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Chesapeake Bay National Estuarine Research Reserve in Virginia Management Plan: 2022-2027

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Chesapeake Bay National Estuarine Research Reserve – Virginia 2022 - 2027 Management Plan



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

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This management plan was 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 Zone Management Program.

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TABLE OF CONTENTS

ACRONYMS & ABBREVIATIONS	vi
LIST OF FIGURES	ix
LIST OF TABLES	xi
EXECUTIVE SUMMARY	1
CHAPTER I. INTRODUCTION TO THE RESERVE SYSTEM	
1.1 The Value of Estuaries	3
1.2 Introduction to the National Estuarine Research Reserve System	4
1.3 Foundation Program Elements	4
1.4 Strategic Planning	5
CHAPTER II. CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE IN VIRGINIA	
2.1 Establishment & Local Management	7
2.2 Environmental & Ecological Attributes of the York River System	8
2.2.1 Climate & Weather	8
2.2.2 Geomorphology	9
2.2.3 Hydrology & Physical Oceanography	9
2.2.4 Water Quality	11
2.2.5 Land Cover & Use	12
2.2.6 Key Biological Components	13
2.3 Cultural History & Social Attributes	15
2.3.1 Cultural History	15
2.3.2 Population Demographics and Socioeconomics	16
2.4 Continuing & Emerging Challenges	19
2.4.1 Natural & Anthropogenic Threats	19
2.4.2 Selected Management Needs	21
2.5 Reserve Component Descriptions	22
2.5.1 Goodwin Islands	22
2.5.2 Catlett Islands	24
2.5.3 Taskinas Creek	26
2.5.4 Sweet Hall Marsh	28
CHAPTER III. RESERVE STRATEGIC ROADMAP	
3.1 Reserve Vision & Mission Statements	31
3.2 Pillars of Operation	31
3.2 Priority Coastal Management Issues	32
3.3 Reserve Action Plan	32
CHAPTER IV. ADMINISTRATION & OPERATIONS	
4.1 Organization Framework & Management Authorities	38

4.1.1 Organization Framework & Management Authorities	38
4.1.2 Key Land Holding Partners	39
4.1.3 Selected State & Federal Partnerships	39
4.1.4 Reserve Advisory Boards	40
4.2 Federal Consistency & Environmental Compliance	40
4.2.1 Federal Consistency	40
4.2.2 Environmental Compliance	40
4.3 Program Goals	41
4.4 Current Staffing, Volunteers & Needs	41
4.4.1 Current Staffing & Responsibilities	41
4.4.2 Fellowships & Intern Programs	45
4.4.3 Volunteers	46
4.4.4 Staffing Needs	46
4.5 Site Security, Enforcement, Fire & Rescue	47
4.5.1 Site Security & Boundary Maintenance	47
4.5.2 Law Enforcement	47
4.5.3 Natural Resource Regulation Enforcement & Response	48
4.5.4 Fire & Rescue	49
4.6 Emergency Response	49
4.6.1 Hazardous Material Spills	50
4.6.2 Severe Weather	50
4.6.3 Threats to Public Health	50
4.7 Archaeological, Historical & Cultural Resources	51

CHAPTER V. RESEARCH & MONITORING

5.1 Introduction	52
5.2 Program Context	52
5.2.1 Geographic Scope	52
5.2.2 Priority York River Issues	52
5.2.3 Program Alignment	54
5.2.4 Program Goals	54
5.3 Program Capacity	55
5.3.1 Staff	55
5.3.2 Fellowship & Intern Programs	55
5.3.3 CBNERR-VA Environmental Data Cente	55
5.3.4 Facilities, Infrastructure & Equipment	55
5.4 Program Delivery	56
5.4.1 NERRS System-wide Monitoring Program	56
5.4.2 Southern Chesapeake Bay Shallow Water Quality Monitoring Program	58
5.4.3 Chesapeake Bay Interpretive Buoy System	58
5.4.4 Virginia Estuarine & Coastal Observing System	59
5.4.5 Chesapeake Monitoring Cooperative	59
5.4.6 Tidal Water Quality Monitoring & Modeling Initiative	59
5.4.7 Coastal Habitat Sentinel Site Initiative	59
5.4.8 Examples of CBNERR-VA Supported Research Projects	60
5.4.9 York River Synthesis & Other Supporting Information Products	60
5.4.10 Advisory Service & Technical Assistance	61

5.5 Needs & Opportunities	61
5.6 Research Policies & Permits	63

CHAPTER VI. EDUCATION & OUTREACH

6.1 Introduction	64
6.2 Program Context	65
6.2.1 Setting & Context	65
6.2.2 Priority Issues	66
6.2.3 Priority Audiences	66
6.2.4 Program Alignment	66
6.2.5 Program Goals	67
6.3 Program Capacity	67
6.3.1 Staff	67
6.3.2 Education & Outreach Advisory Board	67
6.3.3 Fellowship & Intern Programs	67
6.3.4 Partnerships	67
6.3.5 Volunteers	69
6.3.6 Facilities, Infrastructure & Equipment	69
6.4 Program Delivery	69
6.4.1 K-12 Programs	69
6.4.2 College & University Programs	71
6.4.3 Professional Teacher & Informal Educator Development Programs	71
6.4.4 Public Outreach Programs	72
6.4.5 Advisory Service & Technical Assistance	72
6.5 Needs & Opportunities	73
6.6 Monitoring & Evaluation	73

CHAPTER VII. COASTAL TRAINING

7.1 Introduction	74
7.2 Program Context	74
7.2.1 Setting & Context	74
7.2.2 Socioeconomic Context and Geographic Scope	75
7.2.3 Priority Issues & Training Needs	75
7.2.4 Priority Audiences	78
7.3 Program Delivery	78
7.3.1 CTP’s Three Pillars of Program Delivery	78
7.3.2 Professional Development Opportunities & Formats	79
7.3.3 Advisory Service & Technical Assistance	80
7.3.4 Community Engagement	81
7.3.5 Principles of Program Delivery	81
7.3.6 Marketing Strategy	82
7.3.7 Program Alignment	82
7.4 CTP Plan Related Goals, Objectives & Actions	83
7.4.1 CBNERR-VA Program Goals	83
7.4.2 CTP Sector Specific Goals	83
7.5 Program Capacity	85
7.5.1 Staff	85

7.5.2 Coastal Training Program Advisory Board	86
7.5.3 Fellowship & Intern Programs	86
7.5.4 Partnerships	86
7.5.5 Facilities, Infrastructure & Equipment	88
7.6 Needs & Opportunities	89
7.6.1 Digital Delivery Formats	89
7.6.2 New Partnership Opportunities	89
7.7 Monitoring & Evaluation Strategies	89
CHAPTER VIII. RESOURCE MANAGEMENT & STEWARDSHIP	
8.1 Introduction	91
8.2 Management Framework	91
8.3 Approach	92
8.4 Program Delivery	92
8.4.1 Natural Resources Management Plans	92
8.4.2 Restoration Science, Plan Development & Implementation	94
8.4.3 Resource Inventory & Mapping	95
8.4.4 Species & Habitat Management	96
8.4.5 Site Security & Infrastructure Maintenance	96
8.4.6 Public Access & Volunteer Opportunities	97
8.4.7 Advisory Service & Technical Assistance	97
CHAPTER IX. PUBLIC ACCESS & VISITOR USE	
9.1 Introduction & General Policies	98
9.2 Current Public Access Rules & Guidelines	98
9.2.1 Goodwin Islands	98
9.2.2 Catlett Islands	99
9.2.3 Taskinas Creek	100
9.2.4 Sweet Hall Marsh	101
9.3 Opportunities to Increase Public Access & Visitor Experience	101
9.3.1 York River Water & Wildlife Trails	101
9.3.2 Machicomoco State Park	101
9.3.3 Middle Peninsula Public Access Authority	101
9.3.4 Other Public Support Opportunities	102
CHAPTER X. LAND ACQUISITION	
10.1 Introduction	103
10.2 Federal Boundary & Land Acquisition Plan Guidelines	103
10.2.1 Authority & Purpose	103
10.2.2 Core and Buffer Area Designation	103
10.3 Previously Protected Priority Land & Water Resources	104
10.4 Priority Acquisition Areas	105
10.4.1 Project Evaluation Criteria	105
10.4.2 Acquisition Strategies	105
10.4.3 Conservation Partners & Funding Sources	106
10.4.4 Priority Acquisition Targets	106

CHAPTER XI. FACILITIES, INFRASTRUCTURE & EQUIPMENT	
11.1 Introduction	110
11.1.1 Goals & Guiding Principles	110
11.2 Existing Facilities	111
11.2.1 Buildings & Related Infrastructure	111
11.2.2 Field Based Infrastructure	112
11.2.3 Exhibits	113
11.3 Projected Needs & Improvements	114
11.3.1 Buildings & Related Infrastructure	114
11.3.2 Exhibits & Interpretive Trails	114
11.4 Vehicles, Vessels & Equipment	115
11.4.1 Vehicles	116
11.4.2 Vessels	116
11.4.3 SWMP Related Equipment	117
11.4.4 Survey & Water Level Related Equipment	117
REFERENCES	118
APPENDICES	128
Appendix A. MOU between NOAA and VIMS for the management of CBNERR-VA.	129
Appendix B. Federal consistency determination.	134
Appendix C. National Environmental Policy Act (NEPA) determination.	137
Appendix D. MOU between VDCR and VIMS for management of the Catlett Islands component of CBNERR-VA and Machicomoco State Park.	147
Appendix E. MOU between VDCR and VIMS for management of the Taskinas Creek component of CBNERR-VA and York River State Park.	150
Appendix F. MOU between the Tacoma Hunting and Fishing Club and VIMS for the management of the Sweet Hall Marsh component of CBNERR-VA.	155
Appendix G. Coastal Training Program topic area crosswalk.	168
Appendix H. Federal and State laws applicable to natural resource management and protection.	171
Appendix I. Reserve natural area management guidelines.	174
Appendix J. Public comments received during Federal Register public comment period.	181

ACRONYMS & ABBREVIATIONS

Document-Wide (presented once and used through-out document)

CBNERR-VA	Chesapeake Bay National Estuarine Research Reserve in Virginia
CZMA	Coastal Zone Management Act
NERRS	National Estuarine Research Reserve System
NOAA	National Oceanic & Atmospheric Administration
VIMS	Virginia Institute of Marine Science
W&M	The College of William & Mary
U.S.	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USF&WS	United States Fish & Wildlife Service
YRE	York River Estuary
YR&SCB	York River & Small Coastal Basin

Chapter-Specific (presented within each chapter as needed)

ACS	American Community Survey
ADA	Americans with Disabilities Act
ADCP	Acoustic Doppler Current Profiles
B.P.	Before Present
BWET	Bay Watershed Education & Training
C	Carbon
CBIBS	Chesapeake Bay Interpretive Buoy System
CBP	Chesapeake Bay Program
CBSSC	Chesapeake Bay Sentinel Site Cooperative
C-CAP	Coastal Change Analysis Program
CCRM	Center for Coastal Resource Management
CCVATCH	Climate Change Vulnerability Assessment Tool for Coastal Habitats
CCVI	Climate Change Vulnerability Index (NatureServe)
CDM	Coastal Decision-Maker
CDMO	Central Data Management Office
CFR	Code of Federal Regulations
Chla	Chlorophyll a
CMON	Continuous Monitoring
COVID-19	Coronavirus Disease 2019
CTP	Coastal Training Program
Davidson	Margaret A. Davidson
DEIJ	Diversity, Equity, Inclusion & Justice
EIS	Environmental Impact Statement
ERP	Elizabeth River Project
ESL	Eastern Shore Laboratory
FGDC	Federal Geographic Data Committee

