally envisioned that CBNERRVA might eventually include more than 20 components (CBNERRVA 1991). Because of the high number of potential components, designation of CBNERRVA sites was to occur in a phased manner. For administrative purposes, these phases were designated as (I) York River basin, (II) Rappahannock and Potomac River basins, (III) James River basin and western shore of Chesapeake Bay, and (IV) Bay-side Eastern Shore of Chesapeake Bay. The York River basin components were designated in 1991. Based on a number of concerns, some of which are summarized below, both CBNERRVA and ERD have decided not to proceed with expansion at the present time.

Site designations and major expansions involve large time commitments from the ERD staff. ERD staff is currently operating at a minimum staff level necessary to address the present reserve system. In addition to addressing the needs of the currently designated reserves, ERD staff time is further strained by completing ongoing reserve site designations and addressing anticipated future nominations from under-represented biogeographical regions. CBNERRVA has similar concerns as ERD regarding staff and resource limitations with respect to a major expansion of the Reserve. It is clearly understood that expansion of CBNERRVA will not result in supplemental funding by NOAA.

Based on experience gained by ERD and reserve staff from multi-component reserves, it is generally recognized that additional staff time and resources are required to operate multi-component reserves. Currently, only four of the 27 designated NERR's are multi-component systems. With the addition of

eleven more components in Phase II only, it is recognized that staff and resources would be spread too thin to gain much benefit from the designation. Furthermore, after initial review of the nomination package for Phase II of the expansion, there is concern regarding the adequacy of the information about the proposed sites and the time passed since the public comment period. Significant effort would be required to update and revise the nomination package, develop supporting material such as draft management plans and to provide for public comment.

It may be appropriate to consider designating some the areas identified in Phase II – IV, as focus areas for the VECRRS. The purpose for establishing the VECRR system in 1999 was to develop a system of protected sites representative of the Commonwealth's estuarine and coastal lands in which research, monitoring and education could be conducted to support the Commonwealth's coastal resource management efforts. Participation in this program requires coordination with VIMS and CBNERRVA. The staff at CBNERRVA would be available to offer considerable expertise and benefit to these areas in the commonwealth system. ERD and CBNERRVA acknowledge the Commonwealth's Phase II nomination package, but given current funding scenarios, expansion of the CBNERRVA into other tidal tributaries and embayments does not seem prudent at this time. Within the context of current projects and programs, CBNERRVA will take advantage of opportunities to benefit the proposed sites.

4.3.2 Facilities

As outlined in the original Facilities Development Plan (CBNERRVA Management Plan 1991), emphasis for facility improvements focused on the construction of a research and education center at YRSP. Due to severe budget reductions and budget reduction planning exercises within state agencies during 2001-2002, VaDCR thought it unwise to pursue the development of the YRSP facility at that time. Funds were redirected to other priorities at VIMS that resulted in the planning and construction of the CBNERRVA headquarters facility. There is still interest by both VIMS and VaDCR in revisiting a YRSP facility construction project when funding becomes available.

4.3.3 Reserve Boundaries and Land Acquisition

At the time of designation in 1991, the Tick Hill tract of the Reserve's Sweet Hall Marsh component was owned and managed by Chesapeake Corporation. The Tick Hill tract was 76 ha (189 acres) in area and primarily consisted of upland and forested wetlands. Comprising the majority of the tract and serving as a buffer to the core region, the upland portion of the tract was managed by Chesapeake Corporation for pulpwood production and scheduled for harvest in 2004. In the years following Reserve designation, Chesapeake Corporation embarked on new business strategies that resulted in the sale of the West Point mill in 1997 followed by additional divestitures including the sale of significant land holdings. The Tick Hill tract was sold to a private citizen in 2000. A MOU between VIMS/W&M and the new owner does not currently exist. Because of this sale, the Reserve has had to modify its boundaries as to only reflect the property holdings of the Tacoma Hunting and Fishing Club; see Figure 3.7 for an aerial photo of Sweet Hall Marsh Reserve component delineating current core/buffer areas and land ownership.

V. CBNERRVA: Mission and Programmatic Goals

5.1 Reserve Mission Statement

The mission of CBNERRVA is to:

> *preserve a network of reserves that represent the diversity of coastal ecosystems found within the York River estuary and its principal tidal tributaries and manage these reserves to support informed management of coastal resources.*

To fulfill its mission, the Reserve advances scientific understanding of watershed and estuarine systems, conducts education and training programs, conserves coastal resources and provides advisory service. The Reserve's mission complements the three-part mission of the VIMS to conduct interdisciplinary research in coastal ocean and estuarine science, educate students and citizens, and provide advisory service to policy makers, industry, and the public.

Figure 5.1. Tidal marsh creek inlet at Goodwin Islands. Photo credit: George Cathcart.

5.2 Reserve Focus Areas (2008-2012)

The CBNERRVA has developed four focus areas that address national, regional and local issues. Cutting across specific program boundaries, issue focus areas allow the Reserve to address key management concerns in a more integrated and comprehensive manner. Primary focus areas directing Reserve programs that provide direct support for coastal resource management include:

- Functions and linkages of land-margin ecosystems;
- Ecosystem vulnerability to climate and human-induced stressors;
- Water quality and aquatic stressors; and
- Integrated ocean observing systems.

Functions and Linkages of Land-Margin Ecosystems

Land-margin ecosystems, which include the critical estuarine habitats of riparian forests, emergent tidal wetlands and SAVs, are dynamic features which evolve in response to a variety of natural and human-induced disturbances. It is generally recognized that degradation of these habitats has a direct impact on the ecological function or services they provide, such as shoreline stabilization, hydrologic regulation,

water and air contaminant removal/sequestration, and a wide variety of habitat community functions. Independently, land-margin ecosystems provide valuable services, but when viewed collectively along a continuum, synergistic impacts on services as well as enhanced stabilization and/or maintenance of individual habitats may be realized. While it is critical to conduct studies to increase our general knowledge about individual ecosystems and the ecological services provided by these systems, we must also further examine functions and services provided by a continuum of nearshore habitats extending from the riparian uplands to shallow water systems. Emphasis should also be placed on modified shorelines that utilize a range of non-structural and structural methods (e.g., bulkhead, rock revetment, offshore breakwater system) to control erosion. Additionally, consequences of changing specific habitat elements within the land-margin region need to be addressed in a more comprehensive and integrated manner and at the appropriate landscape scales. For example, what are the cumulative impacts on sediment transport, water quality and living resources resulting from the current piece-meal approach to shoreline erosion management within a particular coastal region or waterbody. Finally, efforts should not occur "in a vacuum" but be developed in consideration of principal climate related stressors (e.g., increased storm severity and sea level) in order to maintain habitat diversity and the longevity. CBNERRVA will remain active in land-margin ecosystems studies and increasing awareness of these critical Bay habitats in order to directly support better informed shoreline and water body management decisions.

Ecosystem Vulnerability to Climate and Human-Induced Stressors

Coastal ecosystems are under threat from an unprecedented combination of pressures including climate change and more direct human induced impacts. Potential key climate variables impacting the Bay region and specifically Reserve component ecosystems include sea level rise and associated salt water intrusion, increased storm frequency and severity, increases in air and sea surface temperatures, variations in rainfall amounts and distribution, and drought frequency. Direct human-induced stressors include watershed land use changes, shoreline modifications to reduce erosion, material/contaminant loadings (e.g., sediment and nutrients) and overexploitation of living resources. It is recognized that the severe degradation or loss of coastal ecosystems, and thereby services provided by these ecosystems, would have environmental and human society consequences at local, regional and global scales. The pathways that Bay ecosystems will follow in light of climate and more direct human-induced stressors are difficult to predict. This is in part to limited knowledge with respect to system resilience which describes the capacity of an ecosystem to absorb disturbance without a fundamental change in state (e.g., function, structure)(Walker and Meyers 2004). Increasing evidence suggests that many terrestrial and aquatic ecosystems do not respond to acute or chronic disturbances in a simple manner, instead, controlling variables may have threshold values that when exceeded result in rather dramatic and potentially catastrophic shifts in ecological systems. CBNERRVA will continue its effort to investigate emergent wetland and SAV ecosystem response to large-scale episodic events (e.g., storms and droughts) and longer-term watershed land use and climate-related change (e.g., sea level rise, salinity intrusion, increasing water temperatures) in order to guide resource management within the York River system and apply results to other tributary systems through education and outreach activities.

Water Quality and Aquatic Stressors

Water quality degradation of marine and estuarine environments is of global concern and the Chesapeake Bay along with its York River subestuary is no exception. Key water quality management issues within the Bay are dependent upon support categories (e.g., aquatic life, recreation, shellfish harvest, fish consumption, water supply) and generally include excess sediments and nutrients, introduction of toxics and microbial agents. The overlap in spatial distribution of anthropogenic and naturally derived stressors, along with the complexity of biological and physical processes operating in coastal waters requires extensive monitoring and investigation to properly address water quality impairments. The CBP recently adopted a habitat or designated use scheme to more clearly define current water quality and develop strategies to achieve desired results (USEPA 2003). Principal habitat zones include: (1) spawning and nursery grounds for migratory fish, (2) shallow water for SAV use, (3)

open water for fish and shellfish use, (4) deep water for seasonal fish and (5) shellfish use and deep channel for seasonal refuge use. Specific water quality criteria are focused on the impacts of eutrophication and sediment loadings and include water clarity, dissolved oxygen and chlorophyll a. Expanding NERRS water quality components of SWMP and related surface mapping techniques, CBNERRVAs efforts principally focus on the aquatic life aspects of water quality within the shallow water zone in direct support of CBP. Additionally, Reserve activities investigate impacting watershed and airshed processes and associated material flux.

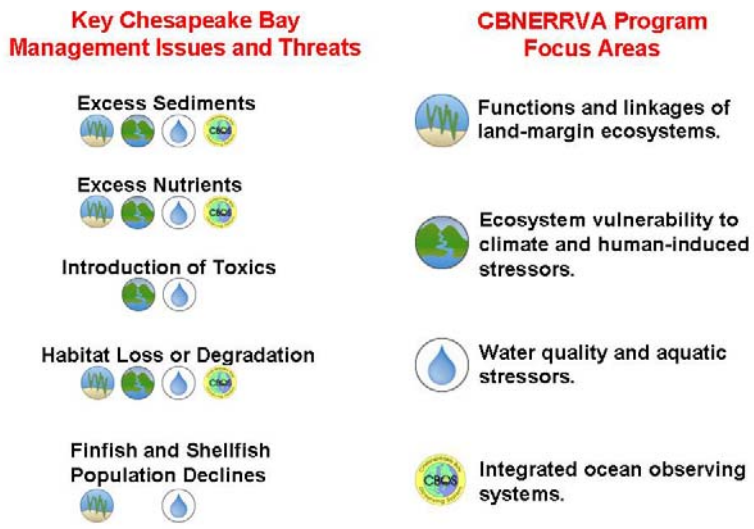

Figure 5.2. Linkages between Reserve focus areas and key Chesapeake Bay management issues.

Integrated Ocean Observing Systems

The Integrated Ocean Observing System (IOOS) is a multidisciplinary system designed to enhance our ability to collect, deliver, and use information from our atmosphere, watershed, and coastal and ocean waters. IOOS allows for a more complete and integrated understanding and characterization of our coasts and oceans. Societal needs addressed by IOOS include, but are not limited to improving weather and climate change predictions, mitigating the effects of natural hazards, protecting and restoring coastal marine ecosystems, improving safety and efficiency of maritime operations, reducing public health risks, improving national and homeland security, and enhancing coastal and ocean literacy of the general public. IOOS is being designed and implemented with both global and coastal interdependent components. The coastal component of IOOS consists of regional observing systems nested in a national backbone of coastal observations. The water quality and meteorological components of the NERRS SWMP are recognized as an integral and fundamental element of the national backbone. The regional and subregional observing systems provide data, information and products to user groups or stakeholders within specified geographic regions. The Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA), one of eleven regional associations, coordinates and facilitates observations of the ocean and estuaries between Cape Hatteras and Cape Cod. This region incorporates seven NERRs. CBNERRVA is also actively engaged at a more subregional and local level through its support of the Chesapeake Bay Observing System (CBOS) and the Virginia Estuarine and Coastal Observing System (VECOS).

Reserve program focus areas provide direct links to principal Chesapeake Bay and York River estuary management Issues (Figure 5.2); see Section 3.2.3 for greater details on key management issues and threats to the Bay system. Details regarding tasks and strategies to address Reserve focus areas are provided in individual program plans (i.e., Research and Monitoring, General Education and Public Outreach, CTP and Stewardship).

5.3 Reserve Goals and Objectives

5.3.1 Management Plan Framework

This management plan has been developed to address specific goals and objectives within the Administration, Research and Monitoring, General Education, CTP and Stewardship programs in order to support the Reserve's mission over the next five years (2008-2012). The Reserve's goals and objectives outlined in this management plan align with the goals and objectives of the NERRS 2005-2010 Strategic Plan (see Section 2.2.3 and Table 5.1). The Reserve's management plan has been subdivided into basic responsibilities and activities associated with primary Reserve programs and operational responsibilities. Individual plans/sections include:

- Administration
- Research and Monitoring;
- General Education and Outreach;
- Coastal Training Program;
- Stewardship;
- Boundary Changes and Land Acquisition;
- Public Access Management;
- Facilities, Site Infrastructure and Equipment Support; and
- Special Programs.

Specific strategies have been developed to address each Reserve goal and objective. Serving as action items, these strategies provide focused guidance and allow for Reserve performance to be monitored.

5.3.2 Overview of Reserve Goals and Objectives

Goals and associated objectives to support the Reserve's mission are provided in Table 5.1. Specific strategies addressing Reserve goals and objectives are presented in the individual plan sections based on programs and operational responsibilities. A complete summary table of Reserve goals, objectives and strategies is provided in Appendix II. In some cases, Reserve goals and objectives target specific programs (i.e., Administration, Research and Monitoring, General Education and Outreach, CTP and Stewardship). Whereas in other cases, activities and strategies associated with specific goals and objectives are integrated across programs. To aid in understanding Reserve operations and clarify program areas of emphasis and responsibility, lead and supporting Reserve programs have been identified for each goal and strategy.

Table 5.1. Summary of 2008-2012 CBNERRVA goals and objectives linked to NERRS 2005-2010 Strategic Plan goals and objectives (see Section 2.2.3). CBNERRVA lead programs are bold-faced with supporting programs in regular font.

CBNERRVA Goals and Objectives	**NERRS Goals (Objectives)**	**Responsible CBNERRVA Program**

Goal 1. Increase recognition of CBNERRVA as a regional leader in applying science and education to support coastal resource management and literacy.	1, 2 , 3	All
Objective 1. Foster mutually supportive relationships/partnerships internally within VIMS and between Reserve programs and externally with academic institutions, governmental agencies, nongovernmental organizations and communities.	2 (1, 2, 3)	All
Objective 2. Enhance CBNERRVA and NERRS visibility among academic, governmental agencies, nongovernmental organizations and the general public.	2 (2, 3)	All
Objective 3. Increase awareness, use and support of CBNERRVA special partnership programs/efforts (i.e., VECRRS and TPWNR).	1 (1, 2, 3) 2 (1, 2) 3 (1, 2, 3)	All
Goal 2. Enhance scientific understanding of coastal ecosystems, surrounding environments and the natural and human processes influencing such systems.	1 , 2	**Research** and **Stewardship**
Objective 1. Characterize and monitor coastal ecosystems and surrounding environments to describe reference conditions and quantify spatial and temporal changes.	1 (2); 2 (1,2,3)	
Objective 2. Determine linkages within and between coastal ecosystems and how linkages affect those systems.	1(2); 2 (1,2,3)	
Objective 3. Promote, coordinate and support research and monitoring activities within Reserve boundaries and the York River system.	2(1)	
Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making.	2 , 3	**CTP**, All
Objective 1. Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management.	2 (2,3); 3 (1,2,3)	
Objective 2. Develop needs assessment and multi-purpose evaluation tools to measure effectiveness and quality of education and training program offerings.	3 (1,2,3)	
Goal 4. Increase public awareness, understanding and appreciation of coastal environments.	3	**Education**, CTP and Stewardship
Objective 1. Increase student and teacher knowledge and understanding of coastal environments through formal education programs.	3 (1,2)	
Objective 2. Increase general public awareness and appreciation of the Chesapeake Bay and other coastal environments through public outreach and interpretation programs.	3 (1,2)	
Goal 5. Provide administrative leadership and resources	1 , 2 , 3	**Administration**,

necessary to fulfill the Reserve's mission. Objective 1. Provide staffing, resources and a structured organization framework that allow for attainment of program goals and objectives. Objective 2. Support staff professional development to assure competence in current positions and allow for preparation for more advanced positions. Objective 3. Provide facilities, equipment and other infrastructure support that allow for attainment of program goals and objectives. Objective 4. Maintain Reserve designation and fulfill grant-reporting requirements.	 1 (2,3); 2 (1,2,3); 3 (1,2,3) 2 (1,2,3); 3 (1,2,3) 1 (1,3)	All
Goal 6. Strengthen the protection and management of Reserve coastal resources to ensure long-term integrity and diversity of its ecosystems and archaeological/cultural sites. Objective 1. Support land and water conservation efforts that ensure representation of the diverse ecosystems found within the York River estuary and protect/conserve the larger landscape ecosystem that impact existing Reserve components. Objective 2. Provide for natural resource protection and management within Reserve boundaries. Objective 3. Provide for historical and archaeological resource protection and management within Reserve boundaries. Objective 4. Manage public access within Reserve boundaries in order to protect the integrity of natural and historical/archaeological resources and provide for non-conflicting traditional uses.	1 , 3 1 (3) 1 (3) 3 (1) 1 (3); 3 (1,2)	**Stewardship**, Administration

VI. Administration Framework and Plan [§921.13(a)(2)]

6.1 Introduction

VIMS is designated as the entity responsible for the overall operation and management of CBNERRVA. However, this management plan is implemented through a cooperative effort between VIMS, NOAA, participating state agencies and landowners, and appointed advisory committees. The following administrative framework identifies the roles and responsibilities of key partners and other entities involved in implementing this plan. Landowners are also invited to participate in decision-making. Agreements committing the agencies and landowners to the long-term protection and management of CBNERRVA are presented in Appendix I. This administration plan also identifies funding strategies used by the Reserve to sustain programs, outlines responsibilities of current Reserve associated faculty and staff, and lists future staff needs.

6.2 Principal Administrative Authorities

6.2.1 National Oceanic and Atmospheric Administration

NOAA, within the U.S. Department of Commerce, has the lead responsibility for administering the NERRS program. ERD, within OCRM, which is within the National Ocean Service (NOS) of NOAA, provides oversight and supports the Reserve through matching grants for operations and management, research and monitoring, education, stewardship, land acquisition and facilities construction. As part of its authority, OCRM and ERD are responsible for ensuring that CBNERRVA is managed according to the NERRS regulations (15 CFR 921) and its approved management plan. NOAA, CBNERRVA and VIMS management and communication structure is presented in Figure 6.1. In addition to review of progress reports and routine communications, NOAA conducts periodic performance evaluations of Reserve operations for compliance under Sections 312 and 315 of the CZMA. If deficiencies are found, NOAA may withhold financial assistance until said deficiencies are resolved. NERRS designation can be withdrawn by NOAA when a reserve is found to be deficient and fails to correct deficiencies within a reasonable amount of time.

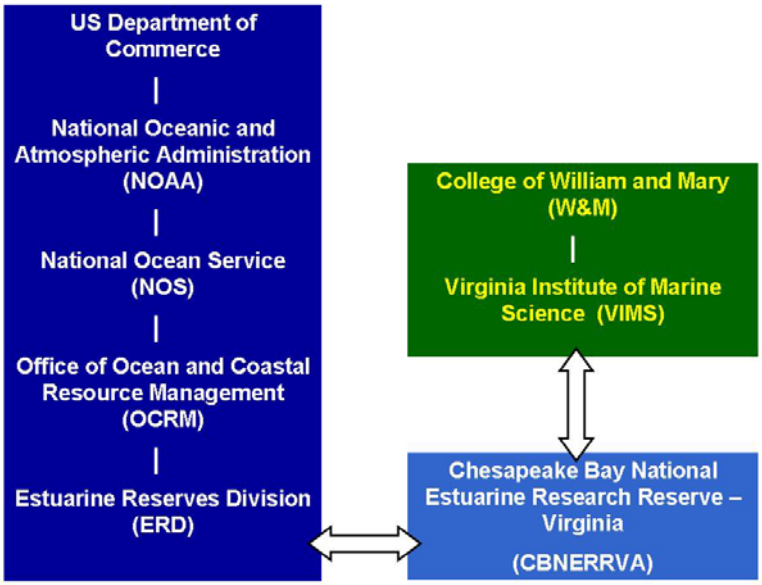

Figure 6.1. Management and communication structure for NOAA, CBNERRVA and VIMS.

6.2.2 College of William and Mary

Located in historic Williamsburg, Va. and chartered in 1693, W&M is one of the nation's premier state-assisted liberal arts universities. Dedicated to teaching excellence and committed to limited enrollment, the College provides high-quality undergraduate, graduate, and professional education. The College has almost 600 instructional faculty in arts and sciences, marine science, education, business administration, law and public policy. With a student enrollment on the order of 7,500, of which 5,500 are undergraduates, the student-faculty ratio is approximately 12 to 1. VIMS serves as the Graduate School of Marine Science for the College.

Chartered in 1940, VIMS is one of five graduate schools of the W&M. VIMS' tripartite mission is to conduct interdisciplinary research in coastal ocean and estuarine science, educate students and citizens, and provide advisory service to policy makers, industry, and the public. VIMS is currently among the largest marine research and education centers in the US and is recognized worldwide for its expertise in estuarine and coastal marine science. Approximately 500 faculty, staff, and students are engaged in marine science activities at the Institute. There are typically 100 to 120 graduate students at the Institute with about half of the students working on masters' theses and half on doctoral degrees. VIMS faculty includes representatives from numerous subdisciplines that include biological, physical and fisheries science, and environmental and aquatic animal health. In addition to academic departments, the Institute has numerous research centers that include CBNERRVA, Center for Coastal Resource Management (CCRM), Virginia Sea Grant, the Aquaculture Genetics and Breeding Technology Center, and the Kauffman Aquaculture Center. Additional NOAA partners located on the VIMS campus include NCBO and the Cooperative Marine Education and Research Program (CMER).

VIMS receives state and federal funds to administer CBNERRVA, serves as headquarters for CBNERRVA, and takes the lead role in implementing and coordinating programs for research and monitoring, education, and natural resource stewardship. All Reserve associated faculty and staff are employees of VIMS and therefore W&M and the Commonwealth of Virginia. In addition to VIMS, other W&M organizations/entities support the Reserve program. The Board of Visitors of W&M holds title to specific Reserve properties (i.e., Goodwin Islands) and serves as grantor for donated conservation easements. As on-site manager of Reserve components, VIMS will ensure the Board of Visitors that use of the sites is consistent with relevant policies and agreements. The Endowment Association of W&M hold gifts donated to the College for the Reserve that are not transferred to the Board of Visitors or donated directly to VIMS. The Endowment Association establishes endowments for CBNERRVA and distributes investment dividends to VIMS for the use in approved research, education and land stewardship programs.

6.3 CBNERRVA Administration Program

6.3.1 Relevant CBNERRVA Goals, Objectives and Strategies

The goals and objectives of the Administrative Plan are to provide support, guidance and administrative structure that allow for full implementation of the Reserve's principal programs. Administrative responsibilities include increasing the visibility and reputation of the Reserve, fostering productive partnerships, responding to state and federal mandates, honoring interagency and private landowner agreements, addressing human resource issues, and maintenance and enhancement of all Reserve assets. CBNERRVA Goal 1 is an overarching goal that serves as a unifying target for all Reserve programs and for the Reserve, as a single entity, to strive towards. The Reserve has made significant progress towards this goal and anticipates further advancement through additional science, education and stewardship contributions of local, regional and national significance. Objective 3 of Goal 1 is specific to CBNERRVA special partnership programs (e.g. VECRRS and U.S.-Republic of China TPWNR Sister Reserve Program) and addressed in Section 14. Goal 5 addresses identified administrative strategies to engage and support Reserve staff, diversify funding to increase Reserve stability and capabilities, and assure Reserve performance. CBNERRVA strives to achieve NERRS and VIMS administrative oriented goals by implementing a variety of strategies in support of Reserve programmatic

goals and objectives listed below (see italicized text for links to national program and lead Reserve programs).

Goal 1. Increase recognition of CBNERRVA as a regional leader in applying science and education to support coastal resource management and literacy. *(NERRS Strategic Plan Goals 1,2 and 3; Lead Program: All)*

Objective 1. Foster mutually supportive relationships/partnerships internally within VIMS and between Reserve programs and externally with academic institutions, governmental agencies, nongovernmental organizations and communities. *(NERRS Strategic Plan Goal #2, Objective 1, 2 and 3)*

Strategies:

- Establish and maintain contact with academic institutions, governmental agencies and nongovernmental organizations involved in coastal and Chesapeake Bay focused research, education and resource management. (All Programs)
- Engage in advisory service to national, regional, state and local community coastal resource management, research and education agencies, organizations and interest groups. (All Programs)
- Support, and where appropriate, coordinate local, regional and national research, general and technical education, and stewardship initiatives. (All Programs)
- Integrate site-based research, environmental monitoring, and natural resource stewardship into Reserve education and training programs. (All Programs)

Objective 2. Enhance CBNERRVA and NERRS visibility among academic, governmental agencies, nongovernmental organizations and the general public. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3)*

Strategies:

- Publish and/or communicate contributions of Reserve to appropriate audiences using a variety of formats including a Reserve annual report, peer-reviewed manuscripts, technical and education reports, newsletters (e.g., The Crest, Virginia Coastal Zone Management Magazine) and program fact sheets. (All Programs)
- Maintain and update CBNERRVA home and associated (e.g., VECOS, VIMS, NOAA/NERRS) websites to highlight Reserve associated opportunities, activities, and accomplishments and to provide data and information directly to users. (All Programs)
- Encourage news releases of Reserve activities and accomplishments. (All Programs)
- Establish and maintain effective mechanisms, such as committee service (e.g., VIMS Administrative Council, Va. Coastal Policy Team) and development of information products (e.g., Reserve annual report), to communicate Reserve accomplishments and needs to VIMS, the State and to NOAA. (All Programs)

Objective 3. Increase awareness, use and support of CBNERRVA special partnership programs (i.e., VECRRS and TPWNR). *(NERRS Strategic Plan Goal 1, Objectives 1,2 and 3; Goal 2, Objectives 1 and 2; Goal 3, Objectives 1,2 and 3)*

Strategies:

- Incorporate currently identified representative examples (i.e, Dragon Run and Rice land tracts) of estuarine, coastal and critical lands into VECRRS.
- As external funds allow, develop component specific reserve land stewardship and management plans.
- As external funds allow, promote and support research, environmental monitoring and education activities within VECRRS components.
- Enhance, through the exchange of information and staff expertise, research, environmental monitoring,

and resource management capabilities of the TPWNNR and CBNERRVA.