GHG	Greenhouse Gases
GIS	Geographical Information Systems
HAB	Harmful Algal Bloom
HADS	Hydrometeorological Automated Data System
IOOS	Integrated Ocean Observing System
ITNS	Information, Technology & Network Services
KEEP	K-12 Estuarine Education Program
K-12	Kindergarten-12 Grade
M	Million
MAMEA	Mid-Atlantic Marine Educators Association
MARACOOS	Mid-Atlantic Regional Association Coastal Ocean Observing System
MARS	Marsh Resilience to Sea Level Rise
MEM	Marsh Equilibrium Model
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MP-PAA	Middle Peninsula Public Access Authority
MP-PDC	Middle Peninsula Planning District Commission
MWEE	Meaningful Watershed Educational Experience
N	Nitrogen
NASA	National Aeronautics and Space Administration
NAWCA	North American Wetland Conservation Act
NCBO	NOAA Chesapeake Bay Office
NEPA	National Environmental Policy Act
NERRA	National Estuarine Research Reserve Association
NGS	National Geodetic Survey
NMEA	National Marine Educators Association
NNB	Natural and Nature-Based
NNOCCI	National Network for Ocean and Climate Change Interpretation
NOS	National Ocean Service
NRCS	Natural Resources Conservation Service
NSC	NERRS Science Collaborative
NWS	National Weather Service
O	Oxygen
OA	Ocean Acidification
OCM	National Oceanic and Atmospheric Administration Office for Coastal Management
P	Phosphorus
PAC	Procurement, Acquisition, and Construction
PAR	Photosynthetically Active Radiation
S	Sulfur
SAV	Submerged Aquatic Vegetation
SET-MH	Sediment Elevation Table-Marker Horizon
SLAMM	Sea Level Rise Affecting Marshes Model
SLR	Sea Level Rise
SSP	Sentinel Site Program
STEM	Science, Technology, Engineering & Mathematics
SWMP	System-Wide Monitoring Program
TMDL	Total Maximum Daily Load
TOTE	Teachers on the Estuary

TPL	Trust for Public Lands
UMCES	University of Maryland Center for Environmental Science
USGS	United States Geological Survey
VASEA	Virginia Scientists and Educators Alliance
VCPC	Virginia Coastal Policy Center
VCZMP	Virginia Coastal Zone Management Program
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDHR	Virginia Department of Historic Resources
VDOE	Virginia Department of Education
VDWR	Virginia Department of Wildlife Resources
VECOS	Virginia Estuarine & Coastal Observing System
VMRC	Virginia Marine Resources Commission
VRUEC	Virginia Resource-Use Education Council
VSG	Virginia Sea Grant
WIP	Watershed Implementation Plan
YRSP	York River State Park

LIST OF FIGURES

- 1.1 May 10, 2020 Moderate Resolution Imaging Spectroradiometer (MODIS) satellite image of Chesapeake Bay with VIMS/CBNERR-VA Headquarters (●) and Reserve components (●) highlighted.
- 1.2 National Estuarine Research Reserve System network map.
- 2.1 Reserve component locations along the York River system.
- 2.2 York River water quality health scores for 2021.
- 2.3 York River watershed landcover. Data source: 2013-2014, 1 m resolution Chesapeake Conservancy 12 Category Land Cover Data.
- 2.4 A depiction of CBNERR-VA's three target geographies: the CBNERR-VA Focal Area (counties pertaining to the York River watershed and its adjacent basins); Rural Coastal Counties (those a part of the Rural Coastal Virginia Community Enhancement Authority); and Virginia's Coastal Zone Counties (as defined by the Code of Virginia § 28.2-100).
- 2.5 Historic, current and projected population estimates in the Chesapeake Bay Watershed, Virginia Coastal Zone, and the York River Watershed, including its adjacent coastal basins. Data source: Chesapeake Bay Program Office Data Center, 2020.
- 2.6 Summary of Chesapeake Bay climate change variables and observed/anticipated response. Data sources: (1) NOAA Climate 2021; (2) Rice and Jastram 2015; (3) IPCC Annex 2013; (4) Irby et al. 2018; (5) Pringle et al. 2021; (6) Sweet et al. 2017; (7) Preston 2004; (8) Ding and Elmore 2015; (9) Hilton et al. 2008; (10) Lee et al. 2017.
- 2.7 Aerial image of Goodwin Islands Reserve component delineating core area.
- 2.8. High resolution habitat map for the Goodwin Island Reserve component. Base map year: 2016/2017; Data Sources: (1) VGIN VMBO 2017 True Color Ortho Imagery (1 ft pixel resolution), Date of Imagery Acquisition: 2/26-3/23/2017.
- 2.9 Aerial image of Catlett Islands Reserve component delineating core area.
- 2.10. High resolution habitat map for the Catlett Island Reserve component. Base map year: 2016/2017; Data Sources: (1) VGIN VMBO 2017 True Color Ortho Imagery (1 ft pixel resolution), Date of Imagery Acquisition: 2/26-3/23/2017.
- 2.11 Aerial image of Taskinas Creek Reserve component delineating core and buffer areas, YRSP and selected state acquired tracts.
- 2.12 Aerial image of Sweet Hall Marsh Reserve component delineating core and buffer areas, and selected private partner owned tract.
- 4.1 CBNERR-VA State-Federal partnership organizational and communication structure.
- 4.2 Reserve organizational chart.
- 5.1 CBNERR-VA maintained real-time CMON water quality stations within the southern Chesapeake Bay region.
- 5.2 Aerial image of harmful algal bloom occurring off Goodwin Islands.
- 5.3 Location map of CBNERR-VA's CMON water quality and meteorological SWMP infrastructure; also included is NCBO buoy and USGS gauging stations.

- 5.4 CBNERR-VA staff conducting routine servicing of a Chesapeake Bay Interpretive Buoy (CBIBS).
- 6.1 Discovery field trip to Goodwin Islands as part of student 'Bay Experience' program.
- 6.2 Meaningful Watershed Educational Experiences model. Image credit: NOAA Chesapeake Bay Office.
- 6.3 Teachers participate in lab activity during Teachers on the Estuary (TOTE) workshop.
- 7.1 Participants in the field during a Perennial Stream Identification training, 2019.
- 7.2 Schematic depicting CTP's Three Pillars of Program Delivery.
- 7.3 Information flows in CTP's knowledge exchange framework.
- 7.4 Watershed mapping exercise with YR&SCB Roundtable, 2019.
- 7.5 Schematic detailing collaborative strategies among disciplines; CTP aims for transdisciplinary methodologies and approaches.
- 7.6 A community of practice takes shape at a restoration workshop in concert with NCBO, 2019.
- 7.7 The York River watershed and its adjacent small coastal basins.
- 8.1 Establishing vertical control of monitoring infrastructure along a saltmarsh transect.
- 8.2 Key elements to assess habitat vulnerability to natural, anthropogenic and climate change related stressors.
- 9.1 Map depicting public access points, including trailerable vessel ramps, sites and lands within the York River system, including the Mattaponi and Pamunkey Rivers.
- 10.1 Aerial image of Catlett Islands Reserve component delineating core area, the single privately owned tract, and the upland Machicomoco State Park (formerly Timberneck Farm).
- 10.2 Aerial image of Taskinas Creek Reserve component delineating YRSP and upper watershed acquisition focus area.
- 10.3 Ecological value map of the upper York River system, including the Mattaponi and Pamunkey Rivers.
- 11.1 Aerial image of the VIMS Gloucester Point campus highlighting selected Reserve and supporting Institute facilities.
- 11.2 Aerial view of CBNERR-VA facilities and infrastructure at VIMS Gloucester Point campus highlighting design elements promoting good environmental stewardship, with a specific focus on residential options.
- 11.3 Aerial view of current and proposed YRSP facilities at the Taskinas Creek reserve component.
- 11.4 Aerial view of CBNERR-VA facilities at VIMS Gloucester Point campus highlighting inadequate and failing shoreline protection infrastructure.
- 11.5 Fixed wing eBee Plus drone used in marsh vegetation surveys.

LIST OF TABLES

- Table 2.1. Socioeconomic data pertaining to CBNERR-VA's three geographic areas of influence: CBNERR-VA's Focal Area, Rural Coastal Counties, and Virginia's Coastal Zone Counties. Developed using 2015-2019 five-year American Community Survey (ACS) estimates.
- Table 2.2. Demographic data pertaining to CBNERR-VA's three geographic areas of influence: CBNERR-VA's Focal Area, Rural Coastal Counties, and Virginia's Coastal Zone Counties. Developed using 2015-2019 five-year American Community Survey (ACS) estimates.
- Table 4.1. Law enforcement agency/department/office contact information.
- Table 4.2. Contact information for natural resource law and regulatory enforcement agencies, as well as those responding to fauna stranding and mortality events.
- Table 4.3. Fire & Rescue agency/department/office contact information.
- Table 4.4. State and county department and office contact information for emergency management services.
- Table 9.1. Traditional and general public use activities by Reserve component.
- Table 10.1. Listing of current and potential land protection and acquisition partners and selected federal government funding programs.
- Table 11.1. Current CBNERR-VA vehicle inventory including vehicle, description, and estimated replacement date. Notes: SB: short bed, LB: long-bed, EC: extended cab; CC: crew cab, 4x4: four-wheel drive, TP: tow package.
- Table 11.2. Current CBNERR-VA trailerable vessel inventory including vessel ID, description and estimated replacement date. All vessels carry a research vessel (R/V) designation and therefore have restrictive passenger requirements. Notes: SC: sport cabin, CC: center console, RHIB: rigid-hulled inflatable boat, SA: single axle, DA: dual axle.
- Table 11.3. Current CBNERR-VA primary SWMP station supporting equipment including description and estimated replacement date. Note: each primary water quality station includes two (2) data sondes so as to allow for continuous measurement and backup as needed.
- Table 11.4. Current CBNERR-VA primary geospatial, supporting reconnaissance equipment and tide gauges including description and estimated replacement date.



EXECUTIVE SUMMARY

Established through the Coastal Zone Management Act, the National Estuarine Research Reserve System (NERRS) represents a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states to promote informed management of the Nation's estuaries and habitats. Designated in 1991, and administered by the Virginia Institute of Marine Science (VIMS) of William & Mary, the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR-VA or Reserve) is one of 30 protected areas, which encompass over 1.3 million acres and make up the NERRS.

As the nation's largest estuary, the Chesapeake Bay contains a diverse collection of habitats and salinity regimes. In order to incorporate the diversity of habitats in the lower Bay subregion, CBNERR-VA incorporates a multi-component network along the salinity gradient of the York River estuary (YRE). The Reserve's four components are: (1) 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 the mouth of the YRE; (2) Catlett Islands (220 ha; 542 ac), consisting of multiple parallel ridges of forested wetland hammocks, maritime-forest uplands, and emergent mesohaline salt marshes; (3) 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; and (4) 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.

This plan aligns with and complements the NERRS 2017-2022 Strategic Plan and VIMS's 2015-2020 Strategic Plan while building upon previous accomplishments and the desire to address current priority issues and meet future challenges. Its intent is to provide a vision and framework to guide Reserve activities for program undertakings over the five-year period from 2022-2027.

To this end, CBNERR-VA will focus its efforts and investments in a collaborative manner that addresses place-based needs while providing regional impact. Functional areas include:

- Enhancing and inspiring stewardship, protection, and management of estuaries, their watersheds and cultural connections through place-based approaches;
- Generation, application and transfer of scientific knowledge with respect to estuarine and coastal watershed resources to increase understanding, appreciation and betterment of coastal communities; and
- Advancement of environmental literacy and appreciation, allowing for better resource stewardship and science-based decisions that positively affect estuaries, their watersheds and communities.

Underlying these functional areas, are CBNERR-VA's core values and orienting principles, represented by its five Pillars of Operation: (1) Five Programmatic Veins; (2) Responsible Conduct of Research; (3) Advisory Service and Technical Assistance; (4) Communications; and (5) Diversity, Equity, Inclusion, and Justice. These Pillars are the bedrock of the Reserve's program development, and the lens through which the Reserve approaches its roadmap toward vision achievement. With respect to the initial Pillar, Five Programmatic Veins, CBNERR-VA promotes cross-program integration, which, in turn, facilitates

success, broader impacts, and applicability. Classified by primary function, Reserve programs include: (1) Administration; (2) Research & Monitoring; (3) Education & Outreach; (4) Coastal Training; and (5) Resource Management & Stewardship. Expected programmatic and operational efforts and outcomes are summarized below:

Administration. Reserve leadership will position the Reserve as a regional leader in estuarine and coastal science, education, professional development and training, and resource stewardship; effectively manage existing resources; continue to seek funding and other resources to enhance all programmatic sectors; foster productive relationships with current and new partners; and support staff professional development.

Research & Monitoring. Reserve scientists conduct applied studies, monitoring, and data analysis/synthesis to assess water and ecosystem quality impacts driven by acute episodic and longer-term climate-driven impacts; participate in NERRS system-wide and Chesapeake Bay regional science-based monitoring initiatives; manage environmental data portals (Virginia Estuarine and Coastal Observing System; Chesapeake Monitoring Cooperative Data Explorer); coordinate and track reserve place-based research; mentor graduate students and undergraduate interns; and provide advisory service and technical support that address questions pertaining to significant coastal management issues across multiple spatial scales.

Education & Outreach. Reserve educators increase awareness and encourage a positive environmental stewardship ethic among students (K-16) and the general public through science-based in-classroom, laboratory, and field-based experiences; provide professional development opportunities for formal and informal educators, and graduate students; provide broader impacts to Reserve and VIMS generated science; and provide professional and advisory services to enhance local, state, and regional environmental education efforts.

Coastal Training. The Coastal Training Program (CTP) fosters informs and empowers decision-making, science-based and community-supported resource management, and socioecological system resilience. It works with coastal decision-makers toward this end through a three-pronged program delivery system focused on capacity building, technical assistance, and community engagement. Efforts in these veins concentrate on four target topic areas (and their synergies): (1) climate change, including sea level rise and coastal resilience; (2) water quality and watershed management; (3) coastal community development and land use planning; and (4) communications and management.

Resource Management & Stewardship. Through natural resource management, restoration, and planning, the Reserve aims to sustain its coastal habitats and provide guidance on a regional scale; provide enhanced protection of species of concern and their critical habitat; conduct priority habitat inventories, map and conduct change analysis; support restoration science and ecosystem monitoring; provide visitor use opportunities and management; mentor undergraduate interns; and support experiential opportunities to enhance stewardship ethic among the local citizenry.

By actively using this Management Plan to guide Reserve programs, CBNERR-VA strives to fulfill its mission to: *exhibit leadership in coastal zone management through relevant estuarine and coastal watershed science and education programs that promote natural resource stewardship and science-based solutions to complex socio-ecological challenges.*



CHAPTER 1 - INTRODUCTION TO THE RESERVE SYSTEM

1.1 THE VALUE OF ESTUARIES

Estuaries represent transitional ecosystems between marine and freshwater dominated systems with features determined by a region's geology and influenced by physical, chemical and climatic conditions. Based on geologic origin, estuaries can be classified as coastal plain, bar-built, deltas, tectonic and fjords. Coastal plain estuaries, such as the Chesapeake Bay (Figure 1.1), were formed by rising sea levels with subsequent flooding of existing river valleys. Marine influences such as tides and the influx of saltwater combine with riverine influences such as freshwater streamflow and watershed material input to create extremely dynamic, diverse, and productive systems.

Estuaries rank among the world's most biologically productive and economically important ecosystems. Estuary regions, which occupy 13% of the land area within the continental United States (U.S.), contribute a disproportionate share of the national economy, including 40% employment, 49% of output and 43% of the population (Colgan 2009). Direct, estuary dependent economic goods and services include recreational and commercial fisheries, energy production, marine transportation, real estate value and recreation opportunities. Additionally, estuary ecosystem structure and function result in ecosystem services that support the production of goods and services valued by society. These include high primary and secondary production, providing critical habitat for commercial and ecologically important species, cycling and storage of natural elements (e.g., C, N, P, O, and S), water purification and protecting coastal infrastructure from natural hazards such as erosion and flooding (Barbier et al. 2011).

Increasing pressures from human-induced activities and environmental change can compromise the ecological integrity of estuaries. Trends suggest that over the next decade, habitat loss and alteration will be a significant impact factor to overall estuary health (Kennish 2002, VIMS 2019, Carey, 2021). Other anticipated issues include a greater incidence of eutrophication and harmful algal blooms (HABs), altered freshwater flow and diversions, overharvest of fisheries and wildlife, and increased establishment of invasive species. Creating a greater understanding of estuaries among the citizens of the United States and encouraging the stewardship of these vital areas is the focus of the National Estuarine Research Reserve System (NERRS).

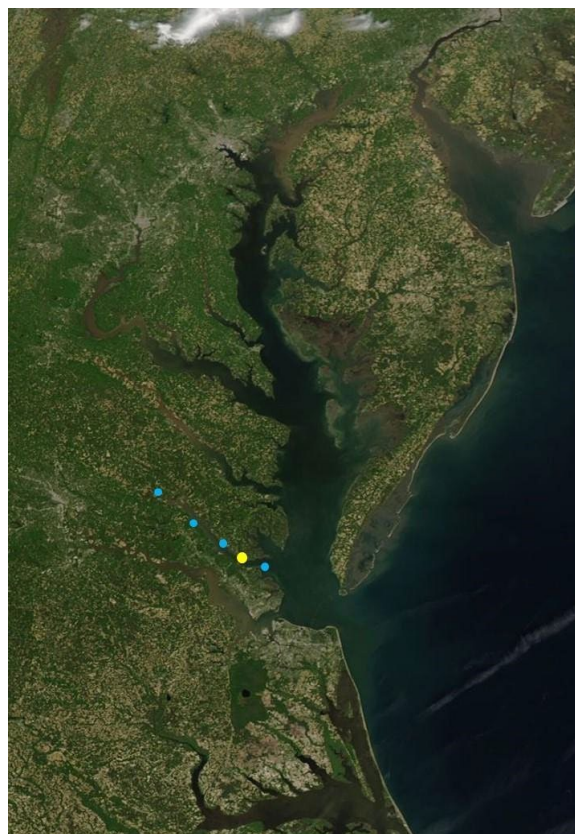


Figure 1.1. May 10, 2020 Moderate Resolution Imaging Spectroradiometer (MODIS) satellite image of Chesapeake Bay with VIMS/CBNERR-VA Headquarters (●) and Reserve components (●) highlighted. Image source: NASA Earthdata.

1.2 INTRODUCTION TO THE NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM

The NERRS is a network of 30 protected estuarine areas that represent different biogeographic regions and estuarine types within the United States (Figure 1.2). Reserves are protected for long-term research, monitoring, education, and coastal stewardship. The Reserve System, created by the Coastal Zone Management Act (CZMA) of 1972, currently protects nearly 1.4 M acres (ac) of estuarine lands and waters. The system is managed in accordance with federal regulations at 15 Code of Federal Regulations (CFR) Part 921.

Each reserve has a unique boundary based on the nature of its ecosystem. The boundaries include the land and water areas needed to protect an intact ecological unit. Reserves classify their land and water areas as either “core” or “buffer,” which determines the level of protection and the types of activities allowed within each area. Each reserve develops the programming most appropriate for its location while also delivering required system-wide programs focused on research and monitoring, education, training, and stewardship.

The Reserve System is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding, national guidance, and technical assistance for reserve operations and system-wide programs, facilities construction and land acquisition, graduate fellowships, and collaborative science projects. The state partner manages the reserve on a daily basis and works collaboratively with local and regional partners. NOAA also leads projects that integrate data or support decision-making at the national level.

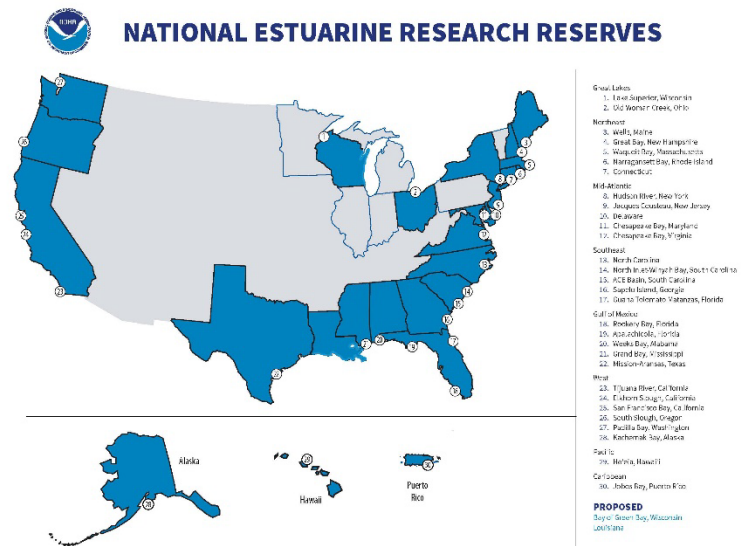


Figure 1.2. National Estuarine Research Reserve System network map. Map source: NOAA/OCM.

1.3 FOUNDATION PROGRAM ELEMENTS

NOAA currently provides leadership and support for three system-wide programs, including the System-Wide Monitoring Program (SWMP), K-12 Estuarine Education Program (KEEP), and Coastal Training Program (CTP).

- **System-Wide Monitoring Program (SWMP).** The SWMP develops quantitative measurements of short-term variability and long-term changes in water quality, weather, biological systems, and land use/land cover characteristics of estuaries and estuarine ecosystems for the purposes of informing effective coastal zone management.
- **K-12 Estuarine Education Program (KEEP).** The KEEP aims to increase the estuary and coastal watershed literacy of students, teachers, and the general public through exposure to essential coastal and estuarine concepts and experiences, enhancing data analysis, and developing critical thinking and problem solving skills. A key component of KEEP is the Teachers on the Estuary (TOTE) professional development program.

- *Coastal Training Program (CTP)*. The CTP is a national training program providing up-to-date scientific information and skill-building opportunities to individuals responsible for making decisions that affect coastal resources and communities.

Additional national level programs directly supporting Reserve System priorities include the NERRS Science Collaborative (NSC), the Margaret A. Davidson Fellowship, and NOAA's Sentinel Site Program (SSP).

- *NERRS Science Collaborative (NSC)*. The NSC supports science for estuarine and coastal decision-makers. Managed through a cooperative agreement with NOAA, the Science Collaborative coordinates regular funding opportunities and supports user-driven research, assessment, and transfer activities that address critical coastal management needs identified by the reserves.
- *Margaret A. Davidson (Davidson) Graduate Fellowship*. The two-year Davidson Fellowship provides graduate level research opportunities that address key coastal management challenges. Fellowship benefits include development of meaningful cross-discipline research projects, professional guidance and mentoring, career-readiness training, and networking opportunities across the NERRS, NOAA, and community partners.
- *Sentinel Site Program (SSP)*. NOAA's SSP provides regionally integrated observations across a multi-partner network to study and address the impacts and possible solutions of sea level changes on coastal resources and communities. Chesapeake Bay represents one of the five Sentinel Sites Cooperatives; other cooperatives include North Carolina, Northern Gulf of Mexico, San Francisco Bay, and the Hawaiian Islands. Information can be found at <https://oceanservice.noaa.gov/sentinelsites/#:~:text=At%20five%20coastal%20locations%2C%20NOAA,level%20change%20on%20coastal%20communities.>

1.4 STRATEGIC PLANNING

Strategic planning has been an integral part of the NERRS for nearly twenty-five years. The planning process is designed to bridge national program direction with local coastal management needs through a representative and participatory process that supports NOAA's mission of science, service, and stewardship. The 2017-2022 Reserve System Strategic Plan (NOAA/NERRS 2017) focuses on the reserve core strengths of research, education, and training to address three central issues: environmental change, water quality, and habitat protection. The Reserve System Strategic Plan goals are framed in the context of protected places, applying science, and educating communities. The most recent NERRS Strategic Plan can be found at <https://coast.noaa.gov/data/docs/nerrs/StrategicPlan.pdf>. It describes the following goals for the system:

- (1) Protecting Places: Enhance and inspire stewardship, protection, and management of estuaries and their watersheds in coastal communities through place-based approaches;
- (2) Applying Science: Improve the scientific understanding of estuaries and their watersheds through the development and application of reserve research, data, and tools; and
- (3) Educating Communities: Advance environmental appreciation and scientific literacy, allowing for science-based decisions that positively affect estuaries, watersheds, and coastal communities.

Each reserve is required to develop a management plan that contains the goals, objectives, and strategies for that reserve (NOAA/OCM 2013). Management plans are updated every five years, and must be approved by NOAA. These plans enable the reserves and NOAA to track progress and realize opportunities for growth. Each plan describes how the reserve will carry out its foundational research, education, and training programs. Each plan also outlines administration, resource protection, public access, land acquisition, and facility plans, as well as restoration and resource manipulation plans if applicable. The plans also incorporate strategies designed to help the reserve contribute to the system's national goals. NOAA periodically evaluates reserves for compliance with federal requirements and their approved management plan.