Goal 5. Provide administrative leadership and resources necessary to fulfill the Reserve's mission *(NERRS Strategic Plan Goals #1, #2 and #3; Lead Program: Administration, Supporting Programs: All)*

Objective 1. Provide staffing, resources and a structured organizational framework that allow for attainment of Reserve goals and objectives. *(NERRS Strategic Plan Goal #1, Objective 3; Goal #2, Objectives 1, 2 and 3; Goal #3, Objectives 1, 2 and 3)*

Strategies:
- Establish and fund positions to address NERRS and CBNERRVA program specific goals and objectives. (Administration)
- Develop and implement a diverse and stable funding strategy. (Administration)
- Seek greater state funding support for core Reserve positions. (Administration)
- Enhance communication between primary Reserve programs by developing a structured framework for information exchange. (Administration)
- Utilize local, state and federal agency expertise and resources to support Reserve operations and programs. (Administration)

Objective 2. Support staff professional development to assure competence in current positions and allow for preparation for more advanced positions.

Strategies:
- Promote staff participation in NERRS and Reserve strategic and budget planning, program operations and committee service. (Administration)
- Support staff professional development through participation in professional conferences and development training opportunities. (Administration)
- Provide annual review of staff that includes opportunities for self-evaluation, identifies professional development goals, and responsibilities of staff and supervisor to enhance job performance and professional development. (Administration)

Objective 3. Provide facilities, equipment and other infrastructure support that allow for attainment of program goals and objectives. *(NERRS Strategic Plan Goal #2, Objectives 1, 2 and 3; Goal #3, Objectives 1, 2 and 3*

Strategies:
- Maintain Reserve facilities, equipment and other infrastructure support to assure a safe and professional work environment. (All Programs)
- Identify and secure funding for additional Reserve facilities, equipment and other infrastructure support needs. (All Programs)

Objective 4. Maintain Reserve designation and fulfill grant-reporting requirements.

Strategies:
- Implement required and/or suggested actions identified in NOAA evaluation reports. (All Programs)
- Submit operation grant performance reports and other relevant reports and performance measures in a complete and timely manner. (Administration)

6.3.2 Key Partners

Virginia's Coastal Zone Management Program (VaCZMP) is a network of state laws and policies through which the Commonwealth and its coastal localities manage tidal and nontidal wetlands, dunes, coastal lands, subaqueous lands, fisheries, point source air and water pollution, nonpoint source water pollution, and shoreline sanitation. A summary of relevant state agencies and associated responsibilities is provided below. Relevant local government and private landowners are also identified. A summary of federal and state natural resource laws are provided in Appendix III.

Department of Environmental Quality (VaDEQ)

The Virginia Department of Environmental Quality (VaDEQ) serves as the lead coordinating agency for this networked program of natural resource agencies responsible for implementing Virginia's coastal resources management laws and policies and is responsible for allocation and assignment of all federal funds received for the CZMP implementation grant. VaCZMP, within VaDEQ, with the assistance of an interagency Coastal Policy Team, monitor and coordinate the Program's activities and administer Virginia's CZMP annual grant award from NOAA.

Supporting the VaCZMP, the Coastal Policy Team, whose members and alternates represent all of Virginia's natural resource, cultural and human management agencies, facilitates cooperation among these agencies and provides a forum for discussion of cross-cutting coastal resource management issues. Coastal Policy Team membership includes the VaDEQ, VaDCR, Virginia Department of Game and Inland Fisheries (VaDGIF), Virginia Department of Forestry (VaDOF), Virginia Department of Agriculture and Consumer Services (VaDACS), Virginia Department of Historic Resources (VaDHR), Virginia Department of Health (VaDH), Virginia Department of Transportation (VaDOT), various Planning District Commissions, the Virginia Marine Resources Commission (VaMRC), VIMS, and the Virginia Economic Development Partnership (VaEDP). The mission of the Coastal Policy Team is to: (1) identify coastal policy issues that cut across agency jurisdictions and develop policy recommendations, (2) guide the development of measures or indicators and the current health and status of our coastal resources, and (3) to make funding recommendations to the VaDEQ Director for coastal zone management projects. The Director of CBNERRVA serves as an appointee to Virginia's Coastal Policy Team, which assures communication, cooperation and interaction between the Reserve and Virginia's network of natural resource agencies/organizations.

As part of the Federal-Interstate Chesapeake Bay Program, VaDEQ works with other state agencies, local governments, and citizens through its Chesapeake Bay Program in the general areas of nutrient point source reduction, toxic substance reduction, and Bay/tributary monitoring. Objectives of the Commonwealth's extensive Bay and tributary water quality and biological monitoring programs are the description or characterization of current conditions, identification of long-term trends, and the improvement in our understanding of processes that control water quality. VIMS and CBNERRVA administer the Chesapeake Bay Shallow Water Monitoring Program for the Commonwealth and serve the data through the VECOS web portal (www2.vims.edu/vecos). The results of these monitoring programs provide a measurement of the success of management actions toward the protection and restoration of the Chesapeake Bay.

The Virginia Water Protection Permit Program administered by the VaDEQ includes protection of wetlands, both tidal (shared responsibilities with the VaMRC) and non-tidal. This program is authorized by Code of Virginia § 62.1-44.15.5 and the Water Quality Certification requirements of Section 401 of the Clean Water Act of 1972. With respect to point source air pollution, the VaDEQ implements the federal Clean Air Act to provide a legally enforceable State Implementation Plan for the attainment and maintenance of the National Ambient Air Quality Standards. This program is administered by the State Air Pollution Control Board (Code of Virginia § 10-1.1300). The VaDEQ also regulates discharges into state waters through Virginia Pollutant Discharge Elimination System and Virginia Pollution Abatement permits. This is accomplished through the implementation of the National Pollutant Discharge Elimination System permit program established pursuant to Section 402 of the federal Clean Water Act. The point source

program, the Virginia Pollutant Discharge Elimination System Permit Program, is administered by the State Water Control Board pursuant to Code of Virginia § 62.1-44.15.

Virginia Department of Conservation and Recreation (VaDCR)

VaDCR holds title and manages lands that comprise YRSP, which contains the Taskinas Creek component of the Reserve. The Department's Division of State Parks manages the park and assists in the cooperative management and operation of the Taskinas Creek Reserve component (see Appendix I.3 for the MOU between VaDCR and VIMS). The Division of Natural Heritage, also within VaDCR, supports CBNERRVA through the development of Reserve component specific natural resource management plans and serves as advisors on relevant natural resource management issues.

VaDCR is also responsible for a number of VaCZMP associated laws and enforceable policies. With respect to nonpoint source pollution, Virginia's Erosion and Sediment Control Law requires soil-disturbing projects to be designed to reduce soil erosion and to decrease inputs of chemical nutrients and sediments to the Chesapeake Bay, its tributaries, and other rivers and waters of the Commonwealth (Code of Virginia § 10.1-560 et.seq.). VaDCR's Division of Chesapeake Bay Local Assistance (CBLAD) regulates activities in Chesapeake Bay Resource Management Areas and Resource Protection Areas within 84 localities in Virginia's coastal zone through a state-local cooperative program established pursuant to the Chesapeake Bay Preservation Act (Code of Virginia § 10.1-2100 thru § 10.1-2114 and Chesapeake Bay Preservation Area Designation and Management Regulations; Virginia Administrative Code 9 VAC 10-20-10 et seq.).

Virginia Department of Game and Inland Fisheries (VaDGIF)

VaDGIF, with shared responsibilities with the VaMRC, regulate commercial and recreational fishing through Code of Virginia § 28.2-200 thru 28.2-713 and Code of Virginia § 29.1-100 thru 29.1-570. This management program stresses the conservation and enhancement of finfish and shellfish resources and the promotion of commercial and recreational fisheries to maximize food production and recreational opportunities. VaDGIF serves as the Commonwealth's enforcement agency with respect to hunting and freshwater fishing and in an advisory capacity with respect to Reserve hunting and fishing policies.

Virginia Marine Resources Commission (VaMRC)

VaMRC, with shared responsibilities with VaDGIF, regulate commercial and recreational fishing through Code of Virginia § 28.2-200 thru 28.2-713 and Code of Virginia § 29.1-100 thru 29.1-570. In addition to finfish and shellfish resources, VaMRC is responsible for the management and protection of subaqueous lands, tidal wetlands, and dunes (Figure 6.2). The management program for subaqueous lands, under Code of Virginia § 28.2-1200 thru 28.2-1213, establishes conditions for granting or denying permits to use state-owned bottomlands based on considerations of potential effects on marine and fisheries resources, wetlands, adjacent or nearby properties, anticipated public and private benefits, and water quality standards established

Figure 6.2. Reserve nekton and habitat studies support management of commercially and ecologically important species. Photo credit: Steve Snyder.

by the VaDEQ, Water Division. Under Code of Virginia § 28.2-1301 thru § 28.2-1320, the tidal wetland program serves to preserve tidal wetlands, prevent their despoliation, and accommodate economic development in a manner consistent with wetlands preservation. The Wetlands Program at VIMS provides extensive support to VaMRC through the review of individual tidal wetland permit applications. Dune protection is carried out pursuant to the Coastal Primary Sand Dune Protection Act and is intended to prevent destruction or alteration of primary dunes through Code of Virginia § 28.2-1400 thru 28.2-1420. In addition, VaMRC, VaDGIF and VaDACS share enforcement responsibilities (Code of Virginia § 3.1-249.59 thru 3.1-249.62) for the State's Tributyltin Regulatory Program. The Tributyltin Program monitors boating activities and boat painting activities to ensure compliance with Tributyltin regulations promulgated pursuant to the amendment.

Virginia Department of Health (VaDH)

Responsible for shoreline sanitation, VaDH regulates the installation of septic tanks, sets standards concerning soil types suitable for septic tanks, and specifies minimum distances that tanks must be placed away from streams, rivers, and other waters of the Commonwealth. This program, which includes monitoring of shellfish waters and regulating shellfish closures due to bacterial contamination, is administered by the VaDH through Code of Virginia § 32.1-164 thru § 32.1-165.

Virginia Department of Forestry (VaDOF)

The Silvicultural Water Quality Law, Code of Virginia §10.1-1181.1, authorizes VaDOF to protect water quality from excessive sedimentation caused by silviculture operations. The Chesapeake Preservation Area Designation and Management Regulation requires VaDOF to oversee and document the installation of best management practices (Virginia Code § 10-20-120.10) for all silviculture activities that occur within Chesapeake Bay preservation areas. The VaDOF also serves the Reserve in an advisory capacity through professional forestry advice, technical management and training programs.

Virginia Department of Historic Resources (VaDHR)

VaDHR is the state agency responsible for the identification, stewardship, protection and use of Virginia's significant archeological, historic, architectural and cultural resources. VaDHR has responsibilities for compliance of projects that affect state-owned landmarks (Section 4-4.01(s), 2000 Virginia Acts of Assembly, Chapter 1073), demolition of state-owned buildings (revised Virginia Code 488.4), architecture review of any new construction or rehabilitation of any building or structure to be sited on state-owned property (Virginia Code § 2.1-488.1), coordination of archaeological investigations and surveys, regulating removal of antiquity on state-controlled projects and lands (Virginia Code § 10.1-2300), and serves as advisor to the VaMRC regarding underwater archaeology permits (Virginia Code § 10.1-2214).

Local Government

Reserve components lie within the counties of York (Goodwin Islands), Gloucester (Catlett Islands), James City (Taskinas Creek) and King William (Sweet Hall Marsh). With respect to natural resources, enforceable local and county policies (e.g. wetlands, Chesapeake Bay Resource Protection Areas) are followed with respect to Reserve construction and other relevant projects and/or activities.

Private Landowners

Owners of private property that are included in core and buffer land management areas of the Reserve retain property rights and liabilities pursuant to the terms of conservation easements or management agreements. Landowners are invited to participate in the decision-making process. They will be kept informed of Reserve activities through meetings, correspondence, and newsletters. Copies of the easements and agreements with private landowners are provided in Appendices I.3-I.5.

6.3.3 Funding Approach and General Strategy

In order to maintain and where possible enhance Reserve programs and personnel, CBNERRVA pursues a general funding strategy that includes maintaining/enhancing primary Reserve operations grants from NOAA and the State, encouraging all Programs to pursue appropriate external funding, and diversifying funding sources. CBNERRVA general operations and programmatic functions are supported through four primary funding sources: (1) the annual NOAA Combined Operations, Research, Monitoring, Education and Stewardship Award, (2) the Commonwealth of Virginia, (3) a variety of competitive grants sources, and (4) private support. The NOAA Combined Operations award provides funds to maintain Reserve operations through direct support of staff, programmatic activities, equipment and indirect costs associated with facility/equipment operation and maintenance. This award requires a 30 percent non-federal match that is provided by the Commonwealth of Virginia through support of core staff positions and waiving a percentage of in-direct costs (IDC) associated with Reserve operation. Faculty and staff associated with the Reserve also secure a significant amount of funding from a variety of competitive grant sources, which are subject to Institute IDC charges, for tasks that compliment Reserve programmatic goals. The Reserve, working through VIMS, has also been successful in receiving additional financial resources from private individuals and organizations. Examples of private source funding sources include the Treakle Foundation, the Rouse-Bottom Endowment and other Institute private donors. While funding opportunities are expected to vary on an annual basis, Reserve budgetary planning is based on general guidelines that include level or near-level funding of NOAA and state operations awards and an annual inflationary and/or cost of living increase based on acceptable index (e.g., Consumer Price Index).

6.3.4 Current Reserve Associated Faculty and Staff

Core staff is essential for the implementation of the CBNERRVA Management Plan and to achieve the Reserve's objectives with respect to research, environmental and biological monitoring, general and technical education, and natural resource protection and management. As well as Reserve responsibilities, faculty associated with CBNERRVA maintains independent research programs that support additional staff that provide the Reserve with additional knowledge, skills and abilities. Core Reserve staff positions are funded through a combination of NOAA reserve operations awards, state program directed funds and external sponsor funds. To date, core staff include: the Reserve Director, Business Manager, Research Coordinator, Laboratory Supervisor, Education Coordinator, Coastal Training Program Coordinator and Stewardship Coordinator positions. Other Reserve supporting positions are supported through a variety of funding sources principally derived from external funds generated by core staff through sponsored research, monitoring, education and stewardship grants, and some NOAA reserve operations award funds. While striving for long-term stability and potential expansion of core and supporting staff positions, variability in year to year funding can lead to changes in staff numbers and responsibilities. The current organizational chart for CBNERRVA is provided in Figure 6.3 and a summary of primary functions of CBNERRVA associated faculty and staff are presented below.

<u>Administrative Staff</u>

Reserve Director / Faculty Appointment (85% State-funded, 15% Sponsored Research funded; Full-time): Undertakes all responsibilities associated with the on-site management of the Reserve. In addition to these responsibilities, the Director is on the faculty of VIMS/W&M and is required to maintain an independent research program, participate in the Institute's education program, and provide Institute governance and advisory service support. Responsibilities specific to the CBNERRVA include: directing and supervising CBNERRVA research, monitoring, general education/outreach, technical education, advisory service, and stewardship programs; acting as a liaison for local, state and federal agencies involved with resource management and protection; overseeing land acquisition and capital construction projects; and represent the Reserve at required NERRS annual and sector meetings, and at regional and national resource management, scientific and technical meetings, conferences and symposia.

Business Manager (85% State-funded, 15% sponsored research; Full-time): Provides administrative support and accounting/budget technical assistance to the Reserve's Director and core staff.

Responsibilities include: technical assistance regarding fiscal year and grant budget preparation; assists in the budget process of externally funded projects; maintains and tracks grant expenditures; and ensures all purchasing actions are within guidelines and regulations of the state college purchase program.

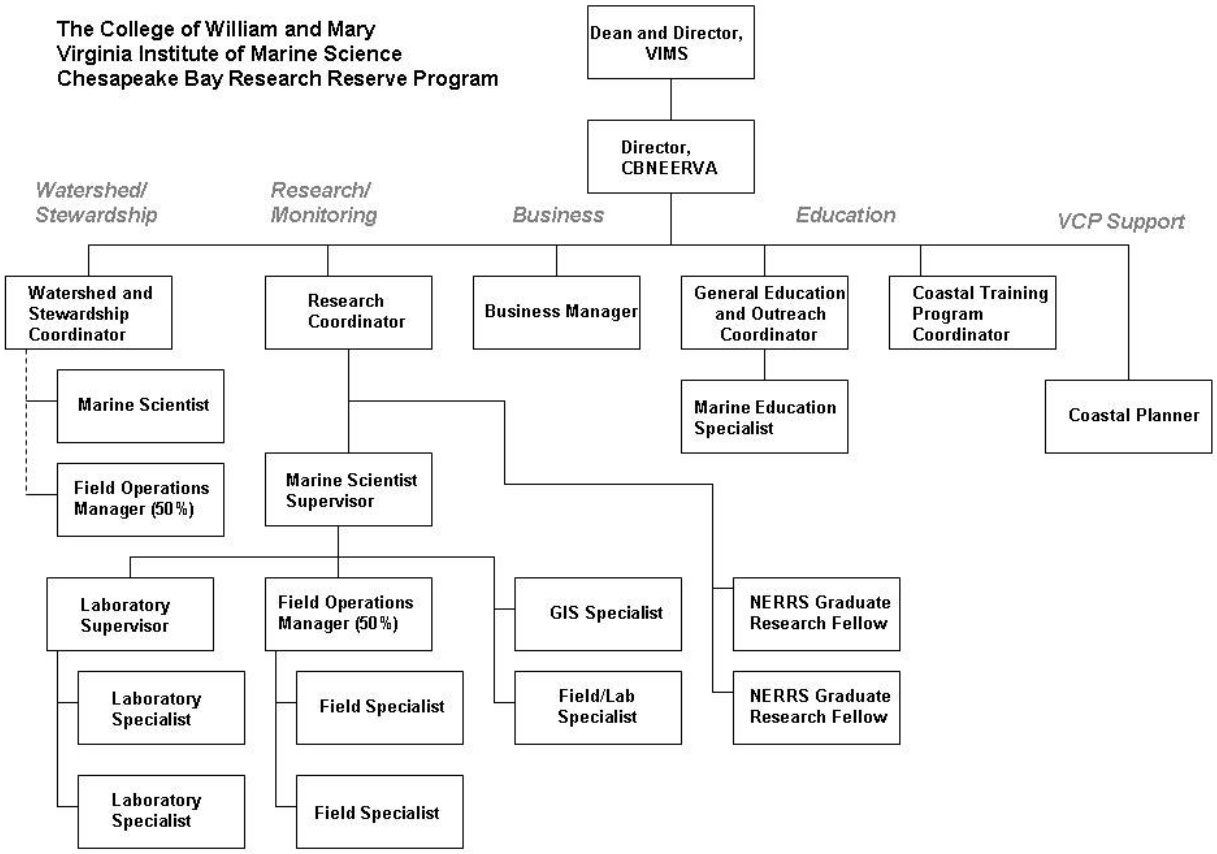

Figure 6.3. Current CBNERRVA organizational chart.

Research Staff

Research Coordinator / Faculty Appointment (75% State-funded, 25% NOAA and Sponsored Research funded; Full-time): Undertakes primary responsibilities associated with the research and monitoring programs associated with the Reserve. In addition to these responsibilities, the Research Coordinator serves as the Assistant Director of the Reserve and is on the faculty of VIMS/W&M and is required to maintain an independent research program, participate in the Institute's education program, and provide Institute governance and advisory service support. Responsibilities specific to the CBNERRVA include: supervision of research staff; development and implementation of long-term research and monitoring programs; review and coordination of research and monitoring projects conducted by others within the reserve boundary; implementation of the NERRS Graduate Research Fellowship Program; serve as a liaison with the science and management community; and represent the Reserve at required NERRS annual and sector meetings, and at regional and national scientific and technical meetings, conferences and symposia.

Marine Scientist Supervisor (Variable % between Sponsored Research and NOAA funding; Full-time): Acts as an operational scientist-in-charge of various field research and laboratory based investigations. Responsibilities include: assist in the oversight of and serve as a principal contact for shallow water quality monitoring programs; support shallow water habitat research studies; coordinate field activities, resources, vessels and vehicles between various groups of users; supervise and instruct technical personnel and graduate students; prepare and analyze scientific data; prepare scientific manuscripts, technical reports and presentations; and small vessel operator.

Marine Scientist I and II. (Variable % between Sponsored Research and NOAA funding; Full-time): Assist in the development, planning, support and implementation of monitoring, research and management activities. Responsibilities vary depending on level of experience and can include: support data collection for research and monitoring projects; support data management and analysis activities; application of GIS and new technologies to monitoring and research programs; development of laboratory and field standard operation procedures; provide technical and other information in support of CBNERRVA resource management activities; maintenance of laboratory and field instrumentation; and small vessel operator.

Laboratory Supervisor (100% NOAA funded; Full-time): Supervises laboratory and field activities associated with water quality aspects of SWMP. Responsibilities include: coordination of all laboratory aspects of the fixed station water quality monitoring program; maintenance of laboratory and remote water quality instrumentation; maintenance and quality assurance of water quality data; submission of data reports to senior scientists; and supervision and training of research staff and students.

Laboratory and Field Specialist/Technician (100% Sponsored Research; Full-time): Assists in the planning, support and implementation of monitoring and research activities. Responsibilities include: assist in field and laboratory aspects of water quality and atmospheric monitoring programs; support other research and monitoring programs; maintain and calibrate laboratory and remote water quality instrumentation; processing multi-media samples; provide data management and analysis support to senior scientists; and small vessel operator.

Education Staff

General Education and Public Outreach Coordinator (100% NOAA funded; Full-time): Directs, develops, and implements the general education, outreach, interpretation and visitor use programs. Responsibilities include: develop and implement environmental education field programs for K-12 students, college and teacher audiences; production of education related material, curriculum, publications and exhibits; provides supervision, training and instruction to other general education staff, interns and graduate students; represent the Reserve at required NERRS annual and sector meetings, and at regional and national marine education meetings, conferences and symposia; and maintain industry standard certification and training with respect to implementing field education programs.

Coastal Training Program Coordinator (100% NOAA funded; Full-time): Directs, develops, and implements the Coastal Training Program. Responsibilities include: develop and implement technical-based education programs and modules; production of technical education related material, curriculum, publications and exhibits; assist in public outreach; and maintain equipment, supplies and field resources used in technical education related activities; and represent the Reserve at required NERRS annual and sector meetings, and at regional and national technical and professional education training meetings, conferences and symposia.

Marine Education Specialist (Variable % between Sponsored Research and NOAA funding; Full-time): Supports CBNERRVA general education and outreach programs. Responsibilities include: assist in the planning, development and implementation of classroom curriculum and field trips; assist in equipment and gear maintenance; and maintain industry standard certification and training with respect to implementing field education programs.

Stewardship Staff

Watershed/Stewardship Coordinator (100% NOAA funded; Full-time): Develops and supports watershed and stewardship directed research and monitoring programs, and coordinates natural resource stewardship activities. Responsibilities include: support ongoing and newly developed watershed, climate change and shoreline management associated studies; oversee the development of Reserve natural resource management plans; coordinate and implement natural resource protection and restoration strategies; support land acquisition efforts; coordinate and maintain atmospheric monitoring programs including SWMP; serve as program's principal GIS contact; provide data analysis and manuscript preparation support; represent the Reserve at required NERRS annual and sector meetings, and at regional and national scientific and resource management meetings, conferences and symposia; and small vessel operator.

Field Operations Manager (50% Sponsored Research and 50% NOAA funding; Full-time): Assists in the planning, support and implementation of research, monitoring and resource management activities as related to the stewardship and shallow water quality monitoring programs. Responsibilities include: support aspects of stewardship directed research and biomonitoring; provide field support for all aspects of the various water quality monitoring programs; aid in the development and implementation of natural resource management plans; maintain Reserve boundary control; support development and implementation of Reserve public access and hunting management plans; serve as the program's vessel and diving safety officer; support maintenance of vehicles, vessels and field instrumentation; and small vessel operator.

Marine Scientist I. (Variable % between Sponsored Research and NOAA funding; Full-time): Assist in the implementation of stewardship associated research, monitoring and management activities. Responsibilities vary depending on level of experience and can include: support research and monitoring projects; water quality and sediment analysis; support of data management; development of laboratory and field standard operation procedures; support maintenance of laboratory and field instrumentation; assist in field-associated stewardship activities; and small vessel operator.

NOAA/NERRS Graduate Research Fellows

The NERRS GRF Program provides master's degree students and Ph.D. candidates with an opportunity to conduct research of local and national significance that focuses on enhancing coastal zone management. Typically, two fellows are supported at each reserve at any one time. CBNERRVA fellows gain hands-on experience by participating in Reserve research, monitoring and education programs.

Virginia Coastal Program Support Staff

CBNERRVA and the VaCZMP have developed an agreement whereby CBNERRVA receives grant support from VaCZMP to provide staff support (1-2 FTE's) for the VaCZMP. VaCZMP support staff hired under this arrangement currently includes a Coastal Planner.

6.3.5 Future Staff Needs

While the Reserve does not anticipate a substantial increase in staff over the next five years, certain positions and changes in funding sources (e.g., from grant to state support) for selected current positions are warranted to achieve Reserve goals in a more complete and efficient manner. In addition to more permanent positions, university interns and institute docents may be used to support selected projects.

Administrative Staff. Programmatic growth over the past few years in research, education and stewardship has resulted in additional administrative demands. To meet the current and anticipated additional future administrative needs, a part-time position to support basic programmatic needs including receptionist responsibilities is deemed necessary.

Research Staff. With respect to the Reserve's Research and Monitoring Program, expansion of staff to include a visiting scientist and/or post-doctoral research position would greatly enhance the Reserve's

ability to address key areas of interest. In addition, a Laboratory/Field Technician is deemed necessary to support the expanded SWMP requirements and research activities of Reserve principal investigators.

Education Staff. The Reserve's General Education and Public Outreach Program has expanded to the point of requiring an additional full-time Marine Science Educator. Currently this position is funded through a variety of mechanisms including external grant generated funds and private funds. This funding scenario is unstable and funding amounts vary from year-to-year. In order to create a more stable and competitively attractive position, the Reserve seeks state support or longer-term partnership opportunities.

Stewardship Staff. Increased land acquisition and associated natural resource management responsibilities on existing Reserve components has created a need for a full-time stewardship support position. Additionally, CBNERRVA has state responsibilities to support the VAECRRS. The VAECRRS initiative did not include funding for stewardship or any staff necessary to implement the program. CBNERRVA will continue to seek state support critical for the continued resource management of its national and state research reserve holdings.

VII. RESEARCH AND MONITORING PLAN

7.1 Introduction

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 (Figure 7.1). Reserve research and monitoring activities are guided by the NERRS Research and Monitoring Plan 2006-2011 (NOAA 2006) 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.

Figure 7.1. Sampling along long-term fixed SAV biomonitoring transect. Photo credit: Kenneth Moore.

7.2 National System-Wide Research and Monitoring Program

7.2.1 National Priority Research Focus Areas

NOAA has recently redesigned its approach to research by moving towards a more interdisciplinary, cross-cutting strategy to address identified priority research areas (NOAA 2005a). The new infrastructure for NOAA's research focuses on four broad mission goals: (1) Ecosystems, (2) Climate, (3) Weather and Water, and (4) Commerce and Transportation. NERRS is a primary contributing member of the Coastal and Marine Resources Program within the Ecosystems Goal Team. The mission of the Ecosystems Goal is to protect, restore and manage the use of coastal and ocean resources through an ecosystem approach to management. Additionally, NERRS also contributes to the Climate Goal and Weather and Water Goal. NERRS has identified the following five priority research areas to complement the funding priorities outlined above:

- Habitat and ecosystem processes;
- Anthropogenic influences on estuaries;
- Habitat conservation and restoration;
- Species management; and
- Social science and economics.

Currently, there are two reserve system-wide efforts to fund priority estuarine research. The Graduate Research Fellowship Program (GRF) supports students to produce high quality research which

addresses relevant focus areas in the reserves (see Section 7.2.3). Secondly, research is funded through the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), which will transition into the National Coastal and Estuarine Research and Technology (NCERT) Program, which supports development and application of tools to enhance understanding and management of coastal ecosystems (see Section 7.2.4).

7.2.2 Partnerships

Current and anticipated expanded partnerships between NERRS and NOAA's National Centers for Coastal Ocean Sciences (NCCOS), Center for Operational Oceanographic Products and Services (COOPS), Coastal Services Center (CSC), Restoration Center, and the National Geodetic Survey (NGS) will help improve data products for coastal managers and other principal user groups. Projected products are expected to include integrated assessments, forecasting and climate models, habitat elevation changes, and robust geographic information system layers to monitor coastal development impacts on estuarine habitat. In an effort to coordinate expertise and resources as well as to increase efficient use of research funds, NERRS is also seeking to enhance partnership opportunities with other entities such as Sea Grant, the National Marine Sanctuaries Program, the USEPA National Estuaries Program, the U.S. Geological Survey, and the National Science Foundation (NSF). These additional partnerships will provide opportunities to expand research activities at the reserves to include studies of coastal ecosystem resiliency, restoration project impacts, and social sciences.

7.2.3 NERRS Strategic Plan 2005-2010

The NERRS mission includes an emphasis on research and monitoring to support wise management of our coastal resources. Research and monitoring policy at NERRS and CBNERRVA is designed to fulfill goals as defined in Federal regulations (15 C.F.R 921(b); see Section 2.2.3). As related to the NERRS Strategic Plan 2005-2010 (see Section 2.2.3), the reserve system research goals are embedded in Goals 1, 2 and 3, provided below, and further outlined in the 2006-2011 Reserve System Research and Monitoring Plan (NOAA 2006).

Goal 1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research and education.

Objective 2. Biological, chemical, physical, and ecological conditions of reserves are characterized and monitored to describe reference conditions and to quantify change.

Goal 2. Increase the use of reserve science and sites to address priority coastal management issues.

Objective 1. Scientists conduct research at reserves that is relevant to coastal management needs and increases basic understanding of estuarine processes.

Objective 2. Scientists have access to NERRS datasets, science products and results.

Objective 3. The scientific community uses data, products tools, and techniques generated at the NERRS.

Goal 3. Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

Objective 3. People apply science-based information when making decisions that could impact coastal and estuarine resources.

7.2.4 NERRS Graduate Research Fellowship Program

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. Funds are available on a competitive basis and no more than two fellowships per designated reserve are allowed at any one time. Fellowships typically start on June 1 of each year. Currently the award is $20,000/annum that may be used for salary, to defray the costs of living expenses, tuition, fees and/or research supplies. Students admitted to or enrolled in a full-time Masters or Doctoral program at U.S. accredited colleges and universities are eligible to apply. Students should have completed a majority of their course work at the beginning of their fellowship, and have an approved thesis research program.

Projects must address coastal management issues identified as having regional or national significance, relate to the reserve system research focus areas and be conducted at least partially within one or more designated reserve sites. Proposals must focus on one or more of 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; and/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.

7.2.5 Cooperative Institute for Coastal and Estuarine Environmental Technology

The Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) is a partnership between NOAA and the University of New Hampshire (UNH). CICEET uses the capabilities of UNH, the private sector, academic and public research institutions throughout the US, as well as the 27 reserves in the national system, to develop and apply new environmental technologies and techniques. Since being established in 1997, CICEET has emerged as a national center for the development and innovative application of environmental technologies and methods for monitoring, managing, and preventing contamination in estuaries and coastal waters. In addition to supporting sponsored research activities at individual reserves, CICEET assists NERRS with the application and evaluation of advanced technologies for enhancing system-wide programs, with data synthesis and the development of dissemination tools and techniques, and developing the capacity to serve as local/regional sources of scientific information and data. Recently, CICEET has become a competitive program that established the National Coastal and Estuarine Research and Technology (NCERT) program that will operate in partnership with the NERRS.

7.2.6 National Monitoring Programs

It is the policy of CBNERRVA to implement each phase of the System-Wide Monitoring Plan initiated by ERD in 1989, and as outlined in the reserve system regulations and strategic plan:

Phase I. Environmental Characterization, including studies necessary for inventory and comprehensive site descriptions;

Phase II. Site Profile, to include a synthesis of data and information; and

Figure 7.2. Goodwin Island SWMP continuous water quality monitoring station equipped with GOES satellite transmitter. Insert: YSI EDS water quality datalogger. Photo credit: William Reay.

Phase III. Implementation of the System-wide Monitoring Program (SWMP).

The SWMP 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 reference sites. The program also takes a phased approach and focuses on three different ecosystem characteristics. These are:

- Abiotic Variables: The monitoring program currently measures temperature, specific conductance, salinity, dissolved oxygen, turbidity, pH, water level and atmospheric conditions (Figure 7.2). 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.

- Biotic Variables: The reserve system is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available.

- 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.

7.3 CBNERRVA Research and Monitoring Program

7.3.1 General Approach and Links to Reserve Focus Areas

The overall goal of the CBNERRVA Research and Monitoring Program is to promote, support, coordinate, and engage in research and monitoring efforts that enhance scientific understanding of estuarine and watershed ecosystems and associated processes and functions, and to communicate results of research to assist in environmental education and wise stewardship of coastal resources. Enhancing scientific understanding of the York River and southern Chesapeake Bay coastal ecosystems, surrounding environments and the natural and human processes influencing such systems requires a broad range of expertise and capabilities. In order to contribute to this increased understanding, the Reserve pursues a variety of approaches including:

- Encouraging, and where possible supporting, research and monitoring by individual investigators or groups with emphasis given to those addressing Reserve priorities;
- Collaborating with individual investigators or groups conducting research and related monitoring within the York River and Bay region;
- Developing in-house research and monitoring programs led by CBNERRVA associated faculty and senior staff; and
- Collecting, synthesizing and publishing/disseminating available information.

The region of scientific emphasis is focused within the four Reserve components, but also extends beyond Reserve boundaries to include the entire York River system (includes Pamunkey and Mattaponi Rivers), its watershed, and water regions that affect or are affected by the York River system. Extending

beyond Reserve component boundaries is necessary to address large-scale processes that influence the York River system and allows for collaborative efforts with other individuals or entities responsible for complimenting research and monitoring programs. This collaborative effort results in more integrated and comprehensive research and monitoring programs for the Reserve and other Bay-wide groups.

There are typically 30 or more research and monitoring oriented projects conducted on an annual basis by researchers from a variety of state and federal agencies, academic institutions, and private consulting firms within Reserve boundaries. An annotated bibliography of research conducted within the Reserves boundaries and relevant work conducted within the York River system was prepared by Parker and Reay (2006) and is available at http://www.vims.edu/cbnerr/research/bibliography.htm. Primary research and environmental monitoring efforts conducted by CBNERRVA scientists address all four Reserve focus areas (see Section 5.2):


Functions and Linkages of Land-Margin Ecosystems;


Ecosystem Vulnerability to Climate and Human-Induced Stressors;


Water Quality and Aquatic Stressors; and


Integrated Ocean Observing Systems

7.3.2 Relevant CBNERRVA Goals, Objectives and Strategies

CBNERRVA strives to achieve NERRS and VIMS research oriented goals by implementing a variety of strategies in support of Reserve programmatic goals and objectives listed below (see italicized text for links to national program and lead Reserve programs). Where appropriate, Reserve focus areas are linked to specific strategies. Additional research and monitoring efforts as related to the Reserve Stewardship Program are provided in Section 10.

Goal 2. Enhance scientific understanding of coastal ecosystems, surrounding environments and the natural and human processes influencing such systems. *(NERRS Strategic Plan Goals 1 and 2; Lead Program: Research; Supporting Program: Stewardship)*

Objective 1. Characterize and monitor coastal ecosystems and surrounding environments to describe reference conditions and quantify spatial and temporal changes. *(NERRS Strategic Plan Goal 1, Objective 2; Goal 2, Objectives 1,2 and 3)*				
Strategies:				
• Maintain and enhance long-term water quality monitoring in the York River and other appropriate water bodies to allow criteria and standards development, and overall water quality condition assessments. (Research)	✓	✓	✓	✓
• Maintain and enhance long-term meteorological and atmospheric monitoring within the southern Chesapeake Bay watershed to quantify key (e.g., nitrogen and mercury) contaminant loadings. (Research)		✓	✓	✓
• Support biological monitoring of critical habitats (e.g., emergent wetlands, submerged aquatic vegetation) and the development of sentinel sites to address ecosystem response to climate and human induced stress. (Research and Stewardship)	✓	✓	✓	✓
Objective 2. Determine linkages within and between coastal ecosystems and how linkages affect those systems. *(NERRS Strategic Plan Goal #1, Objective 2; Goal #2, Objectives 1,2 and 3)*				
Strategies:				
• Determine how circulation patterns, mixing processes and exchange of water between regions (e.g., shoal, channel) of the York River system, its watershed and the Chesapeake Bay proper affect water quality, primary productivity and biological communities (e.g., benthic, nekton, plankton). (Research)	✓	✓	✓	
• Determine watershed (e.g., groundwater, stormwater runoff), airshed and Bay/oceanic material flux into the York River system. (Research)	✓	✓	✓	
• Examine how upland, shoreline and water management changes affect material flux and coastal ecosystems. (Research and Stewardship)	✓	✓	✓	
• Examine how episodic events (e.g., inter-annual variations in hydrologic budgets, large-scale storm events) and longer-term climatic changes affect material flux and coastal ecosystems. (Research)	✓	✓		
• Examine rates and patterns of sea-level rise, subsidence and shoreline erosion and ecosystem responses to these processes within the York River system. (Research and Stewardship)	✓	✓		
• Examine the relationship between environmental factors and the structure and function of coastal ecosystems (e.g., impacts of water clarity and temperature on seagrass beds; impacts of salinity and water level on wetland plant communities). (Research and Stewardship)	✓	✓	✓	

Objective 3. Promote, coordinate, track and support research and monitoring activities within Reserve boundaries and the York River system. *(NERRS Strategic Plan Goal #2, Objective 1)*

Strategies:

- Establish and maintain contact, and where appropriate, coordinate activities among groups with estuarine research, environmental monitoring and stewardship interests. (Research and Stewardship)
- Identify research priority focus areas and encourage their investigation within Reserve components and the broader York River and Chesapeake Bay system. (Research and Stewardship)
- Utilize a permit system to approve and track research and related activities within Reserve boundaries. (Research)
- Continue to implement the NOAA/NERRS Graduate Research Fellowship program. (Research)
- Reserve associated faculty will continue to advise and mentor undergraduate and graduate students through participation in intern programs (e.g., NSF/VIMS Research Experience for Undergraduates,

National Aquarium in Baltimore Conservation Intern Program) and through student advisory committee service. (Research and Stewardship)
- Seek external funding to advance research and monitoring activities. (Research and Stewardship)

Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making. *(NERRS Strategic Plan Goals 2 and 3; Lead Program: CTP; Supporting Programs: All)*				
Objective1. Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; Goal #3, Objectives 1,2 and 3)* Strategies: • Serve in an advisory capacity to national, regional, state and local coastal resource management, research and education agencies, organizations and interest groups. (All Programs) • Provide the best available science-based information and skill building opportunities, with respect to priority needs, to coastal resource decision-makers and other appropriate audiences via a variety of formats including training workshops, sponsored conferences and developed information products. (CTP, Research and Stewardship) • Develop, maintain and/or link to web-based data and information portals to manage and disseminate Reserve associated science and education information products, environmental databases, and associated metadata. (All Programs) • Support the development and implementation of Bay-wide and specific tributary strategies and contaminant reduction plans in support of protection and restoration of water quality and habitats of concern. (Research, Stewardship and CTP) • Participate in local (VECOS), subregional (CBOS) and regional (MACOORA) Integrated Coastal and Ocean Observing System (ICOOS). (Research, Education and CTP)				✓ ✓ ✓ ✓

7.3.3 Key Partners

The CBNERRVA Research and Monitoring Program interacts directly with a large number of individual Principal Investigators, governmental agencies and industry working on a wide range of research and environmental monitoring programs that include efforts within Reserve boundaries or the York River watershed. Additionally, faculty and senior staff associated with the Reserve maintain research and monitoring programs funded through NOAA or other sponsored programs. These efforts result in wide-ranging opportunities and partnerships at the local, regional and national level. Table 7.1 provided a listing of primary partners and Section 7.3.4 describes in detail key partners involved in York River monitoring efforts.

7.3.4 Ongoing York River Monitoring Programs

Partner Category	Local, Regional and National Research and Monitoring Partners
Academic Institutes	• *Local:* VIMS, W&M, Virginia Commonwealth University, Old Dominion University and Hampton University • *Regional*: Chesapeake Research Consortium
Federal Agencies	• *National*: NOAA (NERRS, CSC, NWS, CO-OPS, CBO), USEPA, USGS and USDI
State Agencies	• *Local:* VaDEQ, VaDCR, VaMRC and VaDH • *Regional*: Maryland Dept. of Natural Resources
Federal-State Partnerships	• *Local*: VaCZMP • *Regional*: Mid-Atlantic NERRS (MD, DE, NJ) • *National*: CICEET, NERRS and NADP
Nongovernmental Organizations	• *Regional*: CBOS and MACOORA • *National*: NERRA
Private Industry	• *National*: SAIC

Table 7.1. Reserve Research and Monitoring program local, regional and national partners.

<u>Meteorological and Streamflow Monitoring</u>

- *CBNERRVA System-Wide Monitoring Program (SWMP).* CBNERRVA staff maintains meteorological monitoring stations at the Sweet Hall Marsh (established September 1998), Taskinas Creek (August 1997) and Goodwin Islands (January 2006) components of the Reserve. Measured parameters include air temperature, relative humidity, precipitation, photosynthetic active radiation (PAR), barometric pressure, wind speed and direction. Real-time delivery of this data is currently available for selected stations via the NWS Hydrometeorological Automated System (HADS) webpage (http://www.nws.noaa.gov/oh/hads) and selected archived data is available via the web at the NERRS CDMO (http://cdmo.baruch.sc.edu).

- *VIMS Meteorological Monitoring Program*. VIMS staff maintain a meteorological station at the Gloucester Point campus (May 1986) that is located approximately nine kilometers from Goodwin Islands. Measured parameters include air temperature, precipitation, PAR, and wind speed and direction. Selected data are available via the web (http://www.vims.edu/resources/databases.html).

- *National Streamflow Information Program*. The US Geological Survey (USGS) operates ad maintains stream gages within the York River basin in order to provide long-term information on streamflow. Key stream gages above tidal influence on the Mattaponi and Pamunkey Rivers include the stations at Beulahville (USGS ID: 01674500; data available from 9/19/1941 to present) and Hanover (USGS ID: 0167300; data available from 10/1/1941). Selected data are available via the web (http://www.water.usgs.gov/nsip).

- *National Atmospheric Deposition Program's National Trends Network (NADP/NTN) and Mercury Deposition Network (NADP/MDN)*. CBNERRVA staff maintains the southern Chesapeake Bay NADP/NTN and NADP/MDN station (ID: VA98) located at Harcum, Va. The purpose of the network is to collect data on the chemistry of precipitation for monitoring of geographical and temporal long-term trends of concentrations and loading rates. Measured physical parameters include air temperature, precipitation, PAR, wind speed and direction. Measured chemical parameters include hydrogen ion activity (acidity as pH), sulfate, nitrate, ammonium, chloride, base cations (such as calcium, magnesium, potassium and sodium), total mercury and methyl-mercury. The NADP/NTN and NADP/MDN stations were established in August, 2004 and December, 2004, respectively. Realtime delivery of physical parameters for this station is currently available via the NWS HADS webpage (http://www.nws.noaa.gov/oh/hads). Selected chemistry data are available via the NADP webpage (http://nadp.sws.uiuc.edu).

<u>Water Quality Monitoring</u>

- *CBNERRVA System-Wide Water Quality Monitoring Program (SWMP).* CBNERRVA staff maintain fixed continuous water quality stations at the Goodwin Island (established October 1997), Taskinas Creek (September 1995), and Sweet Hall Marsh (January 1999) components of the Reserve and at Gloucester Point (March 2003), Clay Bank (January 2002) and White House (Marsh 2003) within the York River estuary system. Multi-parameter water quality monitors (model: YSI 6600 EDS) measure water temperature, specific conductance, dissolved oxygen, pH, turbidity, fluorescence and water depth at 15-minute intervals. In addition, the program collects monthly nutrient (nitrate, nitrite, ammonium, phosphate) and chlorophyll a samples at all primary SWMP stations and monthly diel samples at one SWMP station. Real-time delivery of this data is currently available for selected stations via the NWS Hydrometeorological Automated System (HADS) webpage (http://www.nws.noaa.gov/oh/hads) and selected archived data is available via the web at the NERRS CDMO (http://cdmo.baruch.sc.edu) and VECOS (http://www2.vims.edu/vecos).

- *VIMS Virginia Shoal Water Quality Monitoring Program*. CBNERRVA and VIMS staff monitor nearshore surface water quality along a transect in the lower York River estuary. Measured parameters include air and water temperature, salinity, inorganic nitrogen and phosphorus, Chlorophyll a, total suspended solids, PAR, light extinction coefficient, and color. Water quality samples have been collected bi-weekly since 1984.

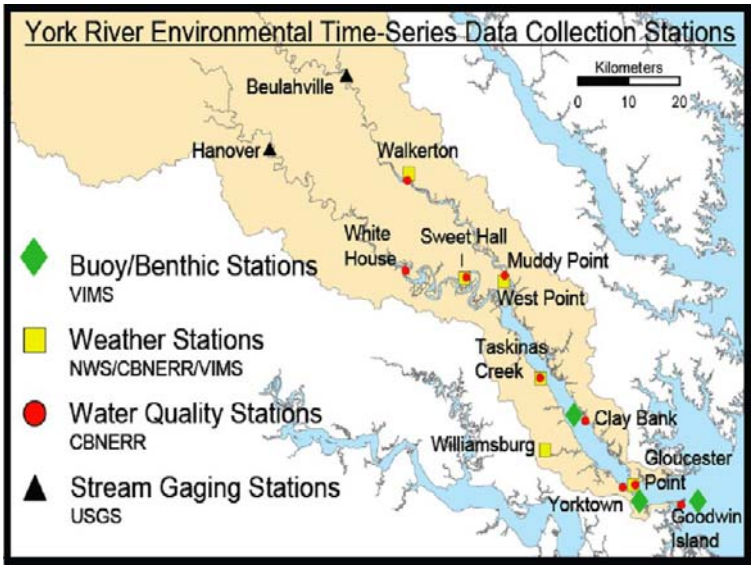

Figure 7.3. York River system continuous environmental data collection stations.

- *Chesapeake Bay Program (USEPA and VaDEQ) York River Water Quality Monitoring Program*. Multi-depth samples are collected along a main channel transect in the York, Mattaponi and Pamunkey Rivers to support the multi-agency CBP. Station ID's: York River proper (WE4.2, LE4.3, LE4.2, LE4.1, RET4.3), the Pamunkey River (RET4.1, TF4.2) and Mattaponi River (RET4.2 and TF4.4). Measured parameters include water temperature, specific conductance, dissolved oxygen, pH, Secchi depth, chlorophyll a, pheaopigments, total suspended solids, dissolved inorganic and total nitrogen, total particulate nitrogen, dissolved inorganic and total phosphorus, particulate phosphorus, dissolved and particulate organic carbon. Water quality samples have been bi-weekly/monthly since 1984. Selected data are available via the CBP webpage (http://www.chesapeakebay.net/data/index.htm).

- *Chesapeake Bay Program (USEPA, VIMS, CBNERRVA and VaDEQ) Enhanced Shallow Water Quality Monitoring Program*. CBNERRVA staff maintains additional fixed continuous (15 minute interval) water quality stations and conducts high frequency spatial water quality monitoring and mapping (using Dataflow) in a number of southern Chesapeake Bay tributaries. With respect to Dataflow, water quality and GPS location measurements are typically taken at 50-100 m intervals along the vessel track in both shallow (<1.5m) and channel areas. Fixed continuous stations and the Dataflow system utilize multi-parameter water quality monitors (model: YSI 6600 EDS) and measure water temperature, specific conductance, dissolved oxygen, pH, turbidity, chlorophyll fluorescence and water depth. Temporal sampling has typically been linked to SAV growing seasons (high salinity: March-November; low salinity: April-September) but recently has expanded to include late winter/spring to capture migratory fish spawning and nursery use in tidal freshwater and low salinity waters. In addition to York River efforts, continuous fixed water quality stations and

Dataflow mapping activities occur within the James (2006-current), Rappahannock (2007-current) and portions of the Potomac (2007-current; fixed stations only). Data are available via the VECOS webpage (http://www2.vims.edu/vecos).

- *VIMS Real-time York River Observation System (VIMS, CBNERRVA and Industry Partners)*. The Institutes Department of Physical Sciences and CBNERRVA have taken the lead to develop a real-time observation system within the lower York River system. Multiple buoy, bottom mounted and land supported systems provide real-time information on current velocity and direction, tide and wave height, and selected water and weather parameters. Part of this effort includes the Goodwin-York Research Observatory (GYRO) that includes a state-of-the-art research and monitoring platform to address environmental and security issues in the Chesapeake Bay. Key industry partners in this effort include Strategic Application International Corporation (SAIC) and Incogen. Real-time delivery of this data is currently available at VECOS (http://chsd.vims.edu/realtime) and NOAA's National Data Buoy Center (www.ndbc.noaa.gov; Meterological station ID: GDIV2; Buoy ID: 44052) web sites

Note: In addition to Biological information, selected water quality and weather information is available for the cited biological monitoring programs below.

Biological Monitoring

- *VIMS Juvenile Fish and Blue Crab Trawl Survey*. Initiated in 1968, the primary goal of this survey is to develop indices of abundance, which measure the relative size of each year class of a target species. These indices indicate annual recruitment success or failure and help predict the future abundance of the stock. Fish and selected invertebrates (e.g., blue and horseshoe crab, squid) are collected monthly (except January and March) at stratified stations and historical fixed mid-channel stations within the York River estuary including the Mattaponi and Pamunkey River systems by the Institute's Fisheries Science Department. Selected data are available via the VIMS Department of Fisheries Sciences webpage (www.fisheries.vims.edu/research.html).

- *VIMS Juvenile Striped Bass Seine Survey*. Initiated in 1967-1973 and reinstated in 1980, the primary objective of this survey is to monitor the relative annual recruitment success of juvenile striped bass in the spawning and nursery areas of lower Chesapeake Bay. Fish and selected water quality information are collected on approximately five biweekly sampling periods from July through mid-September at primary index and auxiliary stations within the York River estuary including the Mattaponi and Pamunkey River systems by the Institute's Fisheries Science Department. Selected data are available via the VIMS Department of Fisheries Sciences webpage (www.fisheries.vims.edu/research.html).

- *CBNERRVA System-Wide Biological Monitoring Program (SWMP).* CBNERRVA staff participate in field monitoring of submerged aquatic vegetation and emergent wetlands within Reserve boundaries. Initiated in 2004, fixed transects located within SAV beds at Goodwin Islands and Gloucester Point are monitored in order to quantify SAV inter-annual variability in shoot density and distribution and identify any relationship to water quality. SAV transect monitoring occurs on a monthly basis, typically from April through October. Fixed transects within emergent wetland vegetation have been established at each of the Reserve components in order to measure plant diversity over time and a function of salinity regime.

- *Virginia Department of Health*. The VaDH/Division of Shellfish Sanitation conducts the Shoreline Survey and Seawater Sampling Programs along a series of sites in the York River estuary (includes lower portions of the Mattaponi and Pamunkey River systems) in order to assess suitability classification of shellfish waters. The Seawater Sampling Program analyzes for fecal coliform bacteria at approximately monthly intervals while the Shoreline Survey inspects all properties within a drainage basin that are deemed capable of impacting shellfish waters at approximately 6-8 year intervals.

Information regarding these programs is available via the VaDH/ Division of Shellfish Sanitation webpage (www.vdh.state.va.us/environmentalhealth/shellfish).

- *Chesapeake Bay Submerged Aquatic Vegetation (SAV) Survey*. Initiated in 1971, SAV distribution, community types and density classes are mapped from aerial photography, primarily at a scale of 1:24,000. Bay-wide information is available for 1978, 1984 - 1987, and 1989 - 2006. Virginia western shore, lower and upper regions are available for 1971 and 1974, 1980 -1981 and 1979, respectively. Data are stored in ArcInfo GIS coverages and information is available from the VIMS Biological Sciences Department webpage (http://www.vims.edu/bio/sav).

7.3.5 Research Policies and Procedures

Research opportunities at Reserve components will be available to any qualified scientist, academician or student affiliated with a university, college or school, any non-profit organization, non-academic research institution (e.g., research laboratory, independent museum, professional society), any private profit organization, and any state, local or federal government agency. Research opportunities will also be available to unaffiliated individuals who have the capability, facilities, and resources needed to perform the work. Research opportunities will be available to all applicants without regard to manner of funding. Financial support for research may come from international, federal, state, local government, non-profit organizations, and from private individual sources. All researchers must complete and submit a CBNERRVA research application permit for work to be conducted within the Reserve system (Appendix IV.1). In addition, research and collecting activities within the Taskinas Creek component of the Reserve require submission and approval of the VaDCR (see Appendix IV.2 for VaDCR Research and Collecting Permit).

VIII. GENERAL EDUCATION AND PUBLIC OUTREACH PLAN [§921.13(a)(4)]

8.1 Introduction

Figure 8.1. Discovery field trip to Goodwin Islands as part of a student 'Bay Experience' program. Photo credit: Sarah McGuire.

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 resources issues and incorporate science-based content. Through its General Education and Coastal Training Programs (see Section IX), Reserve staff work with local communities and regional groups to increase awareness of coastal and estuarine environments and 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 to increase resident ocean and coastal literacy and develop strategies to deal successfully with these coastal resource issues.

8.2 National System-Wide General Education Program

8.2.1 General Overview

The NERRS is one of only four programs within NOAA in which education is federally mandated; others include the National Marine Sanctuary Program, Sea Grant, and Coral programs. Each reserve in the NERRS is responsible for developing and implementing an independent general education and outreach program that links research and stewardship to education. The NERRS General Education Program works predominantly with K -12 education, ranging from hands-on field experiences for students to teacher training programs that include the use of established coastal and estuarine science curricula aligned with state and national science education standards. Additionally, NERRS education programs address the needs of university and college students, and volunteer and general public audiences.

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. General education resources available from the NERRS include distance learning programs (i.e., EstuaryLive and Estuaries Tutorial), curriculum materials which include lesson plans such as Estuaries 101 that utilizes

SWMP data to teach students about Earth System Science, and a searchable education calendar of events throughout the United States. An overall goal of NERR education programs is to focus on the development of educational products that ensure a place for estuarine science in environmental studies, biology, mathematics, physics and other Earth system sciences at all levels of K-12 education. Therefore, NERRS has placed an emphasis on it's K-12 Estuarine Education Program (KEEP) that seeks to develop relevant curricula and lesson plans, make optimal use of the data generated by the SWMP, and establish teacher training programs.