CHAPTER 2 – CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE IN VIRGINIA

2.1 ESTABLISHMENT & LOCAL MANAGEMENT

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 U.S. 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 a NERR. The Virginia Institute of Marine Science (VIMS)/William & Mary (W&M) was designated by the Governor to take the lead role in establishing a suitable research reserve system for the Commonwealth. The Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR-VA or Reserve) was designated in 1991 and became the 18th reserve and first university-administered reserve within the national system. Administration of CBNERR-VA is achieved through a collaborative partnership between NOAA and the Commonwealth of Virginia through VIMS/W&M. An updated memorandum of understanding (MOU) between Virginia and NOAA regarding federal-state relationship that expresses the long-term commitment by the state to maintain and manage the reserve in accordance with Section 315 of the CZMA, 16 U.S.C. 1461, and applicable regulations is provided in Appendix A. Federal consistency certification by Virginia's Coastal Zone Management Program (VCZMP) and NOAA/OCM NEPA findings are provided in Appendices B and C, respectively.

Located within the Virginian biogeographic region that extends from southern New England to North Carolina, the Chesapeake Bay is the nation's largest estuary. Including parts of six states (Delaware, Maryland, Pennsylvania, Virginia, and West Virginia) and the District of Columbia, the Bay's watershed encompasses approximately 166,000 km² (64,000 mi²) and 18,800 km (11,684 mi) of shoreline. Due to its large land-to-water ratio of 14:1, the largest of any coastal body worldwide, the Chesapeake Bay's

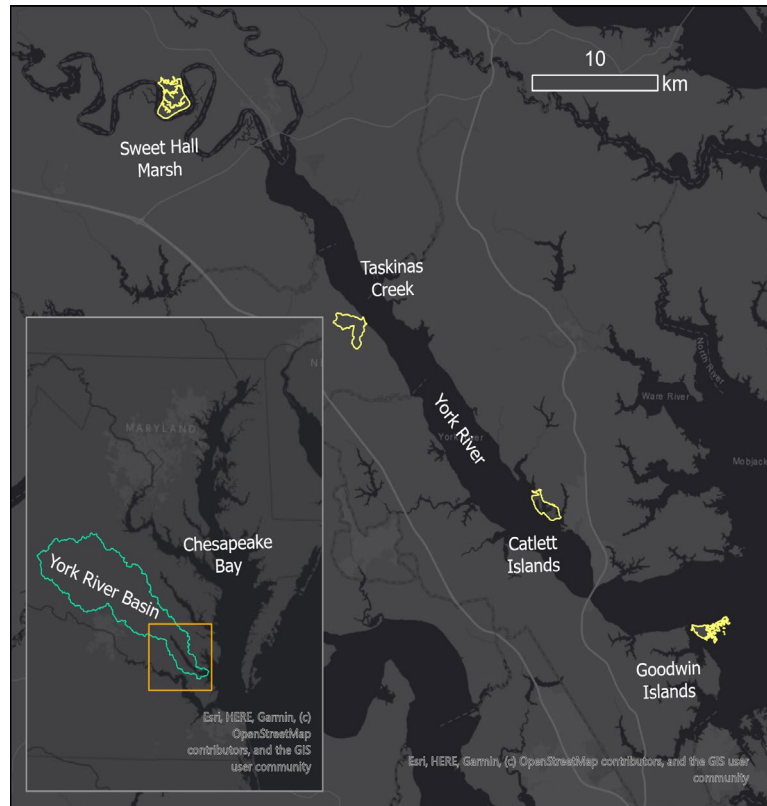


Figure 2.1. Reserve component locations along the York River system. Image credit: D. Parrish.

water quality and health of its natural resources are tied to land use and ultimately actions to manage land use activities. Given its broad geographic scale and diversity of estuarine systems, the Chesapeake Bay is the only water body represented by two NERRs, the Virginia and Maryland Chesapeake Bay NERRs. In order to represent the ecological diversity of lower Chesapeake Bay, a multi-component NERR was established along the salinity gradient of the York River estuary (YRE). CBNERR-VA incorporates four reserve components, from freshwater to polyhaline, reserve components are Sweet Hall Marsh, Taskinas Creek, Catlett Islands and Goodwin Islands. Collectively, CBNERR-VA encompasses 1,244 ha (3,072 ac) of coastal habitats.

2.2 ENVIRONMENTAL & ECOLOGICAL ATTRIBUTES OF THE YORK RIVER SYSTEM

This section draws heavily, and in some cases reprints, from the Reserve's Site Profile (CBNERR-VA 2009) that provides a review of the existing state of knowledge for important geological, physical, chemical, and biological components of the YRE ecosystem. It should also be noted that much of this material was published as a Special Issue of the Journal of Coastal Research (JCR 2009) and is available as an on-line resource (https://www.vims.edu/cbnerr/resources/resources_research_monitoring.php). This section is not designed to be a complete review of all the ecosystem components, but rather is designed to provide, through a series of reviews, an overview of the YRE to students, researchers, resource managers, and the general public. Included in the review is the meteorological, geological, physical, and water quality setting of the overall YRE. Following these sections, are scientific overviews of three important primary producer components and habitats within the region (phytoplankton, wetlands and submerged aquatic vegetation), secondary and higher trophic components (zooplankton, benthos, and fishes), and the principal reptiles, amphibians, birds and mammals that are associated with the local estuarine waters.

2.2.1 Climate & Weather

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 (<https://www.virginia.org/climate/>). The York River watershed is located within the Tidewater and Piedmont climate regions. Climate within the York River basin is moderate exhibiting an average annual temperature of 14 °C (57 °F) and seasonal minimum and maximum daily values varying from 2-5 °C (36-41 °F) and 23-24 °C (73-75 °F), respectively (Reay and Moore 2009). Cooler temperatures are associated with the more northwestern portions of the watershed with lower, southern portions of the watershed exhibiting warmer temperatures. With respect to accelerating climate change impacts to the Chesapeake Bay region, air temperature within Tidewater Virginia has increased 0.7 °C (1.3 °F) over the past century (1901-2017; CBP 2020) but expected to increase 1.2 °C (2.2 °F) by 2030 (Najjar et al. 2010).

Average annual precipitation rates within the watershed vary from 114 cm (44.7 in) in the upper reaches of tidal waters (Walkerton; 1932-2021) to 124 cm (49 in) in lower reaches (Williamsburg; 1948-2021) (Reay and Moore 2009). Over the past century (1901-2017; CBP 2020), rainfall has increased 7.2% within the Tidewater Virginia region with anticipated seasonal changes of increased winter precipitation and drier summers (Najjar et al. 2010). 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 (<http://www.virginiaplaces.org/watersheds/atlanticocean.html>). Excessive rainfall can result from hurricanes and tropical storms that cross Virginia. These large-scale events typically occur in early August, September and October. Between 1948 and 2011, there has been a 33% increase in the

frequency of extreme precipitation events in Virginia with the 1-yr storm now occurring every 9 months (Madsen and Wilcox 2012). As the frequency of extreme events has increased, so has the amount of rain that those storms produce, with Virginia seeing an 11% increase in precipitation from the largest storms between 1948 and 2011 (Madsen and Wilcox 2012). 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% throughout the watershed.

2.2.2. Geomorphology

The Chesapeake Bay owes its location and present form to several extraordinary processes beginning with a bolide impact event at the end of the Eocene epoch (about 35.5 million yr ago) forming the Chesapeake Bay impact crater. With the onset of glacial melting some 18,000 yr ago at the end of the Pleistocene Epoch's last ice age, erosive melt waters helped carve the landscape and form the Susquehanna River valley that was eventually submerged by rising sea levels during the Holocene epoch.

The Reserve's four components reside within Virginia's Coastal Plain province, running from its tidal water fall-line to the Atlantic Ocean with Goodwin and Catlett Islands being located within the outer rim area of the Chesapeake Bay Impact Crater. The surficial geology at each component is of Quaternary age, with modern Holocene wetlands with Taskinas Creek set into older Tertiary age strata (Hobbs 2009). Major marine transgressions and regressions, during which the successively more recent high stands of sea level did not reach or exceed the level of the preceding high stand, defined the late Tertiary and Quaternary geology (Hobbs 2009). Reserve coastal landforms can be broadly categorized as tidal marsh and higher elevation marine terraces. Reserve tidal marshes are characterized by low elevations, on the order of 0.5 m (1.6 ft) relative to mean local sea level, and slopes of 0-1%. Nearshore terrace elevations and slopes vary by Reserve component, with Goodwin Islands, Catlett Islands, and Sweet Hall Marsh exhibiting relatively low elevations, typically ranging between < 3.0-6.1 m (< 10-20 ft), and 0-2% slopes. In contrast, Taskinas Creek exhibits elevated upland elevations on the order of 28 m (92 ft) and moderate (6-10%) to high (20-50%) slopes. The local rate of relative sea-level rise (SLR), is on the order of 5-6 mm·yr⁻¹ (~ 0.2 in·yr⁻¹), as well as associated saltwater intrusion and local erosion are underlying processes driving tidal marsh dynamics at all four Reserve components. A detailed discussion of York River and Reserve component geology can be found in the Reserve's Site Profile (CBNERR-VA 2009) and Hobbs (2009).

2.2.3 Hydrology & Physical Oceanography

The YRE is the Chesapeake Bay's fifth largest tributary in terms of freshwater flow and watershed area. The York River basin, incorporating approximately 6% of the Commonwealth's total land area (6900 km²; 2662 mi²), 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 (see inset Figure 1.2). The YRE receives freshwater from its two major tributaries whose confluence is at West Point located approximately 52 km (32 mi) from the river's mouth near Goodwin Islands. Combined long-term daily mean streamflow from the Mattaponi (1.38×10⁶ m³, USGS Station 01674500, 1942-2018) and the Pamunkey (2.41×10⁶ m³, USGS Station 01673000, 1942-2018) Rivers is on the order of 3.79×10⁶ m³ with additional freshwater input from a large number of smaller ungaged sub-basins and direct groundwater discharge to tidal waters. Approximately 35% of the York River basin is below United States Geological Survey (USGS) gaging stations.

The YRE is classified as a microtidal, partially mixed estuary. 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. The York River channel bed is predominantly mud, while the shoals tend to be sandier, and the mid- to upper York is marked by seasonally persistent regions of high turbidity. Fine sediment is trapped in high turbidity regions in response to tidal asymmetries and local variations in stratification and estuarine circulation. The estuary turbidity maximum (ETM) is situated near the confluence of the Mattaponi and Pamunkey Rivers at the town of West Point, VA and a secondary ETM can occur about 20 to 40 km (12 to 25 mi) from the mouth of the York River estuary (Lin and Kuo 2001).

The mean tidal range is 0.7 m (2.3 ft) at the mouth of the YRE, 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). 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). The tidal prism has been estimated at 110 million m^3 ($3.9 \times 10^9 \text{ ft}^3$) at the mouth and 35 million m^3 ($1.2 \times 10^9 \text{ ft}^3$) at West Point (Sturm and Neilson 1977). Salinity distribution along the YRE ranges from tidal freshwater to polyhaline regimes, with interannual variations in hydrologic budgets and large-scale episodic events (e.g., tropical cyclones) having a significant impact on the short and long-term salinity patterns within the estuary (Reay and Moore 2005). The long-term 1950-2021 relative SLR rate at the mouth of the York River is based is $4.9 \text{ mm} \cdot \text{yr}^{-1}$ ($\sim 0.2 \text{ in} \cdot \text{yr}^{-1}$; NOAA Center for Operational Oceanographic Products and Services; Station ID: 8637689 Yorktown USCG Training Center, VA), with rates increasing upriver near West Point, a region of high groundwater withdrawal. As a result of accelerating SLR rates, current estimates of relative SLR rates near the mouth of the York River are estimated between $5\text{-}6 \text{ mm} \cdot \text{yr}^{-1}$ ($\sim 0.2 \text{ in} \cdot \text{yr}^{-1}$) with rates expected to increase to $9\text{-}10 \text{ mm} \cdot \text{yr}^{-1}$ ($\sim 0.4 \text{ in} \cdot \text{yr}^{-1}$) by 2050. With SLR, it would be anticipated that salt intrusion would occur and be most notable in the upper reaches of the YRE. Rice et al. (2011) projected increases in upper reach salinity on the order 2.5 and 4 psu under typical streamflow rates for 20 and 50 cm (0.7 and 1.6 ft) SLR scenarios by 2100; it should be noted that this study did not incorporate observed and anticipated changes in precipitation and evapotranspiration rates (and subsequently streamflow) as a result of climatic changes. Given observed increases in seasonal (winter and spring) and overall annual precipitation rates, freshening of estuarine waters is also a possibility, at least from a seasonal perspective.

The upper York near West Point, VA is generally less stratified than the lower York near Gloucester Point because of the shallower depths and stronger currents, approaching $1 \text{ m} \cdot \text{sec}^{-1}$, found upstream. Fluctuations in salinity stratification in the York River at tidal, fortnightly and seasonal timescales are associated with tidal straining, the spring-neap cycle, and variations in freshwater discharge, respectively. Estuarine circulation in the YRE, which averages $\sim 5\text{-}7 \text{ cm} \cdot \text{sec}^{-1}$, is often modulated by moderate winds. Waves are usually insignificant, although occasional severe storms have a major impact. Residence time, defined as the time taken for an element to be discharged from the estuary, is dependent on freshwater discharge rates and estimated to be on 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 (Shen and Haas 2004). A detailed discussion of YRE hydrology and oceanography can be found in the Reserve's Site Profile (CBNERR-VA 2009), Friedrichs (2009) and Reay (2009).

2.2.4 Water Quality

Key water quality management issues and threats within the Chesapeake Bay and its tidal tributaries include excess loadings of sediment and nutrients, and the introduction of toxic chemicals and microbial agents. Based on multiple indicators, the 2021 Chesapeake Bay and Watershed Report Card gave the Bay's watershed a moderate ecosystem health score of C+ and its waters a C depicting a slightly improving trend (UMCES 2022). Specific to the York River, its watershed ecological health score was a C with its waters exhibiting a poor score of D (Figure 2.2); river health scores have consistently been poor (range: D- to D+) for over a decade. Accounting for forecasted changes in population, land use and climate change,

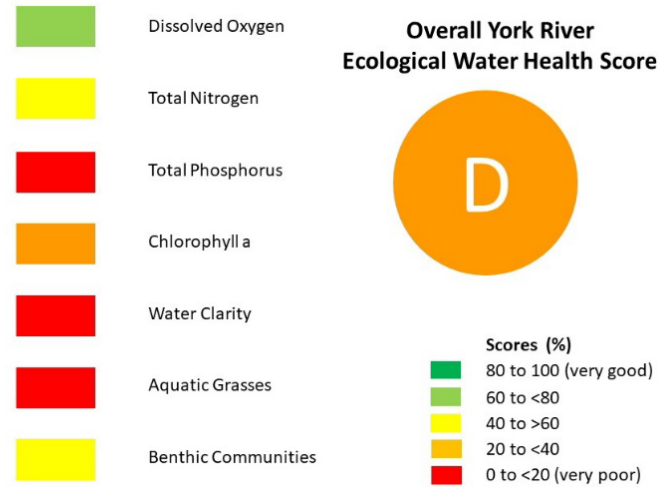


Figure 2.2. York River water quality health scores for 2021. Data source: UMCES 2021.

Virginia's Department of Environmental Quality (VDEQ) approved Phase III Implementation Plan provides the Commonwealth's roadmap to actions needed to meet Chesapeake Bay Program water quality criteria in order to restore the Bay and its tributaries (CVA 2019).

Excess loadings of sediment and nutrients resulting in elevated eutrophic conditions, decreased water clarity, and periodic low oxygen conditions continue to be a persistent and widespread problem in the YRE. Long-term trends (2009-2018) in watershed pollutant loadings at River Input Monitoring stations show degrading conditions for sediment, nitrogen, and phosphorus (USGS 2020). Nonpoint agricultural sources dominate sediment and nutrient inputs, and streamflow is a dominant controlling factor in explaining variability in annual loads. Of more recent concern, are recurring harmful algal blooms (HABs) in the lower portion of the YRE that can elicit adverse effects on aquatic and human health; most notable are the dinoflagellate blooms of *Alexandrium monilatum* and *Margalefidinium polykoides*. Poor water clarity, principally controlled by suspended sediments and phytoplankton, remains a chronic issue with the oligohaline and middle mesohaline regions failing to meet submerged aquatic vegetation (SAV) habitat requirements (SAV criteria: $< 15 \text{ Chla } \mu\text{g}\cdot\text{L}^{-1}$, $< 1.5 \text{ Kd m}^{-1}$, $\text{TSS} < 15 \text{ mg}\cdot\text{L}^{-1}$) (USEPA 2020). Within the polyhaline portions of the YRE, elevated water temperatures routinely result in summer diebacks of eelgrass (*Zostera marina*) (Shields et al. 2018, 2019). With respect to low dissolved oxygen levels, hypoxia derived from oxidation of organic matter and sediment oxygen demand has also been observed repeatedly in the bottom waters of the lower, high salinity reaches when water temperatures exceed 20 °C.

While studies have indicated limited toxic chemical contamination, mercury and PCB fish consumption advisories and restrictions have been issued in the YRE. Mercury impacted regions of the Mattaponi and Pamunkey Rivers receive significant wetland drainage that can enhance the potential for bioaccumulation of mercury in aquatic organisms and those that prey upon them. Sediments in the York River proper exhibit PCB levels ranging from 1-5 ppb with more elevated levels (25 ppb) being observed in some contributing tidal creeks. In contrast to mercury where atmospheric deposition is a primary pathway, PCBs are generally released into the environment from runoff processes occurring at

hazardous waste sites. With varying sources of fecal pollution, 20% (31.1 km²) of the YRE's assessed shellfish waters have been designated as impaired. Condemned waters are restricted to major industrial and defense facility sites and contribute to smaller tidal creek systems. A detailed discussion of YRE water quality can be found in the Reserve's Site Profile (CBNERR-VA 2009) and Reay (2009).

2.2.5 Land Cover & Use

Encompassing an area on the order of 6,900 km² (2662 mi², 1.70 M ac), 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 (USGS HUC ID: 02080105), Pamunkey (USGS HUC ID: 02080106) and York Rivers (USGS HUC ID: 02080107). These three hydrologic units are further divided into 27 water bodies or watersheds and 69 sixth order sub-watersheds. 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. Population centers within the watershed include Poquoson, Gloucester Point, Ashland, West Point, and Spotsylvania Courthouse.

Land use is predominantly rural in nature with forest cover accounting for 61% of the basin's cover, agricultural lands accounting for 21%, wetlands 7%, developed lands 2%, barren lands 1%, and open water accounting for the remaining 8% (Reay and Moore, 2009, See Figure 2.3).

From 1985 to 2019, urban and suburban land areas have increased by 75,958 ac, while agricultural and natural lands have decreased by 34,246 and 41,081 ac, respectively. Correspondingly, the proportion of urban land in this watershed has increased from 5% in 1985 to 10% in 2019 (USEPA, 2021). While there are currently no major metropolitan areas contained within the watershed, growth from Fredericksburg, Richmond and Hampton Roads is impacting the region. NOAA's Coastal Change Analysis Program (C-CAP;

<https://coast.noaa.gov/ccapatlas/>) over the 1992-2016 period, indicated a net increase in developed area (27.2%) and impervious surface (35.6%) and a net decrease in forested (4.3%) and forested-wetland area (6.4%) within the lower YRE region (West Point to Mouth of York River). Total wetland area decreased by 2.4% even with an increase in saltwater wetlands (4.9%) as this was balanced by a decrease in freshwater palustrine wetlands (5.5%).

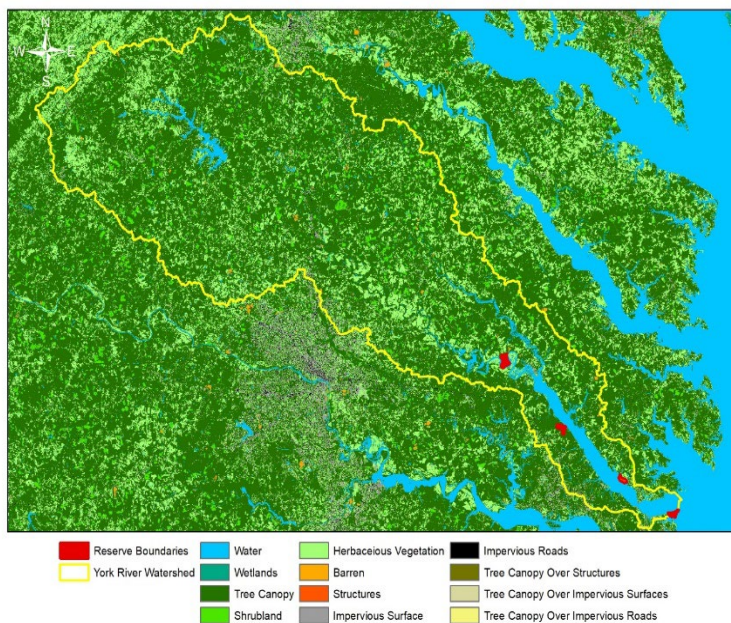


Figure 2.3. York River watershed landcover. Data source: 2013-2014, 1 m resolution Chesapeake Conservancy 12 Category Land Cover Data. Image credit: S. Lerberg.

2.2.6 Key Biological Components

- *Tidal Marshes*. The YRE has nine tidal wetland community types that are distributed along gradients of salinity and tidal inundation. These range from the Saltmarsh Cordgrass community dominated by *Sporobolus alterniflorus* (formerly *Spartina alterniflora*) to the Tidal Freshwater Mixed community that can have more than 50 species in one marsh. These tidal marshes provide a number of important functions and values to the estuarine systems including: high primary productivity, important habitat value, erosion buffering and filtering capacity useful for trapping sediments, pollutants, and nutrients. The tidal marsh communities within the four Reserve sites are situated along the York system salinity gradient, from tidal freshwater to polyhaline. They are largely pristine vegetation communities and have been documented to have abundant fauna characteristic of their individual community types. Changes in the vegetation communities of each site have been documented over time; however more research is needed on the potential effects of projected sea level rise on these habitats, impacts of watershed sedimentation and nutrient enrichment, vegetation succession, and invasive species on the persistence and value of these tidal marsh areas. A detailed discussion of YRE tidal wetlands quality can be found in the Reserve's Site Profile (CBNERR-VA 2009) and Perry and Atkinson (2009).

- *Submerged Aquatic Vegetation*. Submerged aquatic vegetation (SAV) are important habitats within nearshore areas of the YRE. The plants that comprise these communities are distributed in shallow water areas (<2m) along the estuary from polyhaline to freshwater areas according to their individual salinity tolerances. Eelgrass (*Zostera marina*) is the only true seagrass and is found only in the lower York River where salinities average above 20 psu. It is a cool water species that decreases in abundance in the summer due to high water temperatures. SAV in this region have declined precipitously from historical abundances due to excessive levels of turbidity and nutrients. Infection of a marine slime mold-like protist, *Labyrinthula zosterae*, also impacted this species in the 1930s, nearly decimating it from this area. Widgeon grass (*Ruppia maritima*) co-occurs with eelgrass but can also grow in low salinity areas. Pondweeds (*Potamogeton* sp.) and many other SAV species grow in both low salinity and freshwater areas. Macroalgae or "seaweeds" are currently a minor component of SAV in the YRE. Several algal genera common in the area include: *Agardhiella*, *Ulva*, *Enteromorpha* and *Chara*. A detailed discussion of YRE SAV can be found in the Reserve's Site Profile (CBNERR-VA 2009) and Moore (2009).

- *Phytoplankton*. The YRE possesses a diverse phytoplankton community represented by a variety of algal species that includes both freshwater and estuarine flora. The mean annual monthly range of abundance is ca. $5\text{-}20 \times 10^6$ cells \cdot L $^{-1}$ with an extended bi-modal pattern that begins with an early spring diatom peak (March) that declines into early summer. The development of a more diverse representation of taxa in the summer results in a secondary late summer-early fall peak. Diatoms are the dominant phytoplankton component throughout the entire estuary including a variety of pennate and centric species such as *Asterionella formosa* and *Aulacoseira granulata*. Dinoflagellates are more common and abundant in the lower segments of the YRE where they have been associated with recurrent and extensive "red tide" blooms. These include *Cochlodinium polykrikoides*, *Heterocapsa triquetra*, *Heterocapsa rotundata*, *Scrippsiella trochoidea*, and *Prorocentrum minimum*. Cyanobacteria, commonly referred to as blue-green algae, include unicellular, colonial, and filamentous taxa that are predominantly freshwater species. Among the more common taxa are *Microcystis aeruginosa*, a potential bloom producer, *Merismopedia tenuissima*, *Oscillatoria* spp., *Dactylococcopsis* spp., *Chroococcus* spp., and *Synechococcus* spp. The cyanobacteria are generally considered a nuisance category that do not represent a favorable food resource, and are commonly associated with increased trophic status. Chlorophytes, or green algae, including *Ankistrodesmus falcatus*, *Chlorella* spp., *Pediastrum duplex*, *Scenedesmus acuminatus* and *Scenedesmus dimorphus*, are more common from

spring to fall with lowest abundance in winter. Overall, the phytoplankton status in the YRE has been classified as poor/fair condition. A detailed discussion of YRE phytoplankton communities can be found in the Reserve's Site Profile (CBNERR-VA 2009) and Marshall (2009).