8.2.2 NERRS Strategic Plan 2005-2010

The NERRS mission includes an emphasis on education, interpretation, and outreach to increase ocean and coastal literacy among our citizens. General education and public outreach policy at NERRS and CBNERRVA is designed to fulfill goals as defined in Federal regulations (15 C.F.R 921(b); see Section 2.2.3). The General Education relevant goal is to enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation. Two of the five guiding principles of the NERRS core mission necessitate a strong national estuarine education and public outreach program. Relevant guiding principles are:

- Integration of science, education, and stewardship to maximize the benefits to coastal management and produce tangible results; and
- Engaging local communities and citizens to improve stewardship of coastal areas.

As related to the NERRS Strategic Plan 2005-2010 (see Section 2.2.3), the NERRS General Education and Public Outreach Program goals and objectives are embedded in Goal 3.

Goal 3. Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

Objective 1. People are aware of the ecological, economic, historical, and cultural importance of estuarine resources.

Objective 2. People understand how human choices and natural disturbances impact social, economic, and estuarine ecological systems.

Objective 3. People apply science-based information when making decisions that could impact coastal and estuarine resources.

8.3 CBNERRVA General Education and Outreach Program

8.3.1 General Approach and Links to Reserve Focus Areas

The primary goal of the CBNERRVA General Education and Public Outreach Program is to increase awareness, understanding, appreciation and wise-use of the Chesapeake Bay estuary through various informal and formal education programs for K-12 and college audiences, teacher training workshops and programs for the general public. Through these actions, the Reserve contributes to the education mission of VIMS and NERRS.

The Reserve's General Education and Public Outreach Plan is built on two premises: (1) that healthy estuaries and estuarine ecosystems are intrinsically and economically valuable to every member of society, and (2) that those who become aware of estuarine processes and issues will be better equipped to protect estuarine ecosystems, both presently and in the future. CBNERRVA's General Education and Outreach Program strives to enhance student, teacher and public awareness, understanding and appreciation of estuaries by pursuing a number of approaches including:

- Provide hands-on, investigative field experiences, curriculum, and information material tailored to the needs and abilities of a broad range of audiences with an emphasis on applied estuarine science topics;
- Provide multiple-exposure opportunities to all audiences with particular emphasis on students as they advance through K-12 grades;
- Link education program to CBNERRVA's and VIMS's research, environmental monitoring, and stewardship programs;
- Address local, regional, and national coastal issues that emphasize the interrelationships of coastal habitats and human activities;
- Promote a sense of stewardship and individual responsibility;
- Assist aquatic habitat restoration activities with appropriate audiences when possible;
- Develop partnerships that enhance education opportunities;
- Maintain programs at no-cost or low cost to all participants; and
- Increase understanding of and appreciation for the NERRS.

Priority General Education and Public Outreach Program offerings and material developed by Reserve staff address all four Reserve focus areas (see Section 5.2):

 Functions and Linkages of Land-Margin Ecosystems;

 Ecosystem Vulnerability to Climate and Human-Induced Stressors;

 Water Quality and Aquatic Stressors; and

 Integrated Ocean Observing Systems

8.3.2 Relevant CBNERRVA Goals, Objectives and Strategies

CBNERRVA strives to achieve NERRS and VIMS general education and public outreach oriented goals by implementing a variety of strategies in support of Reserve programmatic goals and objectives listed below (see italicized text for links to national program and lead Reserve programs). Where appropriate, Reserve focus areas are linked to specific strategies.

Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making. *(NERRS Strategic Plan Goals 2 and 3; Lead Program: CTP; Supporting Programs: All)*

				
Objective1. Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; Goal #3, Objectives 1,2 and 3)*				
Strategies:				
• Serve in an advisory capacity to national, regional, state and local coastal resource management, research and education agencies, organizations and interest groups. (All Programs)	✓	✓	✓	✓
• Translate results of NERRS research and SWMP information into educational products. (Research, Education and CTP)				✓
• Develop, maintain and/or link to web-based data portals to manage and disseminate Reserve associated science and education information products, environmental databases, and associated metadata. (All Programs)				✓
• Participate in local (VECOS), subregional (CBOS) and regional (MACOORA) Integrated Coastal and Ocean Observing System (ICOOS). (Research, Education and CTP)				

Goal 4. Increase public awareness, understanding and appreciation of coastal environments. *(NERRS Strategic Plan Goal #3; Lead Program: Education; Supporting Programs: CTP and Stewardship)*

Objective 1. Increase student and teacher knowledge and understanding of coastal environments through formal education programs. *(NERRS Strategic Plan Goal #3, Objectives 1 and 2)*				
Strategies:				
• Provide science-based, field, laboratory, and classroom experiences that correlate to national and state education standards and Reserve focus areas, for regional K-12 grade school (emphasis on middle school grades) and college groups. (Education)	✓	✓	✓	✓
• Continue to develop and disseminate general educational material via the web and more traditional venues. (Education)				
• Provide professional teacher (K-12) and informal educator development opportunities and materials for the classroom that emphasis land-margin habitats, water quality and technology subject areas. (Education)	✓	✓	✓	✓
• Provide general education based mentorship opportunities for senior high school and university students. (Education)				
Objective 2. Increase general public awareness and appreciation of the Chesapeake Bay and other coastal environments through public outreach and interpretation programs. *(NERRS Strategic Plan Goal #3, Objectives 1 and 2)*				
• Increase general public awareness and appreciation of the Chesapeake Bay and other estuaries through public oriented, science-based field and classroom programs, lectures, special events, and exhibits. (Education and CTP)	✓	✓	✓	✓
• Support training activities for volunteers and docents that help sustain Reserve and Institute activities. (Education)				
• Develop and interpret on-site projects and activities that demonstrate good stewardship principles. (Education, CTP and Stewardship)	✓	✓		

8.3.3 Key Partners

The CBNERRVA General Education and Public Outreach Program was developed to complement a wide variety of environmental and outreach program providers at VIMS and in the local area while at the same time filling a field-oriented niche that remains in high demand. The Reserve has worked to foster partnerships in order to provide the region with more wide-ranging opportunities and leverage limited staff and resources. Brief overviews of education and outreach programs provided by VIMS and other local partners are provided below and are summarized in Table 8.1.

<u>VIMS Public Relations Department</u>

Formal public outreach and education programs offered by the VIMS Public Relations Department include the VIMS Mini-Marine Science School, a four-week (one evening per week) course that covers pertinent or topics of interest to a specific group (i.e. tidal wetlands, shoreline hardening, riparian buffers, nutrient management), and VIMS Marine Science Day that is an Institute-wide open house program. The Department is also responsible for the production of the Institute's web page, the Institute's quarterly newsletter (The Crest) on which the Reserve's Director serves on the Editorial Board, informational press releases, brochures, and TV/radio segments. In addition, the Public Relations Department develops and maintains informational displays in public areas and at local fairs and festivals, and provides public tours of VIMS and the Institute's aquarium. Along with CBNERRVA and VIMS/CCRM, the Public Relations Department is a sponsor of the VIMS After Hours Seminar Series.

VIMS Marine Advisory Program - Virginia Sea Grant Program

The VIMS Marine Advisory Program, a component of the Virginia Sea Grant Education Program, manages a number of education programs. Formal programs include school programs such as Outlook on Ocean Science, which uses graduate students to discuss marine science careers and lead classroom investigations, and the regional competition for the National Ocean Science Bowl. Professional teacher development programs include a graduate credit summer course for teachers with an oceanography or fisheries science theme, a one-day species of special concern workshop, a teacher training workshop on student oyster restoration and special events for selected other audiences. Virginia Sea Grant also manages on-line ocean science resource centers (Chessie and The Bridge), and the websites for the National Marine Educators Association (NMEA), the Mid Atlantic Marine Education Association (MAMEA), the Mid-Atlantic Center for Ocean Science Education Excellence (MACOSEE) and the Centers for Ocean Science Education Excellence (COSEE).

Partner Category	Local, Regional and National General Education and Public Outreach Partners
Academic Institutes	• *Local:* VIMS, Virginia Commonwealth University, Old Dominion University • *Regional*: Virginia Polytechnic Institute and State University
Federal Agencies	• Regional: CBO/NOAA • *National*: NOAA, USF&WS
State Agencies	• *Local:* VaDEQ, VaDCR, VaDGIF
Federal-State Partnerships	• *Local*: Virginia Sea Grant and VaCZMP • *Regional*: Mid-Atlantic NERRS (MD, DE, NJ) • *National*: NERRS
Local Government	• *Local*: Gloucester and Mathews County School Board
Planning Boards	• *Regional*: MPPDC
Nongovernmental Organizations	• *Local*: Friends of the Dragon Run, • *Regional*: Oyster Reef Keepers of Virginia, Elizabeth River Project • *National*: NERRA, National Geographic Society, National Aquarium in Baltimore
Professional Organizations	• Local: Gloucester Rotary Club

Table 8.1. Reserve General Education and Public Outreach Program local, regional and national partners.

VIMS Center for Coastal Resources Management (CCRM)

The Center for Coastal Resources Management (CCRM) develops and supports integrated and adaptive management of coastal zone resources. Education and outreach programs offered by CCRM include the television and radio public series Chesapeake Bay Watch designed to engage the public in issues regarding the living resources and natural history of the Bay, Teaching Marsh tours and educational walks which aid in public understanding of wetlands and shoreline management techniques. CCRM is also responsible for the publication of the 'Rivers and Coast' newsletter and 'Wetland Reports'. Along with CBNERRVA and VIMS Public Relations Department, CCRM is a sponsor of the VIMS After Hours Seminar Series and serves as a key CTP partner.

VIMS Eastern Shore Laboratory (ESL)

The VIMS Eastern Shore Laboratory (ESL), located in Wachapreague, serves as a field station in support of research and teaching and as a site for resident research in coastal ecology and aquaculture. The ESL affords educational and research opportunities not available elsewhere within the region by virtue of its access to unique coastal habitats, excellent water quality, an extensive seawater laboratory, and a dormitory. The ESL works to provide field trips for interested audiences and hosts the ESL Public Seminar series.

Local, State and Federal Government Partners

CBNERRVA works closely with and through existing local/regional educational programs that compliment the priorities of the Reserve and NERRS. Several of these are NOAA sponsored programs. CBNERRVA has received funding through the competitive NCBO BWET program to provide hands-on, meaningful watershed experiences for students and teachers that focus on the Chesapeake Bay ecosystem and its watershed. CBNERRVA anticipates greater coordination and partnership opportunities on education initiatives with NCBO due to the recent opening of a southern Bay office located at the VIMS Gloucester Point campus. CBNERRVA is also continuing to explore general education and public outreach

opportunities with the VaCZMP. The VaCZMP focuses on the Dragon Run and its watershed in our region through a CZMA Section 309 funded Special Area Management Plan (SAMP) focus area. The MPPDC administers the Dragon Run SAMP and would likewise be a partner in Dragon Run general education and public outreach programs.

An additional education partner is YRSP, administered by the VaDCR/Division of Parks. Staff at YRSP manage a wide range of education and outreach activities which include thematic programs for preschool and junior ranger audiences, teacher training (curriculum: Virginia State Parks, Your Backyard Classroom), and guided canoe trips and hikes. A recently developed statewide corps of volunteers, Virginia Master Naturalist Program, has been established to provide education, outreach, and service dedicated to the beneficial management of natural resources and areas within the Commonwealth. The Virginia Cooperative Extension, VaDCR, VaDGIF, VaDOF and the Virginia Museum of Natural History jointly sponsor the program. The Virginia Master Naturalist Program is a chapter-based program with the Historic Rivers Chapter being based out of YRSP. Park staff have provided organizational support for this chapter. In addition, YRSP staff operate the park's visitors center, organize special events such as Earth and Estuaries Day festivals, and maintain a trail system that includes upland, riverine, and marsh components. Select trails and the education facility at YRSP are handicap accessible.

Local Non-Governmental Partners

As with local and regional governmental entities, CBNERRVA also works closely with non-governmental organizations to deliver environmental education programs and offer advisory service. Selected partners include the Oyster Reef Keepers of Virginia, Friends of the Dragon Run, the Gloucester Courthouse Rotary Club, Schooner Virginia, Jamestown 4-H, Nauticus and the Hampton Roads Alliance of Environmental Educators. CBNERRVA conducts and delivers meaningful field experiences and professional teacher development opportunities in conjunction with these non-governmental partners as well as state and federal partners when possible.

8.3.4 K- 12 Programs

The CBPs Education Workgroup set forth a resolution in Chesapeake 2000 that every school student, starting from the class of 2005, should have a 'meaningful Chesapeake Bay experience' by the time they graduate high school (Figure 8.1). Therefore, field-orientated programs will remain a core aspect of environmental education in Virginia in the near future. The Reserve has used its unique access to VIMS faculty, professional staff, and resources to create a 'Field Marine Science' program that works to incorporate estuarine and biological science and quantitative components into field trips and in-class programs. Implementing field marine science programs present many challenges and requires trained and experienced staff in order to meet the appropriate 'standard of care' when working with students outside a classroom environment. Recent completion of the CBNERRVA Catlett-Burruss Research and Education Laboratory, located on the VIMS Gloucester Point campus, will allow for further development of programs that utilize both field and laboratory activities.

K- 5th Grade Programs

Field-Based Marine Science Programs. CBNERRVA K-5 grade field-based programs provide an introduction to a wide variety of estuarine environments and support aspects of the 'meaningful Chesapeake Bay experience'. Elementary school programs entail 2-6 hour wading field trips focused on specific themes such as oyster restoration, shallow water habitats, and finfish and shellfish investigations. Examples include the 'Oyster Restoration' field trip, which allows students to investigate a restored oyster reef and release young oysters that the students have raised during the school year and the 'Exploring Chesapeake Bay Habitats' field trip that highlights the ecology of a variety of coastal habitats (e.g., underwater grasses, intertidal marshes, and sand flats).

Curriculum and Class Based Programs. The Reserve leverages the educational impact of all field experiences through the use of pre- and post-field trip study. Education staff works to provide advisory

assistance to elementary school teachers by referring them to appropriate programs and educational resources. When possible, CBNERRVA can offer direct assistance for in-class activities. In-class activities include the 'Fish Forms' program where students discover what a fish's morphology can tell them about lifestyle aspects of many Chesapeake Bay fishes, shallow water habitat and estuarine animal presentations, a food web activity and the Estuarine Aquarium Keeping manual which allows for marine science education through the caring of estuarine species. Education staff are currently developing an additional range of activities to take advantage of the Catlett–Burruss Research and Education Laboratory.

Multi-day Student Summer Programs. CBNERRVA conducts multi-day courses during the summer in order to provide year-round opportunities for selected 3rd-5th grade students. These multi-day summer programs typically vary from 2-5 days in length. An example includes the 'Explore the Chesapeake Bay Summer Day Camp' offered in partnership with the NCBO. The five-day camp is offered to teacher-nominated students who have a keen interest in the Chesapeake Bay and have maintained a B or higher grade point average. This weeklong program will expose participants to the York River watershed, wetlands, underwater grass beds, and key Bay flora and fauna species through field trips, group activities, games and crafts. Use of multi-day programs during the summer allows CBNERRVA to run age appropriate 'meaningful Chesapeake Bay experiences' independent of schools leading pre- and post-trip education.

Figure 8.2. Middle-school students explore beach habitats. Photo credit: Robert Carroll.

Middle and High School Programs (6-12)

Field-Based Marine Science Programs. CBNERRVA field-based education programs for middle and high school students is designed to address Virginia Standards of Learning in an applied context. Students are familiarized with a wide variety of estuarine environments during field programs that incorporate many principles of marine science and restoration science. The program links field trips with in-class presentations, marine science investigations/experiments, and monitoring activities based on individual schools needs and teacher vision. Field programs for grades 6 through 12 entail one-half day to 7-day long, wading, canoe, and/or boat field trips focused on specific themes such as oyster restoration, shallow water habitats, marsh dynamics, finfish, shellfish and crustacean investigations, and water quality. These programs are designed to take an in-depth look at selected estuarine topics and foster discussion around the selected topics and integrating concepts. Field trips incorporate hands-on and student-directed activities where students quantitatively measure parameters in the field that will be used for hypothesis testing or descriptive investigation back in the classroom (Figure 8.2). CBNERRVA currently focuses on the 7th grade audience because this grade's Virginia Standards of Learning for Life Science are the best fit for CBNERRVA field-based marine science program approach. Longer programs utilize experts from VIMS, the VaMRC, VaDEQ, advocacy groups, and the aquaculture and commercial fishing industry in order to educate the students about various stakeholder positions involved in resource management and introduces students to a variety of marine careers.

Curriculum and Classroom Based Programs. As stated above, CBNERRVA currently focuses on the 7th grade audience and continues to create classroom activities to augment field experiences for this age group. Current in-class activities developed through support from the NCBO Bay Watershed and Training

Program (BWET) include oyster, blue crab and summer flounder growth and mortality studies, and estuarine food web dynamics. In-class activities created during this project will be made available to a broader audience by placing appropriate activities and presentations on the Reserve's web page and holding teacher-training workshops that focus on the Middle School Marine Science pathways (e.g., oyster restoration, blue crabs, and summer flounder).

Multi-day Student Summer Programs. CBNERRVA conducts multi-day courses during the summer in order to provide year-round opportunities for middle and high school students. These multi-day summer programs typically vary from 2-7 days in length. 'Investigating Current Chesapeake Bay Fishery Issues: A Field Based Education Program' is an example of a Reserve five-day summer offering. This weeklong program for motivated and interested high school students from throughout Virginia used commercial fisheries (blue crabs and hard shell clams) as the integrating concept. Students obtain first-hand understanding of the complexities and far-reaching social and ecological impacts of fishery management in Virginia. The annual Chesapeake Bay Conference is a five-day residential summer program offered in partnership with the Gloucester Courthouse Rotary Club is another example of a multi-day summer program. The Conference is built around a central theme such as Chesapeake Bay fisheries (e.g. oysters or blue crabs) important habitats (e.g. submerged aquatic vegetation, oyster reefs, riparian buffers, and wetlands) as well as special management areas (e.g. Dragon Run Swamp). Themes are used to focus the agenda and provide students with a working knowledge of the various stakeholders involved in marine resource management. The Gloucester Courthouse Rotary Club recruits students that have been sponsored by Rotary clubs from throughout Virginia and are responsible for all logistical matters. CBNERRVA is responsible for the educational content of the program, including field trips, presentations and providing expert speakers.

Multi-day programs allow for desired in-depth marine science investigation by providing ample time for preparation, question formulation, data gathering, data analysis, knowledge acquisition, final analysis and reflection. All of these steps are integral in creating a 'meaningful Chesapeake Bay experience'. Use of multi-day programs during the summer allows CBNERRVA to run 'meaningful Chesapeake Bay experiences' independent of schools leading pre- and post-trip education. Multi-day programs are offered to exceptional students that participate in other Reserve or partner programs in hopes of creating a student environmental leaders network in the region.

8.3.5 College/University and Intern Programs

Field-Based Marine Science Programs

One-day field trips offered to interested college groups are designed to enhance awareness and understanding of the estuary and emphasize the interrelationships of coastal habitats and human activities. Trip themes focus on intertidal and shallow water habitats (e.g., eelgrass, oyster reefs, marshes, and unvegetated flats). Animal collection, water quality work and scientific investigation are planned according to each group's field trip objectives. Field trip opportunities include guided canoe and boat trips to Reserve components, the York River proper, tidal tributaries of the York River, and the Dragon Run Swamp. CBNERRVA currently does not promote Field Marine Science programs for colleges/universities, however may provide support based on a formal request and staff availability.

Intern Programs

Faculty and staff associated with CBNERRVA participate in a number of intern education programs as time permits. Examples of such programs for undergraduates have included: (1) the NSF sponsored Research Experience for Undergraduates Program at VIMS, and (2) the Conservation Work Study Program for under-represented and minority students sponsored by the National Aquarium in Baltimore (NAIB). In addition, with endowment funding directed to CBNERRVA, the Reserve provides support for undergraduate research through the Rouse-Bottom Fellowship award. CBNERRVA also provides support for exceptional, local high school students in the form of yearly mentorships.

8.3.6 Professional Teacher and Informal Educator Development Programs

K-12 teachers and community leaders are a priority audience for the CBNERRVA General Education and Public Outreach Program. Summer teacher-training workshops are conducted by Reserve staff and provide teachers with new insight into the Chesapeake Bay ecosystem using meaningful field experiences and classroom instruction. Workshops are theme based and instruct teachers in all aspects of restoration projects they can do with their students or classroom activities that teach about estuaries. Efforts are made to have all teacher training material accessible on-line through the world-wide web. Short descriptions of developed teacher workshops are provided below.

Water Quality Workshops

The CBNERRVA Water Quality workshop provides a format for high and middle school teachers to include water quality and the use of NERRS SWMP data into their curricula. Teachers receive background information about water quality parameters, water quality testing procedures using affordable test kits, the NERRS water quality monitoring program, use of the NERRS/CDMO web site that has archived water quality data from the 27 NERRS sites around the nation and use of a water quality curriculum created by Reserve staff. Curriculum activities provide students with applied marine science questions and data sets so they can formulate a data manipulation plan, perform calculations and graphing as necessary, and answer the applied questions upon summarizing the data sets. Identifying relationships between water quality parameters, and elucidating parameter trends with tidal, daily and seasonal cycles, and the use of simple statistical analysis are emphasized. The linkage of water quality to Chesapeake Bay living resources is stressed throughout the program by enhancing understanding of principles such as tidal flushing, estuarine salinity gradients, dissolved oxygen dynamics, storm impacts, and water quality criteria of living resources (e.g. SAV, oysters, hard clams, anadromous fishes).

Habitat Restoration Workshops

The 1-3 day CBNERRVA Habitat Restoration workshops provide K-12 teachers the background, knowledge, experience, skills and professional contacts necessary to initiate and lead coastal habitat restoration projects back at their school. Workshop themes include underwater grass, riparian buffer, oyster reef, salt marsh and schoolyard habitats. Course participants receive interactive presentations and hands–on field trips to coastal habitats of concern.

CBNERRVA has also partnered with Virginia Sea Grant and Oyster Reef Keepers of Virginia to offer Oyster Restoration teacher-training workshops. These workshops vary in length from 1-3 days and provide information sessions on oyster biology, ecology and reef restoration as well as hands-on experiences through oyster dissection and field trips. Workshops have been offered for graduate credit though the College of William and Mary School of Education and/or provide re-certification credits through their local school districts.

Estuarine Aquarium Keeping in the Classroom

CBNERRVA also offers 1-day teacher workshops in order to provide new and unique offerings for our growing teacher base. The goal of the one-day teacher workshops is to train teachers in marine science activities they can use in their classrooms. Examples of such workshops include an Estuarine Aquarium Keeping in the Classroom workshop for teachers who wish to maintain estuarine aquariums in their schools. Estuarine aquariums allow teachers to keep Bay organisms in the classroom for student observation, perform water quality testing and generally use the aquarium as a ‘mesocosm’ of the Bay to discuss topics such as eutrophication, dissolved oxygen and habitat in a more applied manner. Reserve staff have written an ‘Estuarine Aquarium Keeping for Beginners’ manual for distribution at these workshops and it is currently available on the CBNERRVA web page.

Schoolyard Habitat

CBNERRVA has partnered with the VaDGIF, the US Fisheries and Wildlife Service (USF&WS) Chesapeake Bay Field Office and the Maryland Association of Outdoor and Environmental Educators to host a three-day Schoolyard Habitat teacher workshop. This workshop trained teachers and community leaders to turn unused schoolyard areas into outdoor classrooms that could be used as a site for 'meaningful Chesapeake Bay or stream outdoor' experiences. A secondary goal of this workshop is to add native meadow, shrub, forest, mixed or wetland habitat to the Chesapeake Bay watershed.

8.3.7 General Public Education Programs

York River State Park Programs

In partnership with YRSP, CBNERRVA offers education programs to increase public awareness and appreciation of estuarine systems. Programs include the Tour of the Reserves canoe trips in which a broad range of audiences can enjoy a five-hour experience exploring habitats in Taskinas Creek and Estuaries Day, which offers the public a wide variety of hands-on activities. CBNERRVA offers a series of two-hour expert guided Naturalist Series field trips for adult audiences that focus on upland and aquatic habitats and associated flora and fauna found within the Taskinas Creek component of the Reserve. During past years, CBNERRVA has also provided funding support for a part-time environmental educator located at YRSP. Support for this position allows the Park to offer year-round programs.

Discovery Labs

Beginning in May 2007, the Reserve has offered a family oriented, hands-on discovery labs on a monthly basis focused on a specific topic. Discovery Labs include an expert presentation, research and management issues as related to the specific topic, as well as relevant kids' activities.

Tour of the Reserves

In partnership with VIMS Public Relations Department, CBNERRVA offers a canoe based 'Tour of the Reserves' program that highlights reserve components and work conducted within the York River estuary. In some cases, these trips are theme based with a leading VIMS scientist on hand to discuss interesting and important aspects of the trip theme as well as the latest research findings. Tours are conducted at all four Reserve components.

Special Events

CBNERRVA also reaches general public audiences by development and exhibition of interactive displays and activities at selected fairs and festivals, including Estuaries and Earth Day at YRSP and the VIMS Marine Science Day. The majority of CBNERRVA staff typically work the various hands-on learning stations which include a beach seining program, boat programs, short lectures and hands-on learning stations that have a wide variety of live estuarine animals to view under binocular microscopes and in aquaria.

8.3.8 Volunteer Programs

The CBNERRVA general education program works in partnership with the VIMS Public Relations Department to provide volunteer docents training in research, monitoring and education activities associated with the Institute and CBNERRVA. The VIMS docent program leads the Summer Saturdays at VIMS public program from May through September and as requested during the week. Recent additions to the docent program include hands-on water quality monitoring and biological sample collection programs for the general public. The Reserve is also supporting the newly developed Virginia Master Naturalist Program, a statewide corps of volunteers providing education, outreach, and service dedicated to the beneficial management of natural resources and natural areas within their communities. It is anticipated that Master Naturalist's will be providing volunteer support for both the Institute and the Reserve.

IX. Coastal Training Program Plan [§921.13(a)(4)]

9.1 Introduction

The availability and understanding of science-based technical information is critical to making informed decisions concerning coastal issues and resources. The ability to achieve a balance between competing uses of coastal resources is becoming ever more difficult due to conflicting interests between increasing coastal development and resource protection. Coastal decision-makers must address complex issues that have long-term implications for coastal and estuarine ecosystems. Unfortunately, these decision-makers often do not have adequate access to relevant and up-to-date science-based information, training, and tools needed to make well-informed decisions. Through the CTP, NERRS can ensure that coastal decision-makers have access to the knowledge and tools they need to address critical resource management issues of concern to local communities (Figure 9.1).

Figure 9.1. Example of a living shoreline installed as an alternative to an exclusive revetment erosion control structure. Photo credit: Karen Duhring.

On a national level, the focus of CTP workshop topics includes coastal development and land use planning, watershed management, water quality and stormwater issues, and coastal habitat restoration. Primary organizational audiences for CTP include local and state governments, businesses and non-governmental organizations. 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 and lectures, hands-on training and participatory workshops often with a reserve-based field activity.