- *Zooplankton*. Zooplankton are a diverse group of heterotrophic organisms that consume phytoplankton, regenerate nutrients via their metabolism, and transfer energy to higher trophic levels. Several studies targeting specific taxa, and time series of multiple taxa, provide an emerging view of YRE zooplankton community composition along with seasonal and longer-term changes. Microzooplankton communities are dominated by ciliated protozoa, and rotifers are important in fresher water regions. In the lower Bay, microzooplankton abundance peaks in spring, and in mid-summer to early fall. The mesozooplankton community is dominated by calanoid copepods (*Acartia tonsa*, *Acartia hudsonica*, and *Eurytemora affinis*). Mysids undergo diel vertical migrations and are important food for many fish species in the Bay. Some taxa such as chaetognaths are not endemic to the bay but are transported in from the continental shelf. Various meroplankton such as larvae of decapods, bivalves, and gastropods become abundant at times. A striking seasonal change in the zooplankton community composition occurs in spring when large gelatinous zooplankton such as the sea walnut ctenophore (*Mnemiopsis leidyi*) and (subsequently in summer) the scyphomedusa sea needle (*Chrysaora quinquecirrha*) "bloom." *Mnemiopsis* blooms now appear earlier in the YRE compared to 40 yr ago, correlated to earlier warming in spring water temperatures. Humans may be influencing zooplankton populations in the YRE via introduced species and eutrophication-induced hypoxia, as well as via input of contaminants. A detailed discussion of YRE zooplankton can be found in the Reserve's Site Profile (CBNERR-VA 2009) and Steinberg and Condon (2009).

- *Benthos*. Benthic organisms and their communities are key components of estuarine systems. Major subtidal benthic habitats in the YRE include soft mud and sand bottoms, with only limited distribution of SAV and oyster shell. Major taxonomic groups of macrofauna dominating muds and sands include annelids, molluscs and crustaceans; similar to those found in other temperate estuaries of the U.S. Mid-Atlantic. Meiofaunal assemblages of soft bottoms are dominated by nematodes and copepods. Species distribution patterns are strongly correlated with salinity and bottom type, while other factors such as eutrophication and hypoxia may be growing in importance. Much of the YRE benthos fails to meet the restoration goals set by the Chesapeake Bay Program. The poor condition of the benthos is expressed as low biomass and abundance and may be associated with degraded water quality, hypoxia and sediment disturbance processes. A detailed discussion of YRE benthos can be found in the Reserve's Site Profile (CBNERR-VA 2009), and Gillett and Schaffner (2009).

- *Fisheries*. The YRE supports a diverse fish fauna represented by members of the shad and herring family, drums, flatfishes, temperate basses, catfishes, sharks, skates, rays, and numerous smaller fishes that serve as forage such as bay anchovy (*Anchoa mitchilli*), Atlantic menhaden (*Brevoortia tyrannus*), and killifish (*Fundulus* sp). The VIMS Juvenile Fish Survey has observed more than 130 fish species in the YRE. Historically, fisheries for blue crabs (*Callinectes sapidus*), American shad (*Alosa sapidissima*), striped bass (*Morone saxatilis*), and Atlantic sturgeon (*Acipenser oxyrinchus*) thrived in the Chesapeake Bay region, but in recent times these fisheries have declined. Fishes of the YRE exhibit divergent life history patterns, from fast growing, highly fecund species such as alewife (*Alosa pseudoharengus*), to slow growing, late maturing species with low fecundity such as Atlantic sturgeon. The young of many species use the YRE as a nursery area and depend on the high productivity of this estuary for conferring fast growth and high survival during the first year of life. Habitat alterations that result in loss of water quality or quantity may deleteriously affect recruitment of young fishes through direct effects on young-of-the-year fish survival, or through disruption of spawning activity (e.g., dam construction, and water

withdrawals that affect salinity and flow). A detailed discussion of YRE fisheries can be found in the Reserve's Site Profile (CBNERR-VA 2009), and Hewitt et al. (2009).

- *Amphibians, Reptiles, Birds and Mammals*. The YRE and its watershed support many natural vegetative communities, from aquatic grass beds to tidal marshes to a variety of woodlands. These communities support a wide variety of resident and migratory amphibians, reptiles, birds and mammals. There are eight families and 26 species of amphibians and ten families and 36 species of reptiles represented within the York River watershed. All three species of sea turtles (loggerhead, *Caretta caretta*; Kemp's Ridley, *Lepidochelys kempii*; green sea, *Chelonia mydas*) are protected under the Endangered Species Act and the Northern diamond-backed terrapin (*Malaclemmys terrapin*) is a species of concern. Approximately 230 bird species, resident and migratory, have been recorded within the Chesapeake Bay area. More than 50 families and 190 species of birds have been observed along the estuarine environments of the York River. Specific Reserve components support Bald Eagle (*Haliaeetus leucocephalus*) nests, Great Blue Heron (*Ardea herodias*) rookeries, and breeding pairs of American black ducks (*Anas rubripes*) and oyster catchers (*Haematopus palliatus*). Nineteen families and 50 species of mammals are represented within the York River and its watershed. Of special note is the infrequent occurrence of large marine mammals, such as the bottlenose dolphin (*Tursiops truncatus*) and manatee (*Trichechus manatus*), within the lower York River region; even harbor seals (*Phoca vitulina*) have made appearances on Reserve shores. A detailed discussion of York River amphibians, reptiles, birds and mammals can be found in the Reserve's Site Profile (CBNERR-VA 2009), and Brown and Erdle (2009).

2.3 CULTURAL HISTORY & SOCIAL ATTRIBUTES

2.3.1 Cultural History

Recent archaeological findings indicate that people have lived in what is now Virginia for 16,000 years or more (Egloff and Woodward 2006; VDHR 2020; VSC 2020). Near the end of the Archaic period, ~3,200 yr ago, the peoples concentrated along the rich floodplain of present-day Virginia totaled perhaps tens of thousands. In the coastal plain at this time, oysters were a rich food source, as indicated by thick middens of discarded shells. The wide range of artifacts which survive from ~400 to 1,000 yr ago indicate that during the Late Woodland Period, the coastal plain Indian tribes in present-day Virginia lived in permanent villages, and they were specialists in river and estuary fishing, especially for shad and sturgeon that spawn upriver. Night fires in dugout canoes were one method for attracting fish, which were caught by a combination of hooks, spears, nets, and fish weirs. Oysters were typically gathered in late spring while the Indian people waited for their crops to grow, and dried oysters and fish were stored in ceramic vessels for consumption year-round.

In the early 1600s, multiple Indian towns and villages were located in the York Basin and adjacent coastal bays (Swanton 1946; Egloff and Woodward 2006; VCI 2008; NPS 2020; VDHR 2020). The northeast shore of the lower Pamunkey River (renamed the York by the English) was the site of one of the most important Indian towns in the entire Mid-Atlantic, namely Werowocomoco, the home of paramount chief Powhatan. In addition, settlements of the Pamunkey, Mattaponi, and Upper Mattaponi tribes were located along the York tributaries which still share their names. At that time, ~30 tribes in the lower Chesapeake region paid tributes to paramount chief Powhatan.

Substantial interactions between Europeans and tribes in the Chesapeake region began in the mid-1500s. Following multiple excursions into the Bay, the Spanish built a Jesuit mission on the shores of the York River in 1570. But following clashes with local tribes, the Spanish left the region in 1572 (Erickson 2013). In 1607, the English established the Jamestown settlement on the James River. Soon after the establishment of Jamestown, an extended period of violent conflict arose between the colonists and the

Powhatan Chiefdom, and by the mid-1600s, the lands of the Powhatan Chiefdom between the York and the James Rivers were taken over by the English (Egloff and Woodward 2006; VDHR 2020). However, the Pamunkey and Mattaponi agreed to pay tribute to the colonial Governor of Virginia in return for peace and autonomous land. In 1658, reservations were formally established by the Virginia General Assembly for each tribe in the southeastern portion of present-day King William County. In the mid-17th century, the upper reaches of the Mattaponi River were still beyond the frontier of English settlement, and the Upper Mattaponi people were not formally recognized by the colonists. This is in contrast with the Pamunkey Indian Tribe, who were recognized in the treaties of 1646 and 1677. The Upper Mattaponi Indian Tribe was officially recognized by the Commonwealth of Virginia in 1983. Federal recognition came to the Pamunkey and Upper Mattaponi Indian Tribes in 2016 and 2018, respectively.

Although their ancestral lands continue to be encroached upon, and centuries of discrimination have taken additional tolls, the Pamunkey Indian Reservation, Mattaponi Indian Reservation, and the Upper Mattaponi Tribal Grounds (in northern King William County) continue to be important centers for these tribes' respective cultures and heritage (Pamunkey.org; Mattaponination.com; UMItribe.org; VIA 2020). Living in harmony with the natural world has always been central to each tribe's values. The Mattaponi and Pamunkey reservations are located on the shores of the respective rivers, and fishing remained especially important to their tribe's members, with shad, catfish, and rockfish being staples of their traditional diets. Reflecting their emphasis on sustainable use of aquatic resources, both the Mattaponi and Pamunkey established shad hatcheries in the early 1900s. In the latter half of the 20th century, more formal partnerships were established between Virginia Department of Game and Inland Fisheries (now Virginia Department of Wildlife Conservation; VDWR) and the Mattaponi and Pamunkey in an effort to further repopulate Virginia's rivers with shad.

2.3.2 Population Demographics and Socioeconomics

CBNERR-VA's geographic scope is regionally broad, including coastal Virginia though also extending across the Chesapeake Bay region. The primary geographic focus area for program delivery however, is the York River watershed and its adjacent small coastal basins. This region, referred to as the CBNERR-VA Focal Area, (see Figure 2.4) is inclusive of 14 counties, 1 city and 3 towns: Caroline County, Essex County, Gloucester County, Hanover County, James City County, King and Queen County, King William County

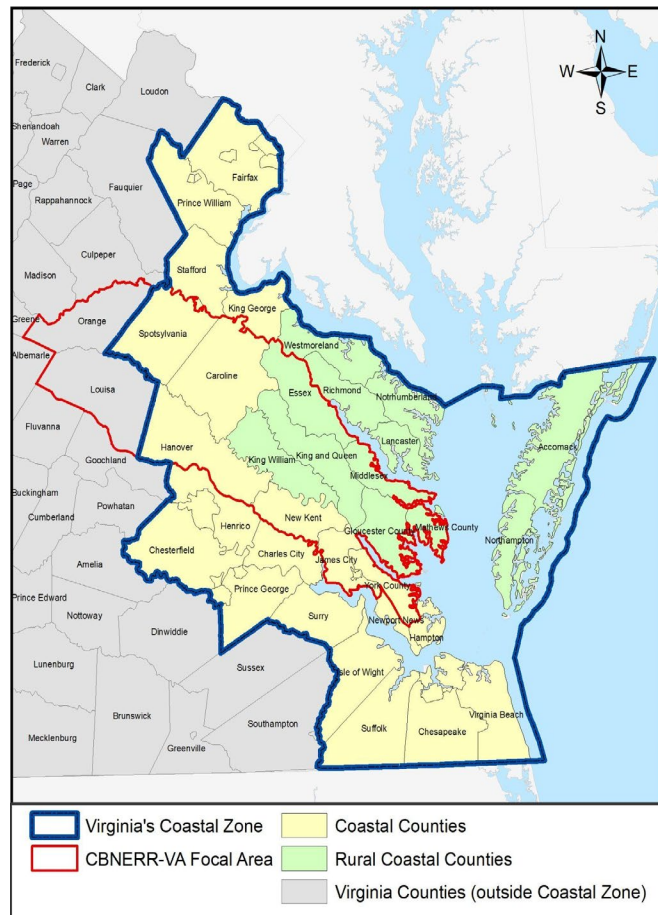


Figure 2.4. A depiction of CBNERR-VA's three target geographies: the CBNERR-VA Focal Area; Rural Coastal Counties; and Virginia's Coastal Zone Counties. Image credit: S. Lerberg.