9.2 National System-Wide Coastal Training Program

9.2.1 Program Participation and Implementation

The overarching goal of the national CTP is to improve decision-making as related to coastal resources management at local and regional levels. Having staff dedicated to research, education and natural resource management that work with communities and coastal decision-makers in their locality and bioregion on a regular basis, the NERRS is uniquely positioned to assume a lead role in supporting management of coastal resources. Additionally, CTPs and associated activities serve to enhance

program integration within the NERRS. The CTP is a voluntary program that is implemented in a phased manner with varying funding levels and expectations associated with each phase. CTP developmental phases include: (1) pre-operational, (2) operational, and (3) fully operational. Consistent with all phases of development is the periodic review of the reserve niche in the training provider market, audience assessments, development of multi-year strategies, and the establishment of an advisory group for program guidance and review. The CTP also 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. Most reserves, including CBNERRVA, are considered operational which exhibit the following attributes/activities: dedicated staff (1-2 persons), implementation of a reserve level marketing plan, ongoing audience needs assessments, providing a moderate level of training (e.g. six training sessions per year), and ongoing program/training evaluation.

9.2.2 Partnerships

National, regional and local partnerships are an important aspect in order to fully implement CTPs. At the national level, ERD staff coordinate the NERRS CTP with Coastal Programs, the National Sea Grant Program and the Coastal Services Center as well as other divisions of NOAA. These partnerships concentrate on strategic and budget planning, and providing support to reserves for local/regional program development and implementation. At the regional and local levels, partnerships are more variable and may include state Sea Grant and Coastal Programs, local/regional universities and research consortiums, local and state government entities, and professional and other non-governmental organizations. Local level partnerships 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.

9.2.3 NERRS Strategic Plan 2005-2010

The NERRS mission includes an emphasis on technical training in support of making informed decisions concerning coastal issues and resources. The CTP policy at NERRS and CBNERRVA is designed to fulfill goals as defined in Federal regulations (15 C.F.R 921(b); see Section 2.2.3). The CTP relevant goal is to conduct and coordinate estuarine research within the system, gather and disseminate information necessary for improved understanding and management of estuarine areas. Three of the five guiding principles of the NERRS core mission necessitate a strong CTP, relevant guiding principles are:

- Integration of science, education, and stewardship to maximize the benefits to coastal management and produce tangible results;
- Implementation of system-wide initiatives to maximize local, regional and national benefits; and
- Engage local communities and citizens to improve stewardship of coastal areas.

As related to the NERRS Strategic Plan 2005-2010 (see Section 2.2.3), the reserve system CTP goals and objectives are embedded in Goal 3.

Goal 3. Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

Objective 1. People are aware of the ecological, economic, historical, and cultural importance of estuarine resources.

Objective 2. People understand how human choices and natural disturbances impact social, economic, and estuarine ecological systems.

Objective 3. People apply science-based information when making decisions that could impact coastal and estuarine resources.

9.3 CBNERRVA Coastal Training Program

9.3.1 General Approach and Links to Reserve Focus Areas

In order to meet the CTP goal of improving decision-making as related to local and regional coastal resource management, the Reserve will enhance its capabilities to: (1) assess the science-based knowledge, skill gaps and needs of local coastal community decision-makers, (2) enhance the capacity of coastal decision-makers trainers, including Reserve staff, to design and conduct effective technical training programs (3) identify and/or develop information products and technical resources relevant to audience needs, and (4) increasing networking and collaboration across disciplines. Evaluating the effectiveness of training programs and materials to ensure that they are adequately addressing the needs of the target audience is a critical and continual process. Program performance measures include both short and long-term criteria designed to assess program offerings and participation criteria, and to see if the training services are resulting in the implementation of techniques and information at the local level, respectively (see Table 9.1).

Initial and Short-Term Measures	Long-Term Measures
• Evaluation surveys, conducted at the end of each training session are designed to gauge content effectiveness, delivery, format, location of the training session, and allow participant feedback for program improvements. • Training metrics, such as the number of registrants for workshops and training programs, cumulative number of training hours provided, and return and referral rates. • Periodic follow-up with participant focus groups to assess the lasting utility of training and supporting material. •Website metrics, such as the number of people accessing the CBNERRVA CTP website and clearinghouse, and the number of downloaded and/or requests for information material.	• Electronic evaluation surveys, conducted several months after the workshop or course to gauge content effectiveness of the training session, lasting utility of the training, and possible incorporation of presented information into a decision-making process. • Legal code and enforcement protocol monitoring will allow for changes to be noted in legal definitions, laws, regulations, or enforcement protocols that indicate incorporation and/or implementation of improved policies and procedures. • Planning and focus group meetings will allow for input by program partners and selected individuals with respect to program performance review and direction.

Table 9.1. Short and long-term performance measures for CTP offerings.

Based on user needs assessments, targeted topic areas for the CBNERRVA CTP include (1) wetlands and riparian buffers, (2) shoreline management, and (3) water quality and water management (see Section 9.3.6).

Priority CTP training and information offerings conducted by Reserve staff address all four Reserve focus areas (see Section 5.2):


Functions and Linkages of Land-Margin Ecosystems;


Ecosystem Vulnerability to Climate and Human-Induced Stressors;


Water Quality and Aquatic Stressors; and


Integrated Ocean Observing Systems

9.3.2 Relevant CBNERRVA Goals, Objectives and Strategies

In 2005, CBNERRVA's CTP became fully implemented and received ERD program approval. Program approval required development, submission and approval of CTP planning documents; strategic planning documents include the Reserve Needs Assessment (CBNERRVA 2005a), Marketing Plan (CBNERRVA 2005b) and Strategic Plan (CBNERRVA 2005c). The overall strategic goal of the CBNERRVA CTP is to

improve decision-making related to coastal resources management at both the local and Chesapeake Bay regional level. CBNERRVA strives to achieve NERRS CTP oriented goals by implementing a variety of strategies in support of Reserve programmatic goals and objectives listed below (see italicized text for links to national program and lead Reserve programs). Where appropriate, Reserve focus areas are linked to specific strategies.

Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making. *(NERRS Strategic Plan Goals 2 and 3; Lead Program: CTP; Supporting Programs: All)*

				
Objective1. Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; Goal #3, Objectives 1,2 and 3)*				
Strategies:				
• Serve in an advisory capacity to national, regional, state and local coastal resource management, research and education agencies, organizations and interest groups. (All Programs)	✓	✓	✓	✓
• Provide the best available science-based information and skill building opportunities, with respect to priority needs (see Section 9.3.7), to coastal resource decision-makers and other appropriate audiences via a variety of formats including training workshops, sponsored conferences and developed information products. (CTP, Research and Stewardship)	✓	✓	✓	✓
• Translate results of NERRS research and SWMP information into educational products. (Research, Education and CTP)				✓
• Develop, maintain and/or link to web-based data and information portals to manage and disseminate Reserve associated science and education information products, environmental databases, and associated metadata. (All Programs)				
• Evaluate CTP offerings and materials as to quality and cost effectiveness. (CTP)	✓	✓	✓	
• Support the development and implementation of Bay-wide and specific tributary strategies and contaminant reduction plans in support of protection and restoration of water quality and habitats of concern. (Research, Stewardship and CTP)				✓
• Participate in local (VECOS), subregional (CBOS) and regional (MACOORA) Integrated Ocean and Coastal Observing Systems (ICOOS). (Research, Education and CTP)				

Objective 3. Develop needs assessment and multi-purpose evaluation tools to measure effectiveness and quality of education and training program offerings. *(NERRS Strategic Plan Goal #2, Objectives 2 and*

Strategies:

- Conduct periodic assessments to evaluate if education programs and materials are adequately addressing the needs of target audiences. (CTP and Education)
- Evaluate education program offerings and materials as to quality and cost effectiveness. (CTP and Education)

Goal 4. Increase public awareness, understanding and appreciation of coastal environments. *(NERRS Strategic Plan Goal #3; Lead Program: Education; Supporting Programs: CTP and Stewardship)*				
Objective 2. Increase general public awareness and appreciation of the Chesapeake Bay and other coastal environments through public outreach and interpretation programs. *(NERRS Strategic Plan Goal #3, Objectives 1 and 2)*				
Strategies:				
• Increase general public awareness and appreciation of the Chesapeake Bay and other estuaries through public oriented, science-based field and classroom programs, lectures, special events, and exhibits. (Education and CTP)	✓	✓	✓	✓
• Develop and interpret on-site projects and activities that demonstrate good stewardship principles. (Education, CTP and Stewardship)	✓	✓		

9.3.3 Key Partners

CBNERRVA's CTP is a coordinated effort between the Reserve, NOAA/ERD and local (geographic range: county and state-wide), regional (Bay-wide and mid-Atlantic) and national entities. Identified active and potential Reserve CTP partners include academic institutes, federal and state agencies, federal and state government partnerships, nongovernmental organizations, professional organizations and planning boards (Table 9.2). Partnerships are an important and necessary aspect of the CTP by providing additional expertise, skills, training sites, logistical and funding support. All partners stand to benefit from a coordinated and targeted training and education program that identifies key coastal management issues, the relevant audiences, and tailored training and education programs.

Partner Category	Local, Regional and National CTP Partners
Academic Institutes	• *Local:* VIMS, W&M, Old Dominion University, Virginia Commonwealth University, Virginia Polytechnic Institute and State University and University of Virginia • *Regional*: Chesapeake Research Consortium
Federal Agencies	• *National*: NOAA, USEPA, USFWS, USDI, USGS, USDOD and USCOE
State Agencies	• *Local:* VaDEQ, VaDCR, VaDOF, VaMRC, VaDGIF and VaDACS • *Regional*: Maryland Dept. of Natural Resources
Federal-State Partnerships	• *Local*: Virginia Sea Grant and VaCZMP • *Regional*: Mid-Atlantic NERRS (MD, DE, NJ) • *National*: CICEET and NERRS
Nongovernmental Organizations	• *Local*: Friends of the Dragon Run •*Regional*: Chesapeake Bay Foundation, Keith Campbell Foundation for the Environment, Chesapeake Bay Trust, Center for Watershed Protection, CBOS and MACOORA • *National*: NERRA
Professional Organizations	• *National*: American Water Resources Association and Association of State Floodplain Managers
Planning Boards	• *Local*: Gloucester • *Regional*: MPPDC, Hampton Roads PDC, Northern Virginia PDC, Richmond Regional PDC, Northern Neck PDC, George Washington PDC and Crater PDC

Table 9.2. Reserve CTP local, regional and national partners.

9.3.4 Coastal Training Program Advisory Board

In order to assure communication and coordination between partner groups, CBNERRVA has established a CTP Advisory Board to assist the Reserve in development, design, and implementation of the program. Roles and responsibilities of the Advisory Board include (1) program guidance and vision, (2) review of strategic CTP documents, (3) review of existing and planned education material and training programs, and (4) policy and program recommendations. The Advisory Board is composed of individuals from the Commonwealth's key coastal resource management agencies, Virginia Sea Grant, NOAA Chesapeake Bay Office and NEMO

representatives, selected individuals from local planning districts and nongovernmental organizations, and selected CBNERRVA and VIMS staff. The Reserve's CTP Coordinator serves as the Advisory Board's chairperson. Membership to the Advisory Board is through a one-year voluntary appointment.

9.3.5 Training Strengths

CBNERRVA is administered by the Virginia Institute of Marine Science, College of William and Mary, with Reserve headquarters located at the main campus of the Virginia Institute of Marine Science. As such, the Reserve enjoys a productive working relationship with an Institute that has approximately 500 faculty, staff and graduate students. VIMS is mandated within the Code of Virginia to provide unbiased scientific information to help policymakers, industry, and citizens effectively manage and conserve coastal and estuarine resources. This relationship and the Institute's mandated role in advisory service afford access to a diversity of estuarine and coastal expertise that relates directly to priority CTP issues. In addition to the science expertise, VIMS has support centers, facilities and equipment that can be utilized for the various training programs. Additionally, CBNERRVA and VIMS has built strong working relationships with various governmental agencies and stakeholder groups. These relationships result in additional expertise and/or other support that can be used to address the needs of the target audience.

9.3.6 Priority Audiences

The issues that the Reserve's CTP has and will target over the next few years are relevant to a wide audience of coastal decision-makers. In an attempt to simplify the intended audiences, the potential participants in the CTP have been listed below and grouped into five categories:

- Local elected and appointed officials, such as city and town council members, county commissioners, citizen wetland boards, planning commission members, city and town managers, planners, engineers, code enforcement officers, environmental health and transportation officials.
- State and local agency staff within departments that provide oversight and advise on land use planning, marine resources, inland fisheries and wildlife, and environmental protection.
- Volunteer boards and members of organizations, such as conservation commissions, land trusts, chapters of environmental organizations, watershed associations, and property owner associations.
- Business organizations such as realty associations, building and development associations, commercial property owners associations, marine trade and construction businesses, environmental consultants, Chambers of Commerce, Rotary International and tourist boards.
- State and regional professional associations that target relevant memberships, such as wetland scientists, environmental educators, estuarine researchers, coastal regulators and planners.

9.3.7 Priority Education and Training Needs

Commensurate with human population growth along the coastal margins of Virginia's Coastal Plain, is an increase in the diversity and complexity of coastal resource issues requiring decisions and actions. Increased development and resulting pressures on the natural resource base must be addressed through multidisciplinary approaches to land use planning and natural resource management. In many instances, decisions about the resources and environments of the coast having long-term implications are made by individuals and groups without adequate science based information. The Reserve's CTP targets those practitioners that make decisions about coastal resources on a daily basis.

CBNERRVA has identified critical issues existing in the Coastal Plain region and those groups, agencies, and other audiences that could most benefit from additional relevant knowledge and training to improve the effectiveness of their decisions. CBNERRVA has conducted and completed an Education Program Supplier Market Analysis (CBNERRVA 2005b) and a User Needs Assessment (CBNERRVA 2005a). Educational and training gaps were determined by comparison of identified needs with the availability of local and regional educational and training opportunities. These identified gaps have presented the Reserve with an opportunity to develop needed educational and training programs by incorporating training methodology and approaches designed to address issues from a cross-disciplined perspective that embraces ecological, social, political and economic considerations.

The CTP User Needs Assessment identified areas (i.e., wetlands, riparian buffers, shoreline management, and water quality and water management) that were considered underprovided from a frequency, affordability, or opportunity basis. Taking into account user identified topic areas and recent opportunities presented by integrated coastal and ocean observing systems, the Reserve's CTP initial and near future efforts will concentrate on three major themes that directly support informed decision-making with respect to coastal natural resources. Targeted topic areas are: (1) wetlands and riparian buffers, (2) shoreline management, and (3) water quality and water management.

Wetlands and Riparian Buffers

The Reserve's CTP has and will continue to work with key partners to develop and offer wetland and riparian buffer topical courses. In partnership with VIMS/CCRM, Reserve staff has been involved with the development and implementation of courses specific to wetlands that included Wetland Identification and Delineation and Winter Wetland Botany. In addition, a wetland seminar course on current wetland issues and a workshop incorporating field examples of problems encountered by wetland board members is offered each year by VIMS/CCRM. CBNERRVA assists with these programs by providing support in agenda development, expert lecturers, field site support and evaluation of program effectiveness through post-event surveys.

Figure 9.2. Field studies and hands-on training component of Perennial Stream Identification Methods Workshop. Photo credit: Alyson Craig.

With respect to riparian buffers, Reserve staff has played a leading role in the development and implementation of several technical training workshops including Perennial Stream Identification Methods and Introduction to Riparian Buffers. These workshops were offered in partnership with VaDCR's Chesapeake Bay Local Assistance Division (CBLAD). A series of courses on riparian buffers are currently under development. The first course of the series is completed and serves as an introduction to the functions, benefits, and management of buffers that would target those needing a broad overview on riparian buffers, such as county board members and local planning directors. Other offerings in the series will give more detailed information and field examples for staff needing additional technical expertise in topical area such as water quality, habitat value, establishment and maintenance. The need to educate local government and landowners on the importance of riparian buffers is particularly important given the goals for water quality and riparian buffers set to be accomplished by 2010. The Chesapeake Bay Forestry Workgroup, composed of partner federal agencies and state partners in Maryland and Virginia, are working to coordinate education efforts for the Chesapeake Bay decision makers on the importance of riparian buffers. It is anticipated that the partner agencies will work together to provide educational workshops on vegetated buffers over the next few years.

Shoreline Management

Current and planned efforts regarding shoreline management by CBNERRVA's CTP and key partners are focused on the Living Shoreline Initiative. Living shorelines emphasize the use of marsh and riparian plantings, low profile breakwaters, and other techniques that provide shoreline erosion control and help maintain the natural function of the shoreline. A series of workshops on living shorelines are currently under various stages of development. To date, Reserve CTP offerings have addressed status and trends

of Virginia's shorelines, assessment of living shoreline structures, design and construction, permitting issues, and comparative water quality and habitat functions. Initial audiences have included the marine contractor and environmental consultant communities with plans to provide offerings to a wider audience.

CBNERRVA and key partners are working to better coordinate Chesapeake Bay-wide efforts with respect to the Living Shoreline Initiative. Initial efforts included a joint 2006 Maryland/Virginia Living Shoreline Summit that brought together individuals from all relevant communities within the Bay and coastal North Carolina region to address "green" alternatives to shoreline protection. Identified participants included government staff and officials, coastal managers, marine contractors, scientists, environmental consultants and private landowners. Topics included the status, trends, and functions of shorelines in the Chesapeake Bay, tools to assess cumulative impacts of shoreline modification, evaluation of combination structures/living resource projects in Virginia and Maryland, design and maintenance of living shoreline features, permitting considerations, and current scientific research. The Summit focused on bringing together diverse stakeholder perspectives on shoreline management and incorporated presentation formats, roundtable discussions, and poster sessions in order to build consensus on developing and implementing alternative erosion protection measures in the Chesapeake Bay. Results from the Summit were published in peer-reviewed proceedings (Erdle et al., 2008). New knowledge, perspectives, and partnerships that resulted from the Summit are leading to additional trainings and educational opportunities on alternative erosion protection measures.

Water Quality and Water Management

There are several anticipated offerings for training programs and opportunities associated with water quality and water management. With respect to ICOOS, the Reserve is involved on several spatial scales and includes the Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA), the subregional Chesapeake Bay Observing System (CBOS) and the local Virginia Estuarine and Coastal Observing Systems (VECOS). The Reserve's Research and Monitoring Program has played a leading role in the establishment of VECOS and supports this system through collection and delivery of data via the VECOS and CBOS web portals. In addition, the Reserve supports the local and subregional observing systems through strategic planning, needs assessments and service on steering boards. The CBNERRVA CTP will further support this effort by providing training opportunities and supporting material to assist the use of observation data by coastal decision-makers.

In addition to IOOS, the Reserve's CTP is also addressing land use and watershed planning topics. Working with state agencies and local and regional planning district commissions, the Reserve is supporting efforts to create training opportunities to address integration of watershed planning techniques into the traditional land-use planning framework. Specific topics include water supply planning, stormwater management, Total Maximum Daily Loads (TMDL's), on-site wetland mitigation, and the Chesapeake Bay Preservation Act. As issues are prioritized, curriculum materials will be developed for presentations at board meetings and topic seminars. The ultimate goal of the partnership between the CBNERRVA CTP and partner planning commissions is to provide a series of course modules that elected/appointed officials or prospective officials could complete to learn more about environmental regulations that impact their coastal communities.

X. Stewardship Plan

10.1 Introduction

Stewardship connotes the responsible management of coastal resources using the best available information in order to maintain and restore healthy, productive and resilient ecosystems. In addition to providing long-term protection of natural and cultural resources within the system's twenty-seven reserves, NERRS stewardship programs serve to develop and implement responsible management practices as a model for other coastal communities. The CBNERRVA reserve components are managed to ensure long-term integrity and diversity of their ecosystems and archaeological/cultural sites. To accomplish responsible management of coastal resources, stewardship programs use a management based approach that incorporates a variety of strategies including assessment, protection, science and technical assistance and community engagement.

Figure 10.1. Assessing invasive plant management strategies at Goodwin Islands. Photo credit: Chris Clapp.

Stewardship activities vary among reserves due, in part, to the unique natural resources and local threats to those resources found within each reserve, and to different management/administration structures under which reserves operate. Examples of stewardship activities commonly observed across many of the reserves include developing natural resource management plans, monitoring and protecting species of concern, controlling and eradicating invasive species, habitat restoration and monitoring, enhancing reserve boundaries through land acquisition and conservation easements, managing public access, providing technical assistance and supporting education and outreach efforts. Stewardship programs often operate on multiple scales from collecting information on processes occurring within individual habitats to studies conducted within the larger watershed. Stewardship must account for and adapt to stressors outside of reserve boundaries including land use changes in adjacent watersheds and climate change impacts including sea level rise. By raising awareness of habitat trends within a reserve and associated stressors from the larger watershed, climate and oceans, natural resource managers can develop and adopt strategies to mitigate these stressors, which may range from habitat restoration activities to developing land acquisition strategies.

10.2 National System-Wide Stewardship Program

10.2.1 National Priority Focus Areas

A strong Stewardship Program within NERRS is essential to help address new research priorities areas as identified by NOAA in their 2006-2011 Strategic Plan (NOAA 2005). As previously discussed within the Research and Monitoring Plan (see Section 7.2.1), the new infrastructure for NOAA's research focuses on four mission goals around which all work is planned and organized. The Reserve System is a primary contributing member to the Ecosystems Goal Team to "protect, restore and manage the use of coastal and ocean resources through an ecosystem approach to management." The Reserve system has identified five priority focus areas based on the research priorities under the Ecosystems goal, of which four apply directly to Stewardship:

- Habitat and ecosystem processes;
- Anthropogenic influences on estuaries;
- Habitat conservation and restoration; and
- Species management.

10.2.2 NERRS Strategic Plan 2005-2010

The NERRS mission includes an emphasis on proper stewardship of coastal natural and cultural resources. Stewardship policy at NERRS and CBNERRVA is designed to fulfill goals as defined in Federal regulations (15 C.F.R 921(b); see Section 2.2.3). Four of the five guiding principles of the NERRS 2005-2010 Strategic Plan necessitate a national stewardship program. Relevant guiding principles are:

- The reserve system integrates science, education and stewardship on relevant topics to maximize the benefits to coastal management;
- Reserves serve as a catalyst and a focal point for demonstrating and facilitating objective problem solving and best management practices;
- Reserves engage local communities/citizens to improve stewardship of coastal areas; and
- Reserves implement an ecosystem-based management approach.

As related to the NERRS Strategic Plan 2005-2010 (see Section 2.2.3), the reserve system stewardship goals are embedded in Goals 1, 2 and 3. NERRS Strategic Plan 2005-2010 objectives addressed by the Stewardship Program include:

Goal 1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research and education.

Objective 2. Biological, chemical, physical, and ecological conditions of reserves are characterized and monitored to describe reference conditions and to quantify change.

Objective 3. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research and education.

Goal 2. Increase the use of reserve science and sites to address priority coastal management issues.

Objective 1. Scientists conduct research at reserves that is relevant to coastal management needs and increases basic understanding of estuarine processes.

Objective 2. Scientists have access to NERRS datasets, science products and results.

Objective 3. The scientific community uses data, products tools, and techniques generated at the

NERRS.

Goal 3. Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

Objective 3. People apply science-based information when making decisions that could impact coastal and estuarine resources.

10.2.3 National Initiatives

The NERRS Restoration Science and Land Use and Habitat Change (LUHC) strategies are two initiatives that provide the framework for national stewardship program priorities. The Restoration Science strategy prioritizes restoration research through demonstration projects, transfer of information to decision-makers, and establishment of reserves as restoration reference sites through two general tracks. Track 1 focuses on the implementation of restoration demonstration projects to address pressing restoration issues within the NERRS system. Five reserves, including CBNERRVA, are currently establishing and monitoring salt marsh restoration reference sites within their boundaries and will apply observed trends to evaluate restoration success on nearby restoration projects funded with Estuarine Restoration Act funds. Track 2 focuses on the collection and dissemination of long-term datasets from restoration reference sites within the NERRS system. The LUHC strategy seeks to examine the inter-connectedness of habitat trends, watershed land use and local sea level impacts on reserve habitats. While this strategy is currently still in development, identified activities include the development of site-based plans for monitoring and mapping reserve habitats as well as development of a plan to assess habitat change on a four-year cycle. Additionally, this initiative includes an assessment of GIS mapping capabilities and requirements at each reserve as well as training in the application of tidal datum and vertical control for all sectors in the NERRS.

10.3 CBNERRVA Stewardship Program

10.3.1 General Approach and Links to Reserve Focus Areas

A primary goal of CBNERRVA's Stewardship Program is the responsible management of natural resources using the best available information for the purpose of maintaining, protecting and restoring the diverse habitats and associated flora and fauna found within the boundaries of Reserve. Management policies and guidelines are intended to explain the general rationale for managing natural communities and rare species, to clarify the reasons for restricting public use and visitation, and to state principles and ideas that guide management of Reserve natural areas. Reserve natural area management guidelines were adapted from the natural area preserve management guidelines developed by the VaDCR, Division of Natural Heritage (VaDCR 2000a) and are provided in Appendix V.1.

Stewardship actions occur at the watershed, reserve, and habitat scales and apply the five key strategies of assessment, protection, restoration, research, and community engagement. In order to contribute to coastal stewardship at a variety of geographic and ecosystem scales, the Reserve pursues a variety of approaches including:

- Developing in-house research, monitoring and restoration programs led by CBNERRVA associated faculty and senior staff that directly address stewardship and resource management needs;
- Collaborating with individual investigators or groups conducting research, related monitoring and habitat restoration within the York River and Bay region;
- Encouraging, and where possible supporting, research and monitoring by individual investigators or groups with emphasis given to those addressing Reserve priorities;
- Continual updating and implementation of Reserve component specific Natural Resource Management Plans;

- Supporting development and implementation of Reserve boundary protection and critical lands acquisition plan (see Section 11); and
- Managing public access (see Section 12).

Principal Stewardship Program activities conducted by Reserve staff address all four of the Reserve focus areas (see Section 5.2 for greater detail):

 Functions and Linkages of Land-Margin Ecosystems;

 Ecosystem Vulnerability to Climate and Human-Induced Stressors;

 Water Quality and Aquatic Stressors; and

 Integrated Ocean Observing Systems.

10.3.2 Relevant CBNERRVA Goals, Objectives and Strategies

CBNERRVA strives to achieve NERRS and VIMS resource management responsibilities by implementing a variety of strategies in support of Reserve programmatic goals and objectives listed below (see italicized text for links to national program and lead Reserve programs). Where appropriate, Reserve focus areas are linked to specific strategies.