County, Louisa County, Mathews County, Middlesex County, New Kent County, Orange County, Spotsylvania County and York County; Williamsburg city; and the towns of Tappahannock, Urbanna and West Point.

The combined York River watershed (the CBNERR-VA Focal Area) is among the Chesapeake Bay’s fastest growing in terms of population (see Figure 2.5). While established population centers found in Hanover and Spotsylvania counties continue to grow, increasing populations in York and James City counties are developing into population centers along tidewaters. On average, relevant counties experienced an estimated growth rate of 8.8% from 2010 and 2019 (U.S. Census Bureau, 2010 and 2019 American Community Survey 5-Year Estimates, <https://data.census.gov/>).

A subset of counties within the CBNERR-VA Focal Area, are also members of another geographic focus: Rural Coastal Virginia Community Enhancement Authority counties, or Rural Coastal Counties (Code of Virginia § 15.2-7600; see Figure 2.4). These 12 counties (Accomack, Essex, Gloucester, King and Queen, King William, Lancaster, Mathews, Middlesex, Northampton, Northumberland, Richmond, and Westmoreland) share social, economic, and environmental characteristics that contribute to the region’s overall vulnerability to external stressors. For example:

- *Decreasing Rural Population Growth.* Unlike adjacent counties, those in Rural Coastal Virginia are currently experiencing declining population changes (U.S. Census Bureau, 2010 and 2019 American Community Survey 5-Year Estimates, <https://data.census.gov/>) and projections to 2045 maintain this decrease (University of Virginia 2019).
- *An Aging Coastal Demographic.* Decreasing population growth has contributed to an aging coastal demographic. An average of 25.8% of the population in Rural Coastal Counties is 65 or older; the average among the whole of Virginia’s coastal counties is 17.5% (U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates). Future projections to 2040 demonstrate an increase in this percentage for Rural Coastal Counties (University of Virginia 2019).

In contrast to its Rural Coastal Counties, Virginia’s coastal counties and localities (as defined by the Code of Virginia § 28.2-100) harbor more diversity and breadth in demographics and socioeconomic characteristics. CBNERR-VA recognizes the varied demographic and socioeconomic nature of the geographies with which it works. Tables 2.1 and 2.2 outline the differences in socioeconomic and demographic categories, respectively, among the Reserve’s three target geographies.

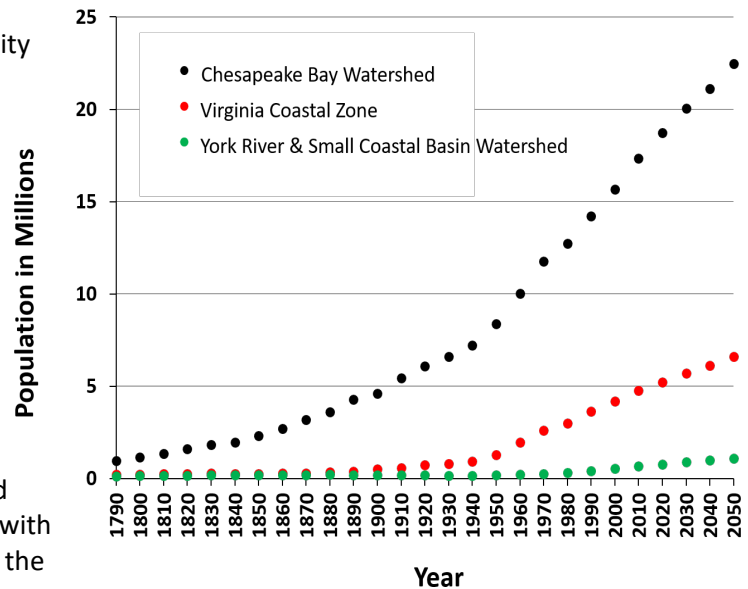


Figure 2.5. Historic, current and projected population estimates in the Chesapeake Bay Watershed, Virginia Coastal Zone, and the York River Watershed, including its adjacent coastal basins. Data source: Chesapeake Bay Program Office Data Center, 2020. Image credit: W. Reay.

Table 2.1. Socioeconomic data pertaining to CBNERR-VA’s three geographic areas of influence: CBNERR-VA’s Focal Area, Rural Coastal Counties, and Virginia’s Coastal Zone Counties. Developed using 2015-2019 five-year American Community Survey (ACS) estimates.

Socioeconomic Category	CBNERR-VA Focal Area	Rural Coastal Counties	Coastal Zone Counties
Households & Families			
● Average household size (persons)	2.5	2.3	2.6
● Average percent (%) households with ≥ 1 person under 18 yr of age	28.5	23.3	29.7
● Median household income (US dollars)	71,726	57,346	73,351
● Percent (%) families whose 12-month income was below the poverty level	4.9	8.6	6.4
Employment			
● Percent (%) population ≥ 16 yr of age in the labor force	63.7	55.2	69.0
● Percent (%) civilian employed population among those ≥ 16 yr of age	59.4	52.4	63.3
● Average mean earnings (US dollars) for full-time, year-round workers ≥ 16 yr of age	62,865	54,315	65,741
● Percent (%) civilian employed population ≥ 16 yr of age in the following sectors:			
○ Educational services, and health care and social assistance	22.2	21.2	21.2
○ Retail trade	12.5	12.1	9.8
○ Professional services (scientific, management, administrative)	11.6	9.5	17.0
○ Construction	8.2	9.7	6.6
○ Arts, entertainment, recreation, and accommodation and food services	9.1	7.5	9.2
○ Public Administration	8.7	7.0	10.2
○ Finance and insurance, and real estate and rental and leasing	6.3	4.9	6.8
○ Transportation	4.9	5.0	4.3
○ Agriculture, forestry, fishing and hunting, and mining	1.1	3.1	4.2

Table 2.2. Demographic data pertaining to CBNERR-VA’s three geographic areas of influence: CBNERR-VA’s Focal Area, Rural Coastal Counties, and Virginia’s Coastal Zone Counties. Developed using 2015-2019 five-year American Community Survey (ACS) estimates.

Demographic Category	CBNERR-VA Focal Area	Rural Coastal Counties	Coastal Zone Counties
• Total population (persons)	611,725	185,520	5,613,052
• Decadal growth rate (%) (as compared with 2010 ACS 5-year estimates)	8.8	-0.7	9.1
• Percent (%) population < 18 yr	21.9	19.0	22.6
• Average percent (%) population ≥ 65 yr of age	20.0	25.8	17.5
• Percent (%) population ≥ 18 yr with Bachelor's degree or higher	31.8	21.2	40.2
• Percent (%) population ≥ 25 yr with graduate or professional degree	13.8	8.4	19.3
• Racial and ethnic composition, average percent (%) of population:			
○ White	76.7	71.4	65.8
○ Black or African American	16.5	23.9	24.4
○ American Indian / Alaska Native	0.3	0.3	0.4
○ Asian	1.7	0.6	3.5
○ Hispanic / Latino origin (any race)	4.3	4.1	8.1
○ ≥ 2 races (or Hispanic or Latino origin)	3.4	2.6	3.6

2.4 CONTINUING & EMERGING CHALLENGES

2.4.1 Natural & Anthropogenic Threats

Degradation of marine and estuarine environments is of global concern and the Chesapeake Bay system is no exception. The Chesapeake Executive Council, consisting of the six watershed state governors, mayor of the District of Columbia, chair of the Chesapeake Bay Commission, and the administrator of the USEPA, reaffirmed their commitment to the restoration and protection of the Chesapeake Bay system by signing the Chesapeake Bay Watershed Agreement in 2014 (Chesapeake Executive Council 2014). Interrelated themes of the plan included restoring clean waters, restoring and protecting vital habitats, sustaining fish and wildlife, conserving land and providing public access, engaging communities, and increasing resilience to climate change.

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, 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; and
- Declining finfish and shellfish populations due to overfishing, disease issues, and habitat loss.

With important anthropogenic greenhouse gases (GHG), carbon dioxide (CO₂) and methane (CH₄), continuing to rise at an alarming rate (2020 global average concentrations: 412.5 ppm and 1892.3 ppb, respectively; NOAA 2021), Chesapeake Bay coastal ecosystems are under additional threats from an unprecedented combination of climate change related stressors. GHG emissions are expected to result in near term (2021-2040) global warming on the order of 1.5 °C and long-term (2081-2100) warming of 2.7 °C under intermediate emission scenarios (IPCC 2021); temperature increases are in reference to 1850-1900.

A warming atmosphere drives climate change with wide-ranging impacts to estuarine systems, including but not limited to, alteration to heat budgets increasing water temperatures, rising sea levels and changes in estuarine circulation dynamics, enhanced extreme weather patterns (i.e., increased storm frequency and magnitude, and summer drought conditions), changes in rainfall and watershed hydrology, along with elevated ocean acidification and eutrophication risks. Observed and anticipated changes in climate related variables with respect to historical conditions are presented in Figure 2.6.

Of special note is the vulnerability of Chesapeake Bay and coastal Virginia to elevated relative SLR rates (long-term NOAA bay tide station range: 3.2 -5.9 mm•yr⁻¹), which represent some of the highest observed in the nation. Contributing to these elevated rates are global steric (changes in water density and volume due to changes in temperature and salinity) and eustatic (changes in ocean water mass due to increased water input from melting ice, increased land runoff and direct precipitation) processes (Meier and Wahr 2002), along with regional subsidence (glacial isostatic adjustment from retreat of Laurentide Ice Sheet; Pope and Burbey 2009; Eggleston et al. 2013) and weakening of the Gulf Stream (Ezer et al. 2013), and local subsidence resulting from groundwater withdrawal (Eggleston et al. 2013). Projected sea level, over 2005 levels for the Chesapeake Bay region, is expected to be on the order of 0.4 m (1.4 ft) by 2050 based on NOAA intermediate projections (Sweet et al. 2022). It is projected that ~109,800 ha (271,400 ac or ~3% of VA Coastal Zone area) in coastal Virginia are at risk from future (2040) flooding (McLeod et al. 2020). With respect to Virginia's coastal communities, projected relative SLR has the potential to impact 545 miles of roadway and almost 31,000 buildings by 2040 assuming a NOAA intermediate-high scenario (McLeod et al. 2020).

Variable	Results
Global Atmospheric CO ₂	Pre-industrial: 278 ppm ↑ Current: ~412 ppm ¹ ↑ ~550 ppm by 2050
Air Temperature	0.023°C yr ⁻¹ (1960-2014) ² ↑ ~0.036 °C yr ⁻¹ ³
Precipitation	↑ 7-24% over current rates
River Flow	↑ 5% (mid 21 st century) ⁴ ↑ Winter/Spring ↓ Summer/Fall
Storms	↑ Frequency & Intensity ⁵
Droughts	↑ Frequency & Severity
Sea Level	Current RSLR 5-6 mm yr ⁻¹ ↑ ~9 mm yr ⁻¹ (mid 21 st century) ⁶
Water Temperature	↑ ~0.02 °C yr ⁻¹ (1949-2002) ⁷ ↑ ~0.032 °C yr ⁻¹ (mid 21 st century) ⁸
Salinity	↑ 0.5-2.0 (1949-2006) ⁹
Tide & Circulation	↑ Tide range (developed shore) ¹⁰ ↓ Tidal range (flooded shore) ¹⁰ ↑ Stratification ↓ Residence time

Figure 2.6. Summary of Chesapeake Bay climate change variables and observed/anticipated response. Data sources: (1) NOAA Climate 2021; (2) Rice and Jastram 2015; (3) IPCC Annex 2013; (4) Irby et al. 2018; (5) Pringle et al. 2021; (6) Sweet et al. 2017; (7) Preston 2004; (8) Ding and Elmore 2015; (9) Hilton et al. 2008; (10) Lee et al. 2017. Image credit: W. Reay.

CBNERR-VA has developed local and regional management needs based on these continuing and emerging anthropogenic and climate-related challenges. CBNERR-VA plans to address key management concerns in an integrated and comprehensive manner through primary focal areas including: (1) critical coastal habitat response and mitigation to environmental change; (2) water quality and quantity assessment to address aquatic life and societal needs; (3) protected area management and community connections; and (4) enhancing community resilience through improved environmental literacy, civic-based decision-making, and promotion of natural features and nature-based approaches (see Chapter 3 for more detail on CBNERR-VA focal areas).

2.4.2 Selected Management Needs

A summary of selected management needs in context with natural, anthropogenic, and climate change threats and stressors is provided below.