Goal 2. Enhance scientific understanding of coastal ecosystems, surrounding environments and the natural and human processes influencing such systems. *(NERRS Strategic Plan Goals 1 and 2; Lead Program: Research; Supporting Program: Stewardship)*				
Objective 1. Characterize and monitor coastal ecosystems and surrounding environments to describe reference conditions and quantify spatial and temporal changes. *(NERRS Strategic Plan Goal 1, Objective 2; Goal 2, Objectives 1,2 and 3)*				
Strategies:				
• Conduct flora and faunal baseline surveys to fill information gaps and to better characterize Reserve living resources and environments with an emphasis on species and habitats of concern. (Stewardship)	✓	✓		
• Support biological monitoring of critical habitats (e.g., emergent wetlands, submerged aquatic vegetation) and the development of sentinel sites to address ecosystem response to climate and human induced stress. (Research and Stewardship)	✓	✓	✓	✓
• Map current and historic coastal habitats, land-use and coastlines within the York River system. (Stewardship)	✓	✓		✓
• Update Reserve site profile. (Research and Stewardship)				
Objective 2. Determine linkages within and between coastal ecosystems and how linkages affect those systems. *(NERRS Strategic Plan Goal #1, Objective 2; Goal #2, Objectives 1,2 and 3)*				
Strategies:				
• Examine how upland, shoreline and water management changes affect material flux and coastal ecosystems. (Research and Stewardship)	✓	✓	✓	

• Examine rates and patterns of sea-level rise, subsidence and shoreline erosion and ecosystem responses to these processes within the York River system. (Research and Stewardship)	✓	✓	✓	✓

Objective 3. Promote, coordinate, track and support research and monitoring activities within Reserve boundaries and the York River system. *(NERRS Strategic Plan Goal #2, Objective 1)*

Strategies:
- Establish and maintain contact, and where appropriate, coordinate activities among groups with estuarine research and environmental monitoring interests. (Research and Stewardship)
- Identify research priority focus areas and encourage their investigation within Reserve components and the broader York River and Chesapeake Bay system. (Research and Stewardship)
- Seek external funding to advance research and monitoring activities. (Research and Stewardship)

Goal 3. Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making. *(NERRS Strategic Plan Goals 2 and 3; Lead Program: CTP; Supporting Programs: All)*

Objective1. Communicate results of research, environmental monitoring and best available science-based information to assist in improved coastal resource management. *(NERRS Strategic Plan Goal #2, Objectives 2 and 3; Goal #3, Objectives 1,2 and 3)*				
Strategies:				
• Serve in an advisory capacity to national, regional, state and local coastal resource management, research and education agencies, organizations and interest groups. (All Programs)				
• Provide the best available science-based information and skill building opportunities, with respect to identified focus areas, to coastal resource decision-makers and other appropriate audiences. (CTP, Research and Stewardship)		✓	✓	
• Develop, maintain and/or link to web-based data and information portals to manage and disseminate Reserve associated science and education information products, environmental databases, and associated metadata. (All Programs)				✓
• Support the development and implementation of Bay-wide and specific tributary strategies and contaminant reduction plans in support of protection and restoration of water quality and habitats of concern. (Research, Stewardship and CTP)	✓	✓	✓	

Goal 6. Strengthen the protection and management of Reserve coastal resources to ensure long-term integrity and diversity of its ecosystems and archaeological/cultural sites. *(NERRS Strategic Plan Goals #1, #2 and #3; Lead Program: Stewardship; Supporting Programs: Administration)*

Objective 1. Support land and water conservation efforts that ensure representation of the diverse ecosystems found within the York River estuary and protect/conserve the larger landscape ecosystem that impact existing Reserve components. *(NERRS Strategic Plan Goal #1, Objective 3)* Strategies: • Develop a Reserve Boundary Protection and Land Acquisition Plan. (Administration and Stewardship) • Where appropriate, communicate and coordinate land and water conservation activities with neighboring private landowners, non-governmental organizations (e.g., land trusts) and local, state and federal government agencies. (Administration and Stewardship) **Objective 2. Provide for natural resource protection and management within Reserve boundaries.** *(NERRS Strategic Plan Goal #1, Objective 3)* Strategies: • Implement developed Reserve component specific Natural Resource Management Plans. (Stewardship) • Monitor and evaluate the effects of invasive/nuisance species control strategies and restoration efforts. (Stewardship) • Update Reserve component specific Natural Resource Management Plans every 5 years. (Stewardship) • Enforce prosecution of offenders of natural resource protection laws and regulations. (Administration and Stewardship)		✓ ✓	✓ ✓	

Objective 3. Provide for historical and archaeological resource protection and management within Reserve boundaries. *(NERRS Strategic Plan Goal #3, Objective 1)*

Strategies:
- Encourage, and when possible support, initial survey/inventory of historical/archaeological resource survey within Reserve boundaries and assure proper stewardship of such resources. (Research and Stewardship)
- Enforce prosecution of offenders of historical and archaeological resource protection laws and regulations. (Administration and Stewardship)

Objective 4. Manage public access within Reserve boundaries in order to protect the integrity of natural and historical/archaeological resources and provide for non-conflicting traditional uses. *(NERRS Strategic Plan Goal #1, Objective 3; Goal #3, Objectives 1 and 2)*

Strategies:
- Clearly identify Reserve boundaries, public use sites, and appropriate public activities at each Reserve component. (Stewardship).
- Maintain and enhance, where appropriate, structures to provide for safe public access and support permitted wildlife watching and hunting activities. (Stewardship)
- Develop public access schedules, where appropriate, to minimize or eliminate user conflict. (Stewardship)
- Monitor and evaluate public use, and other user impacts at existing access points and throughout the Reserve. (Stewardship)
- Honor formal agreements and informal understandings with private property owners and public lands managers. (Administration and Stewardship)
- Enforce prosecution of trespass and vandalism, and offenders of plant and wildlife, antiquities and

hunting and fishing regulations. (Administration and Stewardship)
- Develop and make available information material (e.g. York River State Park trail guides, species inventories) to enhance the public visitor's outdoor experience (Stewardship).

10.3.3 Key Partners

The CBNERRVA Stewardship Program has worked to foster partnerships in order to provide the region with more wide-ranging opportunities and leverage limited staff and resources. National, regional and local partnerships are important elements in order to fully implement stewardship strategies (Table 10.1). At the national level, ERD staff coordinates the NERRS Stewardship Program with NGS, CO-OPS, the Restoration Center, CICEET and the CSC as well as other divisions of NOAA and other federal agencies. These partnerships concentrate on enhancing data networks, restoration projects, strategic planning, and providing support and training to reserves for local/regional program development and implementation. At the regional and local levels, partnerships are more variable and may include state Coastal Programs, local/regional universities, local and state government entities, and professional and other non-governmental organizations.

Partner Category	Local, Regional and National Stewardship Partners
Academic Institutes	• *Local:* VIMS and W&M
Federal Agencies	• *Regional*: NOAA/CBO •*National*: NOAA (NGS, CO-OPS, NWS, Restoration Center, CSC), USFWS, USDI and USDOD
State Agencies	• *Local:* VaDEQ, VaDCR, VaDOF, VaMRC, VaDGIF and VaMRC
Federal-State Partnerships	• *Local*: VaCZMP • *Regional*: Mid-Atlantic NERRS (MD, DE, NJ) • *National*: CICEET and NERRS
Nongovernmental Organizations	• *Regional*: Chesapeake Bay Foundation, Keith Campbell Foundation for the Environment and the Middle Peninsula Land Trust • *National*: NERRA, Trust for Public Lands and the Nature Conservancy
Reserve Property Owners	• *Local:* Tacoma Hunting and Fishing Club and Timberneck LLC.

Table 10.1. Reserve Stewardship program local, regional and national partners.

10.3.4 Reserve Component Specific Natural Resource Management Plans

A primary stewardship goal at each Reserve component is to maintain a functioning ecosystem with a matrix of natural communities that provide long-term support for research and education communities. Threats to biodiversity and the integrity of sensitive ecosystems include: habitat degradation and loss, invasive non-native species, pollution, overexploitation, disease, disruption of fire regimes, land conversion to developed or agricultural uses, water and infrastructure development, logging and mining activities (Wilcove et al. 1998). After habitat loss, invasive non-native species are the greatest threat to terrestrial species (Stein 2000) and water pollution is the most significant threat for aquatic species (Richter et al. 1997). Because of these threats, active management is often needed to restore and maintain natural resources.

Within the York River Watershed, invasive species, problematic native species, land-use changes and longer-term climate changes are all examples of stressors which pose threats to Reserve ecosystems. The complexity of land margin ecosystems and a general shortfall of staff time and funds usually preclude a full understanding of the effects of those stressors on changes to Reserve habitats or instituting all of the necessary management actions to direct and monitor that change. By taking an active and adaptive management approach to prioritize management strategies, using and building upon existing inventory baseline data, and by monitoring trends in natural communities and/or species populations following management actions, successful stewardship of natural resources can be attained.

Reserve-level management and monitoring objectives, as well as cooperative management and protection strategies are based on the best current information and available resources. Management objectives for CBNERRVA components are to:

- Maintain and restore natural communities and habitats of rare species;
- Foster research to accomplish conservation goals and contribute to the body of knowledge on flora, fauna, and natural communities of Virginia;
- Manage habitat to benefit and provide for protection of natural resources, scenic resources, and historic resources;
- Evaluate effects of management on plants, animals, and natural communities; and
- Monitor land-margin ecosystems for long-term vegetation changes due to sea level rise and other climatic factors.

As a first step towards an adaptive management process and meeting these objectives, CBNERRVA and the VaDCR/ Division of Natural Heritage have developed Natural Resource Management Plans for all four CBNERRVA components (Erdle and Heffernan 2005a and 2005b; Myers et al. 2008a and 2008b). These component-specific Natural Resource Plans incorporate the policy and management approach of the Reserve, background information (e.g. location, climate, geologic and hydrologic conditions, surrounding land use, site history), and an inventory of natural resources derived from field surveys and review of literature. Information derived from directed research and environmental and biological monitoring programs are at the foundation of developing and implementing natural resource management strategies. As an outcome, the plans identify resource stewardship/research needs and data gaps as well as provide management recommendations for each Reserve component. The plans serve as the Reserve's principal guide to natural resource management within Reserve boundaries and allow Reserve staff to develop short and long-term plans for managing particular resources, prioritize management need and strategies, and implement the most pressing management actions. These plans have an intended timeline of approximately five years and copies of completed plans are available upon request from CBNERRVA. Details regarding natural resource management issues at a specific Reserve component have been provided earlier in this report (see Section 3.3.3) and are summarized in Table 10.2. CBNERRVA will strive to promote and support management and monitoring strategies that target these Reserve natural resource stewardship issues and needs.

Management Issue	Goodwin Islands	Catlett Islands	Taskinas Creek	Sweet Hall Marsh
Control of known invasive plant species	•	•	•	•
Control of known invasive animal species				•
Control of known native animal species	•	•		
Assessment, protection and restoration of known shallow-water finfish and shellfish spawning and nursery habitat	•	•	•	•
Assessment, protection and restoration of known bird breeding and nesting habitat	•	•	•	•
Assessment of sea level rise and shoreline erosion on critical habitats and geomorphic features	•	•	•	•
Assessment of Land Use Impacts (primarily residential development) on Reserve resources		•	•	•
Determination of water clarity status for surrounding waters and assess the potential for submerged aquatic vegetation restoration		•		
Assessment of groundwater withdrawl and long-term reductions in stream flow on salinity patterns and impacts on plant communities and fish spawning grounds				•
Source identification of mercury and other contaminant inputs and impacts upon the ecosystem				•
What is the historical/archaeological significance of Reserve artifacts.	•	•	•	•

Table 10.2. Summary of identified resource management issues at specific Reserve components.

10.3.5 General Stewardship Operations

Invasive and Nuisance Native Species Management

Nationwide, invasive species have been identified as the second highest threat to biological diversity, second only to loss of species and habitat from development and urban sprawl (Stein et al. 2000). A principal goal of the Reserve's Stewardship Program is to prevent the establishment of aggressive invasive species in high-quality natural communities. Although eradication may not a practical option for some invasive species already well-established at Reserve components (such as *Phragmites* at Goodwin Island), minimizing the spread of established invasives and preventing new invasive species from becoming established within Reserve components is a viable objective. Documented invasive and native nuisance species within Reserve boundaries are presented in Table 10.3.

Using information from Reserve-component management plans and drawing on the expertise of state (e.g., VaDCR), federal (e.g., USF&WS), non-profits (e.g., The Nature Conservancy), and working groups (e.g., Virginia Phragmites Working Group and Virginia Invasive Species Control Council), CBNERRVA can begin to develop and implement a Reserve-wide Invasive Species Control Plan. This plan will identify and prioritize the plant and animal species which are currently and potentially significant threats to the natural resources of the Reserve system. The plan will also identify a wide range of actions and strategies required to achieve the goals of prevention, research, control, and management of each invasive species. Geospatial mapping technologies will be an important component of this plan.

	Goodwin Islands	Catlett Islands	Taskinas Creek	Sweet Hall Marsh
Invasive Species				
Common reed (*Phragmites australis)*	•	•	•	•
Japanese honeysuckle (Lonicera japonica)	•	•	•	•
Japanese stiltgrass (*Microstegium vimineum*)	•		•	
Border privet (*Ligustrum obtusifolium*)	•	•		
Tree of Heaven (*Ailanthus altissima*)			•	
Blue catfish (*Ictalurus furcatus*)				•
Nuisance Native Species				
White tailed deer (*Odocoilus virginianus*)			•	
South. pine bark beetle (*Dendroctonus frontalis*)	•	•		
Raccoon (*Procyon lotor*)	•			

Table 10.3. Reserve documented invasive and native nuisance species.

Due to overabundance, certain native species of animals have become problematic from both ecological and economic perspectives. While these species are native to coastal Virginia, their recent population increases have resulted in negative effects on habitat and individual plant and animal species. Overabundance of some species is often incompatible with a broad array of resource management objectives and control of burgeoning native animal populations may be necessary. CBNERRVA will continue to design monitoring programs to estimate and track native animal populations and impacts in order to guide management actions. Currently, there are two such programs which have been identified as high priority over the next five-year time frame. The Reserve plans to investigate and potentially implement a control strategy of raccoon populations associated with diamond-back terrapin and shorebirds nesting predation at the Goodwin and Catlett Islands. First steps in the process involve a trapping strategy to obtain estimates of predator populations. It has also been recommended that CBNERRVA monitor for Southern pine bark beetle outbreaks within the maritime forest habitats of Goodwin and Catlett Islands. CBNERRVA would coordinate with VaDCR-Natural Heritage Division and VaDOF to develop a response and management strategy should an outbreak occur.

Law Enforcement and Emergency Response

VIMS and CBNERRVA lack their own law enforcement and fire/rescue staff, therefore it is necessary for the Reserve to partner with other agencies/entities when associated issues arise. With respect to natural resources, VaDGIF and VaMRC serve as the principal law enforcement agencies. CBNERRVA relies on local and state law enforcement for all other criminal matters. Likewise, local fire/rescue resources are

used for safety support as needs arise. A summary of other local and state law enforcement agencies assisting in Reserve operations is provided in Appendix V.2.

On the occasion when an emergency response is needed to protect natural resources, CBNERRVA relies on a number of local, state and federal partners. Situations that may require an emergency response can include wetland and subaqueous violations, contaminant spills and other hazardous discharges, fire, turtle and mammal strandings, and fish kills. A summary of agencies and other entities assisting in natural resource emergencies is provided in Appendix V.2. It should be noted that fire can be a natural areas management tool and discussed in further detail below.

Given the level of activity by the Yorktown Oil Refinery and U.S. Naval operations within the York River, and the close proximity of the Reserve's Goodwin and Catlett Islands components to these facilities, contingency plans for an oil or other toxic materials spill have been developed and are ready to be implemented on an emergency basis. Key federal (e.g., USCG, USDOD) and state agencies (e.g., VaDEQ) and other groups (e.g., Western Refinery Yorktown, Inc.) are the lead entities if a spill were to occur. CBNERRVA will participate as a stakeholder and along with VIMS can provide specified expertise and other resources to compliment lead agencies efforts. A Reserve oil spill response plan has been developed and is provided in Appendix V.3.

Site Security and Boundary Maintenance

Operations management is a critical element of natural areas management, especially on lands where recreational uses by members of the public or commercial uses may conflict with the primary Reserve objectives of research, education and natural resource protection. Routine Reserve operations include maintenance and positing of appropriate boundary markers/signage and site security. Boundary line and sign maintenance at Reserve components is the responsibility of CBNERRVA. Site security is provided by the principal managing entities at each Reserve component, they are: CBNERRVA for Goodwin and Catlett Islands, VaDCR and CBNERRVA for Taskinas Creek, and Tacoma Hunt Club and CBNERRVA for Sweet Hall Marsh.

Fire Management

Fire management is frequently an important facet of natural areas management and involves both control and suppression of wildfires and prescribed fire implementation. The protection of structures and other significant resources that are sensitive to fire damage, and protection of human safety will require active fire suppression. The Reserve will utilize the expertise of other agencies and organizations that frequently deal with fire issues. A fire management plan would help coordinate the wildfire suppression response among various state and/or federal agencies in the event of a future fire. This plan would explore the past role of fire on the Reserve and surrounding area, discuss positive and negative effects of fire on resources present at the site, outline the management objectives of CBNERRVA and provide a set of management options should a wildfire occur. Development and implementation of a fire management plan will best be accomplished by Reserve staff working closely with VaDCR, the Virginia Department of Forestry (VaDOF), and local fire departments.

It is also understood that fire is a natural process in landscape ecology and the Reserve may not seek to control all wildfires. Historically, lightning-induced wildfires as well as fires started by Native Americans would have occurred along the uplands of the Lower Peninsula, shaping natural communities and species habitats. While some wildfires are potentially destructive and should be suppressed, in some situations prescribed burning should be explored as an opportunity to realize the benefits of fire in a natural setting. Although prescribed burning is not currently being explored as a management practice at the Reserve, the potential uses and effects of prescribed burning should also be explored. For example, VaDCR is currently developing fire management guidelines pertaining to all prescribed burning on VaDCR lands. Prescribed fire, if used at the Reserve, will be conducted in accordance with these guidelines. If deemed necessary for resource management purposes (such as burning of the invasive weed, *Phragmites australis*), prescribed burns will be conducted only under the supervision of certified burners and in close coordination with local fire departments and relevant state agencies.

Hunting, Fishing and Other Traditional Uses

Details regarding regulation of hunting, fishing and other traditional uses, varies by Reserve component; details are provided in Section 12.3. Waterfowl hunting information and rules specific to Goodwin Islands are provided in Appendix V.4.

10.3.6 Stewardship Directed Research and Monitoring

CBNERRVA has developed focus areas that address national, regional and local issues. Three areas of interest that directly impact stewardship related activities within the Reserve and Chesapeake Bay region include (1) impacts of episodic storm events and climate/sea level rise on critical coastal habitats, (2) short and long-term monitoring of specific habitats within Reserve components to serve as a reference for current and future restoration projects or land acquisition efforts, and (3) impacts of shoreline management strategies on riparian, intertidal and near-shore habitats. The Reserve's Stewardship Program will continue its applied research program to address facets of these issues. These efforts compliment ongoing Reserve programs in research, coastal decision-maker training (e.g., Living Shorelines Initiative) and general education and build upon existing water and meteorological monitoring components of SWMP.

Temporal Analysis of Habitat Change within Reserve Components and Surrounding Watershed

A growing population along with associated land use changes and shoreline modifications are primary factors causing water quality and habitat degradation in the coastal nearshore systems. In addition to direct human-induced impacts, threats associated with natural hazards and long-term climate changes further impair water quality and coastal habitats. Tidal wetlands within the York River watershed encompass a large salinity gradient from freshwater to polyhaline conditions. Accelerated sea level rise is expected to not only reduce the area of tidal marsh habitat, but the corresponding salinity intrusion may result in salinity regime changes that will directly impact the composition of wetland vegetation. This could mean the reduction of the valuable ecosystem services provided by low salinity or freshwater tidal marshes. With losses or changes in wetland habitat, one can reasonably expect some changes to ecosystem services including decreased shoreline protection, hydrologic and flood mitigation, water quality remediation and carbon sequestration, biological diversity and other habitat associated values. As these impacts are realized, wise coastal resource management includes not only documenting these impacts but determining adaptive strategies for preserving or protecting remaining critical coastal resources.

CBNERRVA will continue to use aerial photography and other remotely sensed products to calculate historical erosion rates of Reserve shorelines and measure wetland habitat change in the short and long-term (for example, the conversion of emergent marsh to open water habitat). CBNERRVA will also continue current efforts to verify newly developed NERRS habitat classification GIS based maps through analysis of high-resolution imagery and ground-truthing using the newly acquired arc-pad technology. This data on historical and current habitat changes can be used to develop threshold indices to categorize wetland state (health). Long-term outcomes would be the development of land management and stewardship strategies within Reserve components and larger York River estuary based on an understanding of these short and long-term habitat changes. Efforts will be supported through development/update of GIS based information products.

These effort tie directly into Phase III of SWMP which focuses on tracking and evaluating changes over time in coastal and estuarine habitats and how those changes are a response to anthropogenic influences from the watershed and environmental stressors from climate change. As a large part of this effort, CBNERRVA will be developing a Reserve-Specific Land Use and Habitat Change Plan with one outcome being the development of a land cover inventory of each Reserve component produced every four years according to the approach outlined by Kutcher et al. (2008). Other expected outcomes from this plan (contingent on funding and partnerships) will include watershed-level mapping products developed by the NOAA's CSC on a 5-year interval, digital elevation models at the watershed scale

developed by USGS, a network of Sediment Elevation Tables (SET) to measure elevation changes at the micro-topographic scale, and a system of geodetic benchmarks to support mapping and classification efforts for key reserve habitats and infrastructure.

Ecosystem Based Monitoring and Development of Sentinel Sites

Since its initiation in 1995, CBNERR has fully participated in Phase I of the NERRS SWMP by successfully maintaining a network of long-term, year-round continuous water quality, meteorological and nutrient stations within the York River watershed. With respect to ecosystem based monitoring, as addressed in Phase II of NERRS SWMP, systematic and quantitative monitoring has generally been lacking until recently. Bay-wide SAV distribution surveys were initiated in 1971, and in 2004, CBNERRVA began SAV tier II biological monitoring at selected sites within the York River estuary (see Section 7.3.4; www.vims.edu/bio/sav; Moore and Campbell 2006 for greater detail). A routine and comprehensive monitoring program for emergent wetlands has been lacking and, until recently, the Reserve has relied on individual studies (Doumlele 1981; Perry and Hershner 1999; Davies 2004).

CBNERRVA staff is currently engaged in biomonitoring of critical land margin ecosystems within Reserve boundaries. The Reserve continues to quantify SAV inter-annual variability within grass beds at Goodwin Islands and has developed an emergent wetlands monitoring program that encompasses each Reserve component. In partnership with NOAAs Restoration Center, CBNERRVA was selected as one of five NERRS to receive funds to establish their Reserves as restoration reference sites by collecting information on salt marsh vegetation, ground water, soil properties, and micro-scale change in sediment elevation (using SETs)(Figure 10.2). The data collected from Reserve reference sites will be used to evaluate restoration success on nearby Restoration Projects funded with Estuarine Restoration Act Funds. As part of a larger effort, CBNERRVA in partnership with NOAA NGS and CO-OPS have begun establishing a vertical control network within the York River watershed, including Reserve components, to facilitate the Reserves' ability to study and monitor vertical changes in coastal elevation with respect to local sea level, subsidence, erosion and other issues.

Figure 10.2. Deploying SET to measure sediment accretion on marsh surface. Photo credit: James Goins.

The combination of enhanced biological monitoring of critical habitats and geospatial data directly supports NERRS SWMP Phase II and III priorities and the NERRS Habitat Mapping and Change (HMC) Project. In addition, the efforts by CBNERRVA and the other NOAA programs provide the spatial framework and training required to establish Reserve components as "sentinel sites" to assess and predict ecosystem change, especially in response to large-scale episodic events (e.g., storms), interannual variations in hydrologic budgets (e.g., droughts), climate-driven changes (e.g., sea level rise, salinity intrusion, temperature), and invasive species.

Information requirements to support SAV and emergent wetland sentinel site designation to address episodic, short-term impacts as well as longer-term climate change induced impacts would include:

- abiotic monitoring of the adjacent water body pursuant to standard SWMP protocols;

- local and regional weather (current conditions) and climate (long-term average) information;
- local and regional sea level rise and land subsidence;
- watershed streamflow and land use patterns;
- establishment of tidal datums adjacent to reference sites;
- geographic extent and composition of vegetation in accordance with accepted protocols;
- changing patterns of elevation along the reference marsh to establish patterns of tidal inundation and freshwater runoff;
- establishment of a series of SETs to examine the micro-topographic responses of marshes to episodic large-scale storms and sea level change; and
- monitoring of ground water levels and porewater salinities.

Assessment of Natural and Altered Shoreline Habitats

As a result of regional elevated population growth, sprawl development and the desire to protect waterfront investments through shoreline modifications, there is a continued degrading, fragmentation and eventual loss of critical land margin ecosystems. In addition to direct human-induced impacts, threats associated with natural hazards (e.g., sea level rise, climate change, and large episodic storms) further impact these ecosystems through increased coastal erosion, flooding and changes in ecosystem community type and distribution. Tidal marshes are particularly susceptible and must have the ability to accrete vertically (e.g., sediment deposition and root mass accumulation) or transgress inland in order reduce continued stress from increased flooding and eventual die-off. Unfortunately, due to the desire to enhance viewshed and protect their properties from increased erosion and flooding rates, riparian property owners are expected to continue riparian and shoreline modifications resulting in additional loss or degradation of nearshore habitat and associated ecosystem services. CBNERRVA will continue its efforts to assess the value of ecological services (e.g. erosion protection, nekton habitat value) of a variety of natural fringing wetlands and man-made shoreline protection structures through selected field sampling projects and review of literature. Information will be compiled and be available to support coastal management efforts.

10.3.7 Archaeological, Historical and Cultural Resources Management

The immediate region occupied by the four components of CBNERRVA is rich in archaeological, historical and cultural resources. It is the aim of the Reserve to encourage, and where possible support, initial survey and inventory of objects possessing prehistoric and/or historic significance and to develop plans to protect such sites and objects within its boundaries. Archeological and historic resources within Reserve boundaries will be protected to the best of the Reserve's ability and follow general state management guidelines. Reserve policy as related to archaeological, historical and cultural resources is:

- Archaeological investigations and removal of historic artifacts from federal lands requires an Archaeological Resources Protection Act permit;
- As with Commonwealth historical preservation laws, CBNERRVA forbids the unauthorized excavation and collection of upland and underwater archaeological and cultural sites;
- The collection of historic or archaeological artifacts for research purposes will be allowed only with approved collecting permits. Permits are required by VADHR, VaDCR (Taskinas Creek) and CBNERRVA;
- Non-disruptive research and educational use of archaeological and cultural sites requires approval by VaDCR (Taskinas Creek) and CBNERRVA;
- Collection of prehistoric, historic and cultural artifacts by the general public is prohibited within Reserve boundaries, as is the use of metal detectors; and
- Archaeological and cultural sites will be protected and care will be taken not to draw public attention to these sites.

XI. Boundary Changes and Land Acquisition Plan

11.1 Introduction

The core mission of the CBNERRVA is to preserve a network of reserves that represent the diversity of coastal ecosystems found within the York River estuary and its principal tidal tributaries and to manage these Reserve components to support informed management of coastal resources through, estuarine research, education and stewardship. Habitat fragmentation and increased population growth continues to threaten Reserve components and nearby lands. To adequately protect and conserve the larger landscape ecosystem that impacts existing Reserve components and to more fully represent the diversity of coastal ecosystems found within the York River system, further land acquisition and conservation efforts may be required.

11.2 National System-Wide Land Acquisition

11.2.1 Development of a NERRS Land Acquisition Strategy

With passage of the CELCP, NERRS is assumed to play a key role in the effort to expand land protection and acquisition activities within the coastal zone. Traditionally, land acquisition primarily occurred during a reserve's designation process. However, as reserves become more mature and are impacted by increasing development and climatic change pressures, individual reserves are moving toward land protection and conservation as a regular management strategy. In order to meet its responsibilities at a broader nation-wide scale, the NERRS supports development of a national land acquisition plan. To move towards development of a national plan, three initial strategies have been identified (Wellenberger 2002b); these include:

Strategy 1. Reserve-wide comprehensive land acquisition planning, based upon agreed guidelines developed by NERRS;

Strategy 2. NERRS support of land acquisition legislation at the national level which includes CELCP; and

Strategy 3. Identification and support the development of partnerships with national and regional organizations that have a strong history of protecting critical coastal habitats.

11.2.2 Principal Federal Funding Sources

Key funding sources for reserve land acquisition initiatives include NERRS Construction and Acquisition funds and CELCP. In addition to annual operations funding support, NERRS receives federal funding for construction and acquisition to upgrade, and construct reserve facilities, and acquire priority lands. Distribution of NERRS Construction and Acquisition funds is based on a competitive program using selection guidelines established by NOAA. Project eligibility requires: (1) applicants to be NERR lead state agencies or universities in coastal states, (2) requested federal funds are matched by the applicant at 30 and 50 percent of total project cost for construction and land acquisition awards, respectively, and (3) the project must demonstrate how it complements and advances the goals of the reserve management plan.

CELCP was established in 2002 to protect coastal and estuarine lands important, in part, for their ecological and conservation values and/or threatened by conversion from a natural to a more developed

use. The program provides state and local governments with funds to permanently protect ecologically significant areas. Since its establishment, CELCP has matured into a strategic, competitive program based on guidelines published by NOAA. Project eligibility requires: (1) location to be in a state, territory or commonwealth with either a federally-approved coastal zone management program or NERRS, (2) that the state, territory or commonwealth have a NOAA approved state CELCP Plan, (3) that the project complements and advances the goals, objectives or implementation of federal, state, or local coastal management plans, (4) project submission is by a public entity, (5) the project provides for non-federal public ownership in perpetuity, and (6) non-federal matching resources at 50% of the total project cost are provided by the applicant in the form of cash or in-kind contributions.

11.2.3 Federal Boundary and Land Acquisition Plan Guidelines

Authority and Purpose

These guidelines are provided by the NOAA pursuant to Section 315 of the CZMA of 1972 as amended (16U.S.C. 1461); general authority of these guidelines is 15 CFR 921. The purpose of these guidelines is to provide NERRS with system-wide direction and assistance with the development of site level land acquisition plans. Use of these guidelines by individual reserves will help insure better consistency across the NERRS regarding plan development and the minimum level of information provided in the plans. The procedure for proposed boundary amendments generally includes the following elements: (1) development of a natural resource inventory of the proposed site(s), (2) identification of core and buffer areas, (3) acquisition of the property, and (4) approval by NOAA (CFR 921.33).

Core and Buffer Areas

Land and water areas associated with a reserve generally consist of core areas within the designated boundary and adjacent buffer areas. Core areas include the most important ecological units essential to maintaining the representativeness of the area and its resources. These areas are managed to ensure long-term viability and able a reserve to meets its research, monitoring, educational and stewardship purposes. Human activities or natural processes occurring outside the core areas could pose a risk to the integrity of core areas. Buffer areas adjacent to or surrounding the core are designed to protect the long-term integrity of the core and provide additional protection for estuarine dependent species. According to these criteria, core or scientific zones encompass natural features of the highest quality and/or portions of a reserve where access is generally restricted to scientific research, monitoring and managed education groups. Buffer areas are suitable for educational and other public use activities. Hiking trials, observation decks, interpretive devices, facilities and other public use improvements are typically restricted to these outlying buffer areas. Criteria for setting boundaries are contained in the NERRS regulations and changes in the boundary of a reserve and area designation require written approval by NOAA (CFR Part 921.33).

Mechanisms for Land Acquisition

Mechanisms for land acquisition will be accomplished through fee title acquisition, gift or donation, lease, easement or cooperative management agreements with federal, state and local government agencies, nongovernmental organizations, and private landowners. Under the developed plan, all land acquisition will be performed in accordance with federal laws and regulations for real estate acquisition, including independent appraisals. Property will be acquired only from those organizational entities and private landowners willing to participate in the program. There will be no condemnation.

Property and Resource Management

Establishing boundaries of reserves connotes a degree of control by the managing entity over human activities and the natural resources within the reserve. In general, NERR boundaries encompass both core and buffer areas. Control is exercised by direct ownership or jurisdiction by a reserve or by indirect means such as easements and administrative measures.

11.3 CBNERRVA Boundary and Acquisition Plan

11.3.1 General Approach and Links to Focus Areas

The overall goal of the Boundary and Acquisition Plan is to ensure adequate Reserve representation and management of the diverse ecosystems found within the York River system. In order to accomplish this goal, the Reserve must take a more comprehensive approach to land acquisition planning which would incorporate a number activities including:

- Identify, through enhanced scientific understanding, ongoing and potential future threats to current Reserve components and the broader York River system;
- Actively pursue land acquisition or other land conservation strategies for currently identified priority lands; and
- Work towards more comprehensive land acquisition planning which would include the development of a land acquisition plan and coordinating efforts with appropriate partners.

The Boundary and Acquisition Plan is directly linked to a number of Reserves focus areas. Current Reserve components and future enhancements to boundaries are focused on critical land margin-habitats including coastal upland, riparian, intertidal and shallow aquatic ecosystems. The ecology and management of these ecosystems is a key Reserve focus area. Enhanced understanding of these ecosystems, which includes watershed and airshed impacts, will help identify threats to these systems and subsequently guide a more comprehensive land acquisition planning effort. Conversely, once additional lands and ecosystems are incorporated into the Reserve, long-term protection and access will support additional research and education efforts. Additionally, CBNERRVA must strategically address longer-term impacts to York River ecosystems from climatic changes which includes sea-level rise. Given that much of the Reserve consists of sensitive lands, CBNERRVA must consider the ability for ecosystems within current Reserve boundaries to either regress inland (e.g., tidal wetlands) or maintain themselves in light of anticipated longer-term environmental changes which include temperature and salinity changes, increased water depths and reduced water clarity.

11.3.2 Relevant CBNERRVA Goals, Objectives and Strategies

Assuring a protected and representative network of coastal ecosystems is central to the Reserve's ability to fulfill it's mission. At the local level, the individual reserve's NOAA approved management plan continues to serve as the principal guiding document to outline land acquisition goals and provide the foundation for successful boundary protection and expansion. Based under an overarching Reserve goal, it is the aim of the Boundary and Acquisition Plan to assure proper protection and administrative management of existing Reserve components and provide necessary planning for expansion of boundaries to conserve critical coastal habitats in light current and anticipated threats. Relevant programmatic goals and objectives, along with implementation strategies are listed below (see italicized text for links to national program and lead Reserve programs).

Goal 6. Strengthen the protection and management of Reserve coastal resources to ensure long-term integrity and diversity of it's ecosystems and archaeological/cultural sites. *(NERRS Strategic Plan Goals #1, #2 and #3; Lead Program: Stewardship; Supporting Programs: Administration)*

Objective 1. Support land and water conservation efforts that ensure representation of the diverse ecosystems found within the York River estuary and protect/conserve the larger landscape ecosystem that impact existing Reserve components. *(NERRS Strategic Plan Goal #1, Objective 3)*

Strategies:
- Amend Reserve boundaries to represent current holdings and agreements. (Administration and Stewardship)
- Initiate land acquisition activities for identified near-term priority lands. (Administration and Stewardship)
- Develop a Reserve Boundary Protection and Land Acquisition Plan. (Administration and Stewardship)

11.3.3 Key Partners

Establishing and maintaining partnerships to help address issues such as local community support, funding, ownership, and management is recognized as an integral part of developing a land acquisition strategy and plan. Key partners provide a reserve with additional expertise in environmental law issues, finance, real estate, fund raising and government relations. Furthermore, a partnership approach will also allow a broader view of land acquisition through watershed based planning and management strategies. Partnerships are expected to involve collaboration between public agencies, private organizations and private landowners who share interest in, or jurisdiction over identified lands and/or resources of interest. Identified partnership opportunities for CBNERRVA include but are not limited to those presented in Table 11.1.

11.3.4 Development of a CBNERRVA Boundary Protection and Land Acquisition Plan

The principal guiding document for a reserve is its NOAA-approved management plan that includes a boundary protection and land acquisition plan. This plan outlines the land acquisition goals of a reserve, identifies key lands that could serve as core and buffer regions of a reserve, includes management strategies of newly acquired lands, and identifies how a property meets the programmatic functions (i.e., research, education, stewardship) of a particular reserve. While specific individual elements of a CBNERRVA boundary protection and land acquisition plan exist, efforts will be required to develop an updated and more fully comprehensive plan. A NERR land acquisition plan is not intended to be limited to only those lands currently within reserve boundaries. Lands outside current reserve boundaries which are identified as critical to the protection of reserve resource, even if the ownership of the land is by another entity, should be included in the plan.

CBNERRVA has been involved in the development of natural resource management plans for each of its four Reserve components. The purpose of these plans is to guide an adaptive management process that supports the research and education mission of the Reserve and protects natural resources. A key element of these plans is the identification of land acquisition and protection needs. In 2005, the VaDCR/Division of Natural Heritage completed natural resource management plans for the Goodwin Islands and Catlett Islands components of the Reserve. Natural resource management plans for Taskinas Creek and Sweet Hall Marsh were completed in 2008. These plans serve as a foundation in the development of a CBNERRVA Boundary Protection and Land Acquisition Plan. Recent publications, “A National Strategy for NERRS Land Acquisition” (Wellenberger 2002a) and “A Land Acquisition Inventory of the NERRS” (Wellenberger 2002b), will also serve as supporting documentation.

Key elements of a reserve boundary protection and acquisition plan include: (1) habitat and land use classification, and natural heritage (threatened or endangered natural communities and/or species) inventory maps and geospatial referenced databases, (2) archaeological, historical and cultural resources inventory maps and geospatial referenced databases, (3) properties database including existing reserve boundaries, adjacent land tracts and property ownership, (4) watershed build-out and habitat change

analysis, (5) identification, justification and prioritization of focus or areas of concern, (6) management strategies for newly acquired lands, (7) identification of key land management and acquisition partners, and (8) identification of appropriate sources of acquisition and matching funds. CBNERRVA is at various stages of accessing or developing key elements of a reserve boundary protection and acquisition plan.

Partner Category	Local, Regional and National Land Protection and Acquisition Partners
Academic Institutes	• *Local:* VIMS and W&M
Federal Government Agencies	• *National*: NOAA (NERRS 315 Acquisition Funds; Coastal and Estuarine Land Conservation Program (CELCP); Coastal Zone Management Program 306 funds), USFWS (Coastal Program; Cooperative Endangered Species Conservation Fund; North American Wetlands Conservation Act; National Coastal Wetlands Conservation Grant Program); USDI (Wetlands Reserve Program; Farmland Protection Program; Forest Legacy Program), USEPA Protection Agency (Clean Water State Revolving Fund; 319 Nonpoint Funds), USDOT (Transportation Efficiency Act for the 21st Century) and NFWF (Challenge grants)
State Government Agencies	• *Local:* VaDOF, VaDGIF, VaDCR, VaMRC, VaDEQ/CZMP, Virginia Land Conservation Foundation
Other Government Entities	• *Local:* MPPDC, Gloucester County, James City County, York County, Mathews, and King William County
Nongovernmental Organizations	• *Local*: Middle Peninsula Land Trust, Friends of the Dragon Run, Mattaponi and Pamunkey River Association • *Regional*: Virginia Outdoors Foundation • *National*: TPL, the Nature Conservancy, The Archaeological Conservancy, The Conservation Fund, Ducks Unlimited, Izaak Walton League, Land Trust Alliance, National Audubon Society, Natural Heritage Institute
Reserve Property Owners and Corporate Organizations	• *Local:* Tacoma Hunting and Fishing Club and Timberneck LLC. • *National*: John Hancock Insurance Company

Table 11.1. Listing of current and potential government and non-governmental organizations land protection and acquisition partners. Federal government programs of interest are also presented.

11.3.5 Reserve Boundary and Ownership Amendments

With the approval of this management plan, the CBNERRVA will be reduced from a total of 1302 ha (3217 ac) to a total of 1244 ha (3072 ac). This change is attributable to boundary modifications at the Sweet Hall Marsh and Taskinas Creek components of the Reserve. At the Sweet Hall Marsh, 76 ha (189 ac) of buffer are being removed from the reserve boundary due to a change in ownership of the Tick Hill parcel. At Taskinas Creek, the 18.0 ha (44.5 ac) Harrison tract is being incorporated as new acreage within the boundary as a buffer to the core reserve habitat.

Sweet Hall Marsh

At the time of designation in 1991, the Tick Hill tract of the Reserve's Sweet Hall Marsh component was owned and managed by Chesapeake Corporation (Figure 11.1). Since Reserve designation, Chesapeake Corporation embarked on new business strategies that resulted in the sale of the Tick Hill tract in 2000. A MOU between VIMS and the new owner does not currently exist. Because of this sale, the Reserve has had to modify its boundaries and exclude buffer area lands associated with the Tick Hill tract. The Sweet Hall Marsh component of the Reserve now only encompasses property holdings of the Tacoma Hunting and Fishing Club as delineated in Figure 3.7. Low ground natural resources within the Tick Hill tract included approximately 16-20 ha (40-50 ac) of seasonally flooded, palustrine deciduous forested and scrub-shrub plant communities. The remaining acreage, on the order of 55 ha (135 ac) was represented by loblolly pine and mixed hardwoods. This tract is deemed important to Reserve operations and attempts will be made to establish working relations with the new property owners hopefully leading to the development of a new management agreement. Additional information is provided in Section 4.3.3.

Taskinas Creek

Through NOAA Acquisition and Development Award NA16OR2512, derived from 2002 Coastal and Estuarine Land Conservation Program (CELCP) funds, CBNERRVA reimbursed the Trust for Public Land (TPL), on behalf of VaDCR, for purchase of the 18.0 ha (44.5 ac) Harrison Tract (see Figure 3.8 for core and buffer delineation at the Taskinas Creek component of the Reserve. The tract is located at YRSP, which encompasses the Taskinas Creek component of the Reserve. The property was transferred from TPL to the Commonwealth of Virginia on February 28, 2003. The title of the property is vested with VaDCR and subject to NOAA grants requirements. This tract has recently been incorporated, as a buffer

region, into the Taskinas Creek component of the Reserve (see Appendix I.3 for the updated MOU between VIMS and VaDCR). This land tract was deemed critical to Park and Reserve operations from both a natural resource protection and security perspective. Plant communities or habitats within the Harrison Tract include temporarily flooded, palustrine deciduous forests along the ravine bottomlands and mesic hardwood forests along the ridges and slopes. A naturally maintained impoundment is also present on the property.

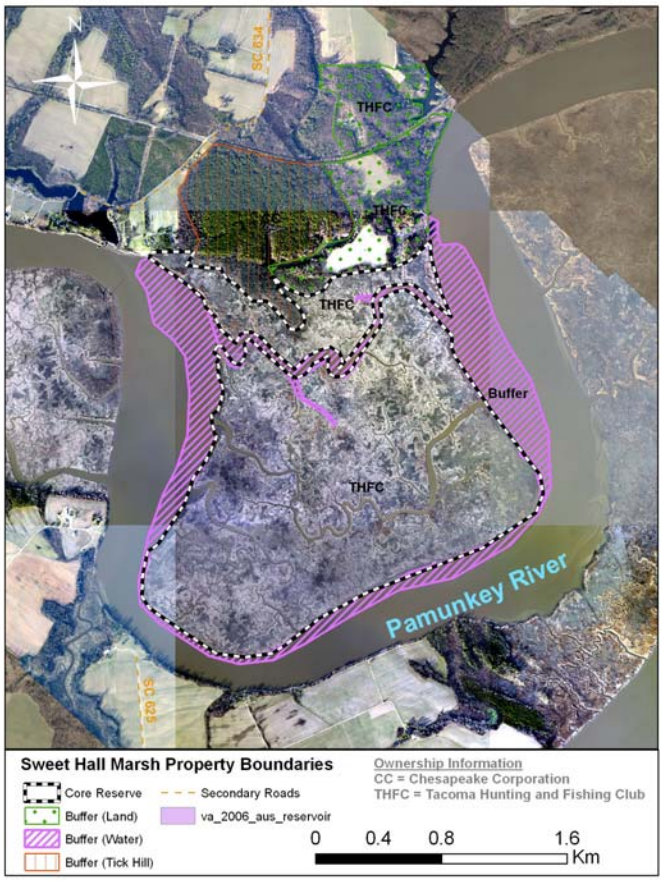

Figure 11.1. Aerial photo of Sweet Hall Marsh Reserve component delineating current core and buffer areas and Tick Hill tract.

Catlett Islands

NOAA Acquisition and Development Award NA16OR1293 was used to purchase a 20 ha (48 acre) tract of property on the Catlett Island component of the Reserve (Figure 3.9). The tract is located on the most southeastern portion of the Catlett Island complex (Tract ID: 65). Title to the property title was transferred from the Foodbank of the Virginia Peninsula, Inc., and the Boys and Girls Club of Greater Hampton Roads, Inc. to the VIMS/W&M on June 24, 2003. This land tract was deemed critical to Reserve operations from a land conservation perspective and will continue to support research and education activities. Primary ecological community groups occurring at this tract include tidal meso and polyhaline marshes, forested wetlands and maritime upland forests (see Section 3.3.3 for greater detail). Because the referenced property was already incorporated into the core region of the Catlett Island component through a previous Memorandum of Understanding, no boundary amendments are required and the property will be managed in accordance with this management plan.

Additional efforts at Catlett Islands involve the development of a more accurate landward Reserve boundary. The original language of the conservation easements between the Catlett and Burruss families and the Commonwealth of Virginia listed the boundary as “the wetland/upland border where the marsh meets the tree line on the landward side of the islands”. In July 2007, the Catlett Islands (minus the Ablowich tract) and the adjacent upland Timberneck Farm were sold to Timberneck LLC. Timberneck LLC. will be developing the property to accommodate low-density residential housing. As part of this upland conversion, Timberneck LLC. and CBNERRVA have been working in partnership to develop a more legally defined and surveyed boundary.

11.3.6 Near-Term Land Acquisition Priorities

To adequately protect and conserve the larger landscape ecosystem that impacts existing Reserve components and to more fully represent the diversity of coastal ecosystems found within the York River system, further land conservation efforts are required. There are a number of key areas where CBNERRVA will focus land acquisition efforts over the next several years.

Continue towards fee-simple ownership of the Catlett Islands

The Reserve has an interest to continue towards fee-simple ownership of the Catlett Islands component. Currently, ownership of the Catlett Islands is held by three separate entities, these include: (1) Timberneck LLC., (2) the north-west tract owned by the Ablowich Family and (3) the most south-east tract purchased by the Reserve through FY 2002 Acquisition and Development Award NA16OR1293. Aside from the Ablowich tract, all tracts are currently incorporated into the Reserve's core boundary; conservation easements are held on the Timberneck LLC. holdings. The continuing effort to secure the six remaining tracts on the Catlett Islands (ID numbers: #64, #87+#89, #90, #91 and the Ablowich tract; see Figure 3.9 for land tract identification number and ownership) through fee simple ownership is to strengthen the long-term protection, operation and management of this Reserve component in light of potential change in ownership(s) and desired uses. The desired tracts consist of maritime upland forests, tidal meso/polyhaline marshes and surrounding waters. These communities have stayed remarkably free of threats posed by exotic plant species. The Catlett Islands have been essential in allowing the Reserve to meet its mission from both a research and education perspective. Research conducted at the Catlett Islands has been instrumental in ecosystem-based restoration and management of the blue crab, quantifying edge-effects of wetland habitats and the enhanced utilization of fringing marshes by fin and shellfish. The acquisition of Catlett Island land tracts is consistent with the Land Acquisition Inventory Plan of the NERRS and the Reserve's 2008-2012 Management Plan and Natural Resource Management Plan for Catlett Islands (Eyrdle and Heffernan 2005b)

Stieffen Tract Adjacent to York River State Park

The Reserve, in partnership with VaDCR, has identified the Stieffen tract as a high priority land acquisition property. Given its natural resources, large tract size (163 ha; 402 ac) and location immediately adjacent to YRSP, the Stieffen tract would serve to enhance the core and buffer area for the Taskinas Creek component of the Reserve which resides within the park boundaries (Figure 11.2). The site exhibits a variety of coastal vegetative communities including emergent creek marshes, non-riverine forested wetlands, mesic hardwood forests, and headwater seeps and coastal plain seepage swamps. This tract would protect the long-term integrity of the core area of the Reserve and provide additional protection for key habitats and species. The threat for land use conversion from forested to residential development is high. The acquisition of the Stieffen Tract supports the Reserves mission and are consistent with the Land Acquisition Inventory Plan of the NERRS and the Reserve's 2008-2012 Management Plan and Natural Resource Management Plan for Taskinas Creek (Myers et al. 2008a)

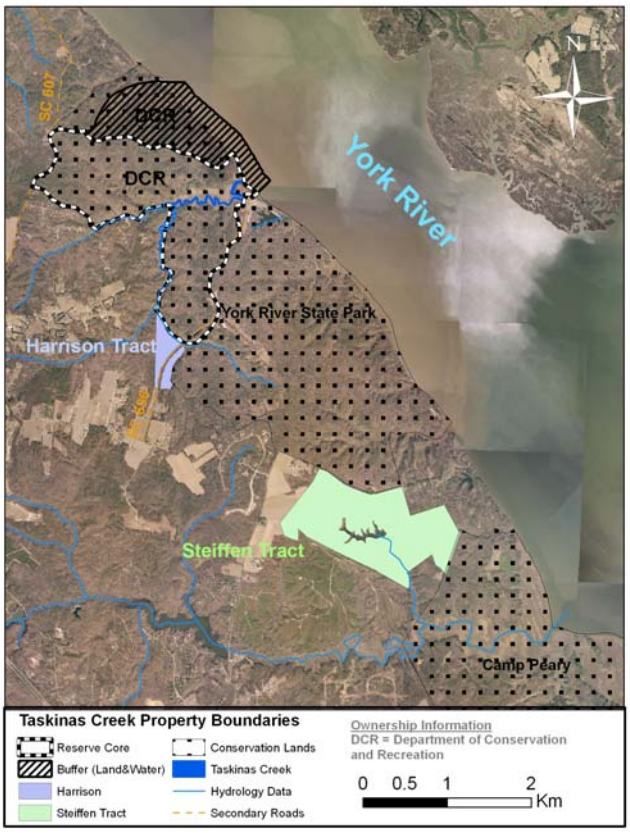

Figure 11.2. Boundary map of Taskinas Creek component, York River State Park, Harrison and Steiffen tracts.

Natural Resource Plan Recommendations for Lands Adjacent to Current Reserve Components

Habitat fragmentation, increased population growth and water quality degradation continues to threaten Reserve components and nearby lands. CBNERRVA has developed natural resource management plans for each of its Reserve components. A key element of these plans is the identification of potential

land acquisition and protection needs to adequately protect and conserve the larger landscape ecosystem of each Reserve component. This may be accomplished through fee-simple ownership, conservation and open-space easements, and/or management agreements.

At Sweet Hall Marsh, priority land acquisition and protection needs include the Tick Hill tract (76 ha, 189 acres; discussed in detail in section 11.3.3) and other adjacent undeveloped marsh/upland/agricultural tracts (Meyers et al 2008a). Due to the threat of increasing habitat fragmentation and the need to mitigate these impacts, undeveloped marsh/upland/agricultural tracts located adjacent to Sweet Hall Marsh are designated as high priority. With respect to the Taskinas Creek component of the Reserve, the Stieffen tract (163 ha, 402 acres; discussed in detail in section 11.3.4) located immediately adjacent to YRSP has been identified as a priority land acquisition property. Additional lands include tracts located within the upper creek watershed and in other nearby regions that influence water quality and provide critical habitats (Meyers at al. 2008b). For Catlett Islands, high priority areas include unprotected lands on Catlett Island proper and the primarily undeveloped marsh, upland and agricultural tracts located north, northeast, and east of Catlett Islands (Eyrdle and Heffernan 2005b). At Goodwin Islands, priority areas include the undeveloped marsh/upland tracts located south, southwest from Goodwin Islands (across the shallow channel), or north of Goodwin Islands, across the mouth of the York River (Eyrdle and Heffernan 2005a).

Incorporate a New Tidal Freshwater Component

Sweet Hall Marsh is located within the freshwater-oligohaline transitional zone of the Pamunkey River and was originally selected to represent the tidal freshwater marsh component of the Reserve. At that time, Sweet Hall Marsh represented the lower-most tidal freshwater marsh within the Pamunkey River. Due to concerns regarding salinity intrusion, as a result of periodic drought conditions and longer-term issues associated with climate change and sea level rise, CBNERRVA has identified acquisition of a “true” tidal freshwater area within either the Pamunkey or Mattaponi Rivers as a high priority. Currently, mean monthly salinities between the months of April through October are characteristic of oligohaline (0.5-5 ppt) salt regimes with mean monthly freshwater (<0.5 ppt) regimes being observed during periods of higher river discharge. Changes in vegetation patterns, believed to be a result of salt intrusion, have been documented at Sweet Hall Marsh (Perry and Hershner 1999).

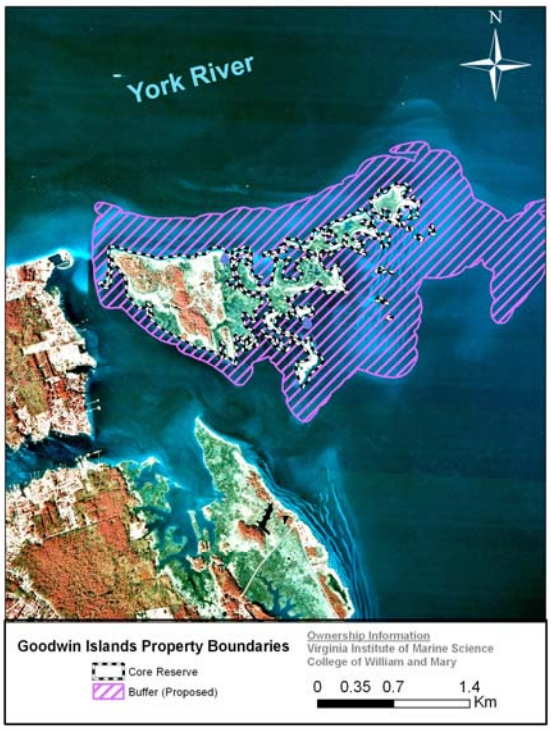

Figure 11.3. Proposed Goodwin Island subaqueous buffer area.

Incorporate Submerged Bottoms Buffers

The Reserves original Management Plan highlights proposed subtidal buffer areas adjacent to selected Reserve component core areas (CBNERRVA 1991). Significant subaqueous bottom buffers were proposed for both the Goodwin and Catlett Island components of the Reserve. The proposed buffer zone surrounds the Goodwin Islands and to the north, east and south extends seaward of the core’s mean low water mark to a depth of 2 meters and to the Thorofare channel to the west (Figure 11.3). This area encompasses extensive SAV, oyster reefs, mud and sand flats, and shallow open water. The proposed buffer zone surrounding Catlett Islands extends seaward of the core’s mean low water mark to a depth of 2 meters and encompassed submerged mud and sand bottoms (Figure 11.4). Within the Commonwealth of Virginia, subaqueous bottoms defined as lands below mean low water, are state owned are regulated by the VaMRC. Management of cited subaqueous bottoms by CBNERRVA would be desirable from research, monitoring and management perspectives.

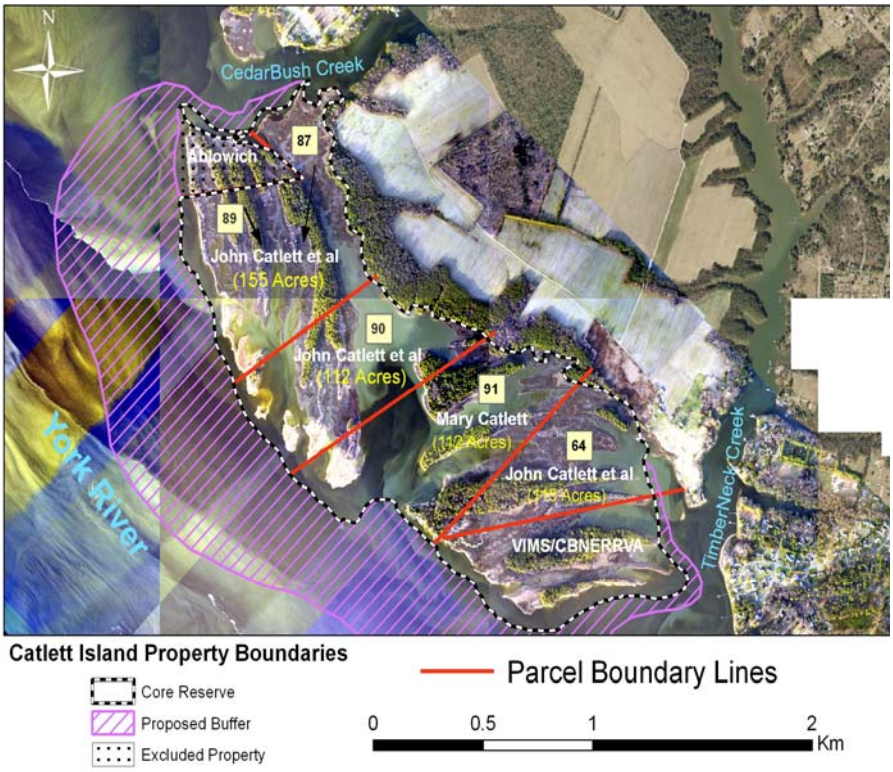

Figure 11.4. Proposed Catlett Island subaqueous buffer area.

XII. PUBLIC ACCESS MANAGEMENT

12.1 Introduction

CBNERRVA is responsible for the long-term management of its Reserve components in order to protect the ecological integrity of the natural system and provide a stable environment to support research, monitoring and education missions. In some cases, the Reserve component can be managed to meet this objective while still supporting some level of public use. Public access to the four Reserve components is managed on a site-specific basis. The objective of managed access is to maintain each site's integrity for research and education while permitting traditional uses which do not conflict with Reserve goals or agreements with private landowners and public lands managers. CBNERRVA and site property owners/managers reserve the right to impose additional restrictions to curtail any activity threatening to disturb natural conditions or ongoing research and education activities.

It should be noted that some specific public uses are not compatible, for example bird and wildlife watching is not compatible with concurrent waterfowl hunting. In such cases, The Reserve and property managers will strive to minimize conflicts through spatial and temporal separation strategies. If negative public access impacts are observed, the causative public use(s) will be determined and re-evaluated. When warranted, the assistance of local and state law enforcement agencies may be called upon to enforce access regulations. Prosecution of violators will serve as a deterrent against vandalism, littering, arson and other violations.

12.2 Water and Wildlife Trails

Virginia has developed a network of water and wildlife watching trails of which several Reserve components serve as sites. Goodwin Islands and YRSP, which includes the Reserve's Taskinas Creek component, are visitation sites on the Lower Peninsula loop of the coastal Virginia Birding and Wildlife Trail. The VaDGIF is the lead state agency responsible for administration of the Virginia Birding and Wildlife Trail and more information is available at the following website: http://www.dgif.state.va.us/vbwt. Sweet Hall Marsh and YRSP are visitation sites on the Mataponi, Pamunkey and York Rivers section of the Captain John Smith Chesapeake National Historic Trail. It should be noted that Sweet Hall Marsh is privately owned and permission for land and/or marsh access is required by the owners. VaDCR and the Mattaponi and Pamunkey River Association (MPRA) are the primary entities responsible for administration of the Mataponi, Pamunkey and York Rivers section of the Captain John Smith Chesapeake National Historic Trail and more information can be found at the following websites: http://www.baygateways.net/ and http://www.mpra.org/.

12.3 Public Access Rules and Schedules

12.3.1 Goodwin Islands

CBNERRVA maintains a limited-use public access policy for the Goodwin Islands component of the Reserve. In accordance with that policy, Goodwin Islands are managed exclusively for research and education while allowing for some traditional uses. Goodwin Islands are only accessible by shallow draft boats and there are no docking facilities or designated trails on Goodwin Islands. The following access rules apply to Goodwin Islands:

- Public access is limited from dawn to dusk and therefore overnight camping is prohibited;
- Building of any type of fire is prohibited;
- Collection of plants, animals, minerals, or artifacts is strictly prohibited;
- Visitors must obey posted signs that may be placed seasonally to protect sensitive species;

- Beach areas can be used for picnicking, beachcombing and other non-destructive activities if visitors do not willingly or negligently disturb the environment or scientific experiments/equipment;
- Bicycles, off-road vehicles, and horses are prohibited;
- Waterfowl hunting from floating blinds is allowed, however, a Reserve issued permit is required. No stationary blinds are allowed;
- Upland and wetland hunting activities are not permitted;
- Fishing, crabbing and collection of shellfish is allowed if in accordance with applicable state laws and regulations; and
- Dogs or other domestic animals accompanying visitors must be kept on a leash at all times.

12.3.2 Catlett Islands

With the exception of a single tract acquired by VIMS/W&M, the Catlett Islands component of the Reserve is privately owned. Visitation is controlled by the property owner(s) and general public access is not permitted. The Islands are posted against trespass. Hunting, trapping and oyster gathering are the exclusive rights of the property owners and their assigns. In waters around Catlett Islands, commercial and recreational harvest of fish and crabs is allowed if in accordance with applicable state laws and regulations.

12.3.3 Taskinas Creek

The Taskinas Creek component of the Reserve is within the boundaries of YRSP. Access is controlled by park regulations. The Park is open year-round from 8 am to dusk. The eastern portion of Taskinas Creek within park boundaries is used for passive recreation and nature study. This region contains the Park's Visitor Center and outdoor amphitheater, which are open seasonally (closed in the winter) to provide opportunities to learn about coastal environments and local history. Visitors are encouraged to use more than 40 km (25 mi) of self-guided hiking, biking and equestrian trails. YRSP and/or park concessionaire charges a nominal park entrance fee and rental fee for picnic shelters, canoes and other recreational items. Picnic tables are available throughout the park on a first-come, first-served basis. Playground equipment, horseshoe pits and volleyball courts are also available. Many of the facilities and trails are Americans with Disabilities Act (ADA) compliant.

Croaker Landing provides access to the York River and includes a newly constructed fishing pier, a parking area, a boat launch and dock, and restrooms; parking and launch fees are required at all times. Currently, no overnight facilities are available. Fishing and boating opportunities exist within an upland freshwater pond, Taskinas Creek and the York River proper. Boat (pond only) and canoe rentals are available seasonally. Deer hunting is only allowed in season (November/December) during special controlled hunts. During the hunts, the Park is closed to all other visitors. Access to the western portion of the Reserve is generally not encouraged; however, currently there is a hiking/access trail in this area that is open for hiking/wildlife watching.

The effort to increase visitation and visitor participation through various recreational activities and opportunities within the Park has the potential to negatively impact park resources. Potential inappropriate public uses include illegal artifact collection, unauthorized hunting, and non-permitted collection of animals, plants and minerals. The Park attempts to anticipate and monitor impacts and develop procedures for mitigating and correcting the impacts, or redirecting usage. Results of impact monitoring are incorporated into the Park Operations Plan and at times may result in periodic changes to public access policy for specific portions of YRSP.

12.3.4 Sweet Hall Marsh

The Sweet Hall Marsh component of the Reserve is privately owned. Visitation is controlled by the property owner(s) and general public access is not permitted. Hunting and trapping are the exclusive rights of the property owners and their assigns. In waters around Sweet Hall Marsh, commercial and

recreational harvest of fish and crabs is allowed if in accordance with applicable state laws and regulations.

XIII. Facilities, Site Infrastructure and Equipment Support Plan

13.1 Introduction

Adequate facilities, vessels, vehicles and support equipment are necessary in order to implement Reserve research, monitoring, education and stewardship programs. Acknowledging that facilities serve as a physical expression of reserve values and priorities, facility siting, design and construction will be guided by basic principles that exhibit responsible ecosystem management. To the greatest extent possible, CBNERRVA will be guided by the following principles:

- Facilities will be designed and located to support multiple Reserve goals;
- Facilities design will be compatible, as possible, with the character of the local community and surrounding structures;
- Facilities planning will strive for energy efficiency and anticipate technological advances;
- Facilities will comply with the requirements of the Americans with Disabilities Act (ADA);
- Facility siting factors will include consideration of impacts associated with increased site use, including parking and pedestrian access routes, stormwater runoff, and wastewater disposal;
- Construction techniques shall be adapted for minimal environmental impacts; and
- Native plant species will be utilized in landscape and new plantings.

13.2 Relevant CBNERRVA Goal, Objective and Strategies

CBNERRVA strives to maintain and improve its facilities, supporting infrastructure and equipment in order to achieve program goals. As funds become available, the Reserve will implement relevant strategies highlighted below (see italicized text for links to national program and lead Reserve programs).

Goal 5. Provide administrative leadership and resources necessary to fulfill the Reserve's mission *(NERRS Strategic Plan Goals #1, #2 and #3; Lead Program: Administration, Supporting Programs: All)*

Objective 4. Provide facilities, equipment and other infrastructure support that allow for attainment of program goals and objectives. *(NERRS Strategic Plan Goal #2, Objective 1; Goal #3, Objectives 1 and 2)*

Strategies:

- Maintain Reserve facilities, equipment and other infrastructure support to assure a safe and professional work environment. (All Programs)
- Identify and secure funding for additional Reserve facilities, equipment and other infrastructure support needs (see Section 13.4 for project descriptions). (Administration)

13.3 Existing Facilities, Infrastructure and Equipment Support

13.3.1 Virginia Institute of Marine Science

VIMS includes facilities and resources of a fully functional marine research and graduate education institute. Primary Institute facilities support administration, core science disciplines, a graduate education program, advisory services, and various Institute support centers. In addition, VIMS supports several research centers located at the Gloucester Point campus including the ABC, the CCRM, CBNERRVA and Virginia Sea Grant. Additional research centers and laboratories include the Kauffman Aquaculture Center in Topping, VA and the ESL in Wachapreague, VA. Through the Vessels Center, the Institute operates and maintains a fleet of 30 plus research vessels. Included in the Vessels Center are the fabrication and instrumentation facility and the dive locker. The Institute's library is one of the nations finest resources for estuarine, coastal and ocean information. The library has an industrial-strength search engine, BRS/Search, which enables users to index vast amounts of textual information and make it searchable on the web. Library holdings include over 500 periodical subscriptions, 22,000 monograph titles, 50,000 bound volumes (books and periodicals), complete Institute theses, dissertations and reports, and almost 5000 maps and charts.

13.3.2 Chesapeake Bay National Estuarine Research Reserve in Virginia

Existing primary facilities of CBNERRVA include an administrative office facility, a research and education laboratory, partial use of a modular facility, and two equipment storage structures. All existing facilities are located on the VIMS Gloucester Point campus. Existing facilities comply with the requirements of the ADA.

CBNERRVA Administration

Administrative offices of CBNERRVA are housed in the CBNERRVA Headquarters (total office area: ≅1660 ft^2). The facility was occupied in late 2002 by the Reserve program. The facility currently contains office space for twelve persons that include most core administrative, research, education, stewardship and supporting staff. The facility also contains a classroom (area: 540 ft^2) and conference room (area: 440 ft^2) with occupancy rates of 30 and 12 persons, respectively. Funds for the purchase and modification of the original facility were provided by NOAA.

Figure 13.1. The Catlett-Burruss Research and Education Laboratory dedicated in 2005. Photo Credit: William Reay.

CBNERRVA Research

CBNERRVA 's principal research and monitoring laboratories are located in the Catlett-Burruss Research and Education Laboratory (Figure 13.1). This 5480 square foot facility is located immediately adjacent to the reserve's headquarters. Currently there exist four research laboratories (total area: 1405 ft^2) and two storage areas (total area: 908 ft^2) within this facility. These laboratories support the water quality monitoring programs and specific research projects conducted by Reserve faculty and staff. The facility was completed in spring 2005 with funds provided by NOAA. Supporting research laboratory and storage space is also available in a modular facility. The modular facility, which has a life expectancy of ten years, was purchased in 1995 with funds provided by NOAA. Support facilities for the Catlett-Burruss

Research and Education Laboratory include two equipment storage structures (total area: 360 ft^2) located adjacent to Reserve headquarters and the modular facility.

CBNERRVA Education

The Reserve's principal education facilities include a 30-person classroom (570 ft^2) and an education laboratory (area: 1105 ft^2). The classroom is located in Reserve Headquarters and is used for general education programs, public forums and seminars, and workshops for educators and environmental professionals. The education laboratory, which can support up to thirty students/participants, is located within the Catlett-Burruss Research and Education Laboratory.

CBNERRVA Vessels and Vehicles

Given the extensive research, monitoring and field-oriented education programs conducted by CBNERRVA, dedicated vessel and vehicle support is a critical element to assure Reserve success. Currently, the Reserve utilizes three vessels in support of research, monitoring and education activities. These are the R/V Skimmer (2003 C-Hawk 22 ft Sport Cabin; Figure 13.2), R/V Moray (2004 C-Hawk 25 ft Sport Cabin) and R/V Bittern (2006 Maritime 20 ft Center Console). In addition, the Reserve's education program makes use of a canoe rig (trailer and eight canoes) to support general education and public outreach activities. CBNERRVA also operates and maintains three trucks; these are a 2002 GMC 1500 series truck and two 2005 Chevrolet 2500 series trucks. In addition to this equipment, the Reserve does have access to additional vessels and vehicles for a fee through the VIMS's vehicles operations.

Figure 13.2. R/V Skimmer. Photo Credit: William Reay.

13.4 Future Facility, Site Infrastructure and Equipment Support Needs

In order to address the goal of the CBNERRVA Facilities, Site Infrastructure and Equipment Support Plan, efforts will focus on the identified tasks listed below. Proposed facilities improvements, new construction, vessel, vehicle and equipment procurements are not presented in a prioritized order in order to take advantage of opportunities as they become available. All proposed actions are subject to funding and staff needs. It is also recognized that a high priority is placed upon maintaining current facilities, vessels, and vehicles in good order to assure CBNERRVA's ability to accomplish its goals.

Additional Reserve Office and Laboratory Space

The recently completed CBNERRVA Headquarters, which provides office space for Reserve staff is at full capacity. Functional space to support additional office space for Reserve staff, the archive/library, and GIS center, which was expected to be available in the new headquarters, is still needed. The Catlett-Burruss Research and Education Laboratory only provides the necessary facilities and equipment to support Phase I of the Reserve's SWMP, and the research programs of the Reserve's associated faculty. CBNERRVA foresees the need for additional laboratory space to support a visiting scientist program and

increasing activities associated with an enhancement of the SWMP and other system and Reserve-wide needs.

Education and Interpretive Facility Improvements at VIMS and York River State Park

Recommendations outlined in the VIMS Master Plan and newly developed YRSP Long-term Development Plan includes facility improvements in order to facilitate educational and interpretive uses at the VIMS Gloucester Point campus and YRSP. Currently, VIMS and CBNERRVA facilities can accommodate two group sizes, these are: (1) up to 30 persons and (2) from 200-250 persons. The Reserve frequently has a need to have education and training facility access for up to 100 persons. With respect to the YRSP Visitors Center, plans call for the movement of office facilities from the current visitors center to a new facility and for the construction of a new facility or renovation of the current visitors center to develop an education and interpretive center. Renovation of existing structures or new construction for education and interpretive facilities is proposed when state, federal or private funding becomes available.

Exhibits that are well designed and contain current information about estuaries and watersheds are essential to increasing public awareness about the importance of coastal resources and the impact of human activities on these resources. CBNERRVA does not have a facility that will permit the public display of the many programs offered in support of coastal resource management and ocean literacy. Because CBNERRVA does not plan to emphasize general public casual visitation at it's Headquarters, an interpretive exhibit area in the proposed VIMS Visitation Center and the YRSP Visitors Center will provide for much of this visitation. Reserve staff plan to design and develop educational material and exhibits as state, federal or private funds become available.

Maintain and/or Purchase Support Vessels, Vehicles and Equipment

Acquisition of a certified education vessel is mandatory in order for the Reserve's General Education and Outreach Program to better engage more students, teachers, volunteers and the general public. In addition, this vessel could support the expanded research and monitoring responsibilities of the Reserve within the Chesapeake Bay region. As with vessels, field support vehicles are essential to support extensive research and monitoring and field-oriented education programs conducted by the Reserve. In order to meet Reserve vehicle needs, routine maintenance will be conducted on current vehicles and new vehicles will be acquired as needed. Due to CBNERRVA's extensive research program and its leading role with respect to local and regional monitoring programs and observing systems, there exists a need to expand the Reserve's current research and monitoring laboratory capabilities. The Reserve will seek to enhance its capabilities through the procurement of identified analytical and communication equipment as state, federal or private funds become available.

Trails, Boardwalks, Observation Platforms and Boat Access

In order to protect the ecological integrity of the Goodwin and Catlett Islands and Sweet Hall Marsh, no significant improvements for public access are recommended. Improvements to the boat launch area at Sweet Hall Marsh would provide a staging area for research, monitoring and managed education activities. CBNERRVA will continue construct and improve stationary waterfowl hunting blinds as required to implement the Reserve's waterfowl hunting management program at Goodwin and Catlett Islands. On a limited basis, observation platforms may be constructed on Goodwin and Catlett Islands to support the low impact wildlife watching initiatives. Improvements are primarily needed to prevent damage to the wetlands at these sites. Because of significant public visitation at Taskinas Creek, whose boundaries are within YRSP, improvements to trails, canoe support facilities, and other various platforms to support the park's new development plan and the Commonwealth's Birding and Water Trail initiative are encouraged.

XIV. Special Programs

14.1 Introduction

CBNERRVA has been identified as a key partner in a number of federal and state initiatives, these include: (1) the Virginia Estuarine and Coastal Research Reserve System (VECRRS) and (2) the International Sister Research Reserve Program initiated by NOAA. While these programs are outside the primary mission of the Reserve, they do provide additional opportunities to support Reserve related goals with respect to research and monitoring, education and stewardship of coastal resources. Funds to directly support these programs have been limited and the Reserve, to the extent possible, strives to achieve the outlined goals and objectives as funding sources and opportunities present themselves.

14.2 Virginia Estuarine and Coastal Research Reserve System

14.2.1 Overview

The VECRRS was created in 1999 by the General Assembly of Virginia (Code of Virginia 28.2-1103 and 28.1-1104; see Appendix VI.1). The mission of VECRRS is to establish a system of protected sites representative of the Virginia's estuarine and coastal lands in which research and long-term monitoring can be conducted in support of the Commonwealth's coastal resource management efforts. VIMS is responsible for administration of the VECRRS, and to the extent possible, VECCRS initiatives should be coordinated with CBNERRVA.

14.2.2 Current Focus Areas

With respect to the VECRRS, current efforts initiated and coordinated by CBNERRVA include specific sites within the Dragon Run watershed and the tidal freshwater region of the James River.

<u>Dragon Run Watershed</u>

The Dragon Run, headwaters to the Piankatank River, is one of the Chesapeake Bay's most pristine waterways. The Dragon Run watershed remains largely undeveloped and

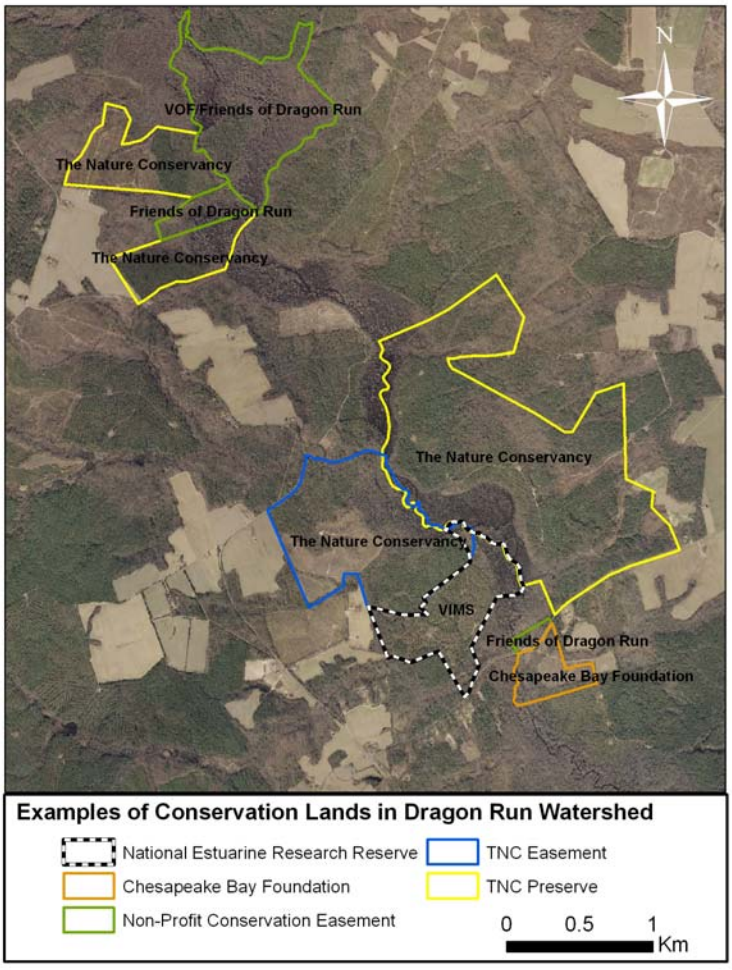

Figure 14.1. Arial view of the VIMS Dragon Run tract in support of the VECRRS.

represents one of Virginia's most extensive and relatively unimpacted swamp forest communities. The Dragon Run contains the northernmost example of Baldcypress-Tupelo Swamp community in Virginia and four other natural vegetation communities (i.e., Fluvial terrace woodland, Tidal Baldcypress-Tupelo Swamp, Tidal Baldcypress-Woodland/Savanna, and Tidal freshwater marsh) and up to fifteen state rare species. The majority of these vegetation communities are currently not represented within the four York River NERR components.

CBNERRVA has been an active participate in the Dragon Run Watershed Special Area Management Plan (SAMP), a partnership between VaCZMP and the Dragon Run Steering Committee of the MPPDC. The Dragon Run Watershed SAMP's mission is to support and promote community-based efforts to preserve the cultural, historic, and natural character of the Dragon Run, while preserving property rights and the traditional uses within the watershed. A watershed management plan for the Dragon Run has been developed and serves as a guide to achieve the mission of the Dragon Run SAMP (MPPDC 2003). Utilizing, in part, CZMA 306A funds provided by the VaCZMP, VIMS purchased a 50 ha (121 ac) tract on the Dragon Run to support the VECRRS (Figure 14 .1). Research and education programs, coordinated through CBNEERVA, have been developed and implemented at this site. In the near future, this site will be officially designated as a component of the VECRRS.

Rice Land Tract on the Tidal James River

The James River represents one of the country's most ecologically and culturally significant rivers. The Rice land tract, 139 ha (343 ac) of land and a 28 ha (70 ac) lake on the north bank of the James River, is owned and managed by Virginia Commonwealth University (VCU). The University is developing the Inger and Walter Rice Center for Environmental Life Sciences at this site. The Center will serve as a pre-eminent, nationally recognized academic program focused on enhancing research, education and public policy related to large river ecosystems and their riparian landscapes. Based at the Inger and Walter Rice Center for Environmental Life Sciences, the proposed Virginia Rivers Initiative will establish a leading academic institution for research and scholarship in the ecology, conservation, restoration and public policy of large river systems. CBNERRVA has been coordinating efforts between VCU and the VIMS to incorporate the Rice Land tract as a component of the VECRRS. An active environmental monitoring program following a NERRS SWMP approach has been implemented at this site.

14.3 Tianjin Palaeocoastal and Wetland National Nature Reserve

14.3.1 Overview

The Chesapeake Bay Virginia and Maryland NERRs have developed a formal relationship with the Tianjin Palaeocoastal and Wetland National Nature Reserve (TPWNNR) in the People's Republic of China (PCR) as part of a US-PRC cooperative agreement (US-China Marine and Fishery Science and Technology Agreement Protocol for Cooperation 1979). The TPWNNR was founded and ratified in October 1992 and is one of seven national nature reserves in China administered by the State Oceanic Administration. The Reserve is located on Bohai Bay and incorporates 10,750 ha (26,560 ac) within its core areas and buffer zones. Significant natural resources of the Reserve include cheniers, relic oyster reefs, and expansive wetlands. Four parallel cheniers, or shelled dykes which trace the ancient (600-4700 years ago) coastline, are amongst the largest in the world. The relic oyster reefs, which formed between 2000 and 7000 years ago, can be up to five meters deep and contain fossilized remains of *Crassostrea gigas* and *C. revularis*. The Qilihai wetland area is classified as a relict lagoonal wetland in the lake-marsh ecosystem. The wetland is a valuable habitat and includes twelve plant communities (66 species) and a large number and variety of animal species.

14.3.2 Cooperation Agreements

A General Cooperation of Intention between the CBNERRVA and TPWNNR was signed in November 2001. Cooperation included but was not limited to: (1) exchange of data, documentation, and research materials in fields of mutual interest, (2) exchange of scholars, researchers, administrators, and students, and (3) coordination of such activities as joint research, lectures, seminars, workshops and symposia.

The general cooperation agreement between CBNERRVA and TPWNNR was updated in 2005 (Appendix VI.2).

14.4 Relevant CBNERRVA Goals, Objectives and Strategies

CBNERRVA strives to achieve its Special Programs responsibilities by implementing a variety of strategies as funding and staff capabilities become available (see italicized text for links to national program and lead Reserve programs).

Goal 1. Increase recognition of CBNERRVA as a regional leader in applying science and education to support coastal resource management and literacy. *(NERRS Strategic Plan Goals 1,2 and 3; Lead Program: All)*

Objective 3. Increase awareness, use and support of CBNERRVA special partnership programs (i.e., VECRRS and TPWNR). *(NERRS Strategic Plan Goal 1, Objectives 1,2 and 3; Goal 2, Objectives 1 and 2; Goal 3, Objectives 1,2 and 3)*

Strategies:

- Obtain state funds to provide for staff and other resource support to accomplish the full range of activities associated with the VECRRS.
- Incorporate currently identified representative examples of estuarine, coastal and critical lands into VECRRS.
- As external funds allow, prepare a VECRRS land acquisition plan and acquire estuarine, coastal and critical lands that support the mission of the VECRRS.
- As external funds allow, develop VECRRS component specific reserve land stewardship and management plans.
- As external funds allow, promote and/or support research, monitoring and site characterization activities within VECRRS components.
- As external funds allow, promote and support research, environmental monitoring and education activities within VECRRS components.
- Enhance, through the exchange of information and staff expertise, research, environmental monitoring, and resource management capabilities of the TPWNNR and CBNERRVA.
- Update the General Cooperation of Intention between CBNERRVA and TPWNNR as necessary.