- *Critical Ecosystem Vulnerability to Acute and Chronic Stressors.* Several critical YRE ecosystems, most notably tidal herbaceous and woody wetlands, wetland-upland ecotones and underwater grass beds, are sensitive and vulnerable to short-term, stochastic stressors, as well as long-term, broader geographic-scale climate change factors. The most often cited stressors to wetland and ecotone vegetative communities include inundation from rising sea levels and subsiding lands, associated salt water intrusion within tidal freshwater wetlands and associated upland ecotones, periodic drought conditions, reduced wetland soil/sediment vertical accretion, mechanical damage due to enhanced storm activity, and the spread of invasive species. With respect to SAV, stressors include freshwater flushing events and mechanical damage due to enhanced storm activity, elevated summer water temperatures and increased seasonal variability, and decreased water clarity. While CBNERR-VA successfully monitors and documents these stressors and their associated impacts on ecosystems (and key species), translating results to support effective natural resource management as well as the ability of the management community to respond effectively remains a significant challenge. Emphasis placed on developing a greater understanding of critical interactive processes leading to habitat vulnerability, and development of actionable mitigation strategies to enhance natural resource resiliency, is desired. There is a dearth of site-specific information on ecosystem services under different climate scenarios, and options for reasonable restoration approaches to mitigate the loss of these valuable services. Research that advances the identification, quantification, and valuation of ecosystem services (e.g., water quality, carbon sequestration, erosion control and habitat value) under different environmental conditions and climate change scenarios, as well as research that explores ecosystem restoration strategies mitigating current and anticipated stressors, is a site priority.
- *Water Quality and Quantity.* The YRE continues to suffer from chronic water quality issues driven by excessive loads of sediment, nutrients (N, P) and to varying degrees, oxygen consuming material (e.g., organic matter). Moreover, emerging issues such as estuarine and coastal water acidification, and impacts of HABs on aquaculture practices are becoming of greater local concern. Additional insight into how episodic events (e.g., inter-annual variations in hydrologic budgets, large-scale storm events), longer-term climatic changes, and man-induced activities (water withdrawal and discharge) affect estuarine water quality and material flux is warranted. Moreover, this work may be fully utilized through collaborative efforts between communities engaged in research, water management, and resource protection.
- *Increasing Coastal Habitat and Community Resiliency.* In the 2019 U.S. Army Corps of Engineers Chesapeake Bay Comprehensive Plan (USACE 2019), the Commonwealth of Virginia identified the York River, Piankatank River, and Mobjack Bay as a priority area for natural and nature-based (NNB) shoreline resiliency projects to benefit coastal communities. This region was selected as a NOAA Habitat Focus

Area in 2022, and as such, will enhance partnership efforts to restore critical fish and shellfish habitats and improve coastal community resilience. To promote coastal resiliency efforts in Virginia, CBNERR-VA, in conjunction with regional partners, is supporting the development of a York-Piankatank-Mobjack Bay NNB nearshore restoration “Community of Practice” to collectively advance coastal community resiliency projects. Climate-adaptive nearshore nature-based resiliency projects would include those focused-on wetlands, oyster reefs, living shorelines, and SAV. Goals of this community of practice include: (1) identification and prioritization of restoration sites; (2) creation of detailed design plans for climate adaptive NNB nearshore restoration projects in this geography; (3) collaborative efforts to implement selected resiliency projects; and (4) the development and use of common protocols for the monitoring and evaluation of projects. Once implemented, these projects could help promote coastal community resiliency by reducing wave energy and shoreline erosion, protecting human health and safety and enhancing quality of life, while at the same time providing habitat for critical Chesapeake Bay species of ecological and economic concern. Creative efforts to further advance the “Community of Practice” and coastal resiliency efforts is a CBNERR-VA priority.

2.5 RESERVE COMPONENT DESCRIPTIONS

CBNERR-VA is a multi-component reserve that encompasses the broad salinity regime found within the YRE. Starting downriver, reserve components include Goodwin Islands (York County, York River - Mobjack Bay complex), Taskinas Creek (James City County, York River), Catlett Islands (Gloucester County, York River), and Sweet Hall Marsh (King William County, Pamunkey River); see Figure 2.1 for geographic distribution of Reserve components within the YRE. Collectively, the Reserve encompasses 1,244 ha (3,072 acres) of coastal habitat representative of the southern Chesapeake Bay region. The following sections provide component specific information with respect to location, ownership, physical and habitat characteristics, cultural resources, and identified management needs; additional details can be found in the Reserve’s Site Profile (JCR 2009).

2.5.1 Goodwin Islands

- *Location.* The Goodwin Islands (37° 13' N; 76° 23' W) component of CBNERR-VA is located on the southern side of the mouth of the York River (Figure 2.7). The islands are at the northeastern tip of York County approximately 10 km (6 mi) down the York River from VIMS.
- *Ownership and Management.* Goodwin Islands are owned by the W&M Foundation. CBNERR-VA serves as the on-site manager of the islands.
- *Physical Conditions.* Tides at Goodwin Islands are semidiurnal and display an average range of 0.75 m (2.5 ft). Mean monthly water temperature ranged from 9.0-20.2 °C for spring (Mar-May), 25.3-27.9 °C for summer (Jun-Aug), 12.9-24.8 °C for fall (Sep-Nov), and 5.5-8.2 °C for winter (Dec-Feb). Located within the meso-polyhaline region of the YRE, mean monthly salinity ranged from 17.5-18.2 psu for spring, 17.8-20.0 psu for summer, 19.9-20.2 for fall, and 18.6-19.6 psu for winter. Data sources: tidal range (SWMP GI CMON station, 2017-2020), temperature and salinity (SWMP GI CMON station, 2003-2020).
- *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 2.7). 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); see Figure 2.8 for Reserve generated high-resolution habitat map. 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 sea rocket (*Cakile edentula*). Salt shrubland community, consisting primarily of groundsel trees (*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 grass beds of eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) approximately 71 ha (175 ac) in area (Orth et al. 2019), large expanses of unvegetated bottoms, and shallow open estuarine waters

- *Species of Concern.* 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 with the last reported single nest occupation in 2013 (CCB 2021). Diamondback terrapin (*Malaclemys terrapin*) is considered a keystone species within



Figure 2.7. Aerial image of Goodwin Islands Reserve component delineating core area. Image credit: S. Lerberg.

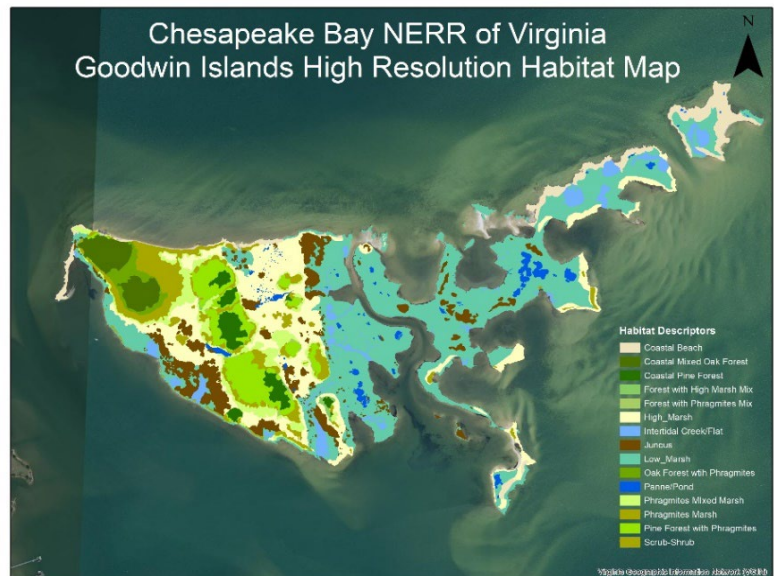


Figure 2.8. High resolution habitat map for the Goodwin Island Reserve component. Base map year: 2016/2017; Data Sources: (1) VGIN VMBO 2017 True Color Ortho Imagery (1 ft pixel resolution), Date of Imagery Acquisition: 2/26-3/23/2017; (2) Habitat field data collected with Trimble Geo7x to subfoot (less 30 cm) accuracy collected in 2015/2016. Image credit: S. Lerberg.

estuarine systems along the Atlantic and Gulf Coasts of the U.S. and has been documented at all four Reserve components. While this species currently has no federal protection afforded to it based upon the Endangered Species Act lists of federally threatened or endangered species, Virginia's DWR's Species Wildlife Action Plan list terrapins as a Tier II Rank A species. This state listing is provided to species with very high conservation needs. Additional species of elevated interest include eelgrass (*Zostera marina*) that suffer from annual summer heat stress dieback; Atlantic horseshoe crab (*Limulus Polyphemus*) that use the islands as a breeding site; and American oystercatcher (*Haematopus palliatus*) use of the islands for breeding and nesting.

- **Representative Soils.** Saltmarsh soils are represented by the Axis very fine sandy loam soil series, characterized by low slopes (0-2%), very poor drainage, and shallow water table depths (0-30 cm; 0-12 in). Upland maritime forest soils are represented by the Dragston fine sandy loam type with similar low slopes, somewhat poor drainage, and 30-76 cm (12-30 in) water table depths. Soils information was derived the USDA/SCS soil survey (USDA/SCS 1985).
- **Cultural and Historic Resources.** An archaeological survey has not been conducted at Goodwin Islands. Based on observations and personal communications, Goodwin Islands contain 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 palliatus*), and diamondback terrapins (*Malaclemys terrapin*); (4) assessment of SLR and shoreline erosion on critical habitats and geomorphic features; (5) restoration of SAV beds to past aerial coverage, (6) assess impacts of harmful algal blooms; (7) continued implementation of hunting management plan; (8) assessment of direct and indirect impacts of fishing activity on natural resources; (9) development of petroleum/toxic material spill contingency and response plans; (10) development of a fire contingency plan; (11) assessment of increased development and public access pressures on natural, cultural and historic resources; (12) survey of archaeological resources and development of an archaeological resource management plan; and (13) unauthorized public use of the Reserve which includes non-permitted collection of plants and animals, artifact collection, unleashed dogs and cats, and camping.

2.5.2 Catlett Islands

- **Location.** The Catlett Islands (37° 18' N; 76° 33' W) are located approximately 18 km (11 mi) from the mouth of the York River and 8 km (5 mi) from VIMS, on the North side of the York River in Gloucester County, Virginia (Figure 2.9). 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 Islands ecological unit except for a single tract (Owner: D. and M. Ablowich; Size: 32 ha or 79 ac; Parcel ID: 88) located on the most northwest portion of the islands (Figure 2.9). The majority of land comprising the Catlett Islands component is owned by the W&M/VIMS. VIMS serves as the on-site manager of the Catlett Islands and

assures consistency with the joint Memorandum of Understanding (MOU) between VIMS and VDCR (Dated: October 18, 2019, Appendix D).

- **Physical Conditions.** Tides at Catlett Islands are semidiurnal and display an average range of 0.77 m (2.5 ft). Mean monthly water temperature ranged from 8.6-19.2 °C for spring (Mar-May), 8.6-19.2 °C for summer (Jun-Aug), 24.8-27.9 °C for fall (Sep-Nov), and 4.3-9.0 °C for winter (Dec-Feb). Located within the meso-polyhaline region of the YRE, mean monthly salinity ranged from 14.2-15.0 psu for spring, 15.0-19.0 psu for summer, 17.7-19.7 for fall, and 15.6-17.1 psu for winter. Data sources: tidal range (Nobeltec Tides & Current, Cheatham Annex), temperature and salinity (SWMP CI Nutrient station, 2002-2020).

- **Representative Coastal Habitats.** The Catlett Islands component, approximately 220 ha (542 ac) of core area, consists of multiple parallel ridges of forested hammocks and emergent wetlands (Figure 2.7). Primary ecological community groups occurring at Catlett Islands include tidal meso and polyhaline marshes, forested wetlands, and maritime upland forests (Erdle and Heffernan 2005b) see Figure 2.10 for Reserve generated high-resolution habitat map. Smooth cordgrass (*Spartina alterniflora*), predominantly ‘short form’, 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-water shrub (*Iva frutescens*), groundsel tree (*Baccharis halimifolia*), southern bayberry (*Myrica cerifera*) and northern bayberry (*Myrica pennsylvanica*), occur in transitional areas from salt marsh to forested wetlands and hammock regions. Maritime upland forests, dominated by



Figure 2.9. Aerial image of Catlett Islands Reserve component delineating core area. Image credit: S. Lerberg.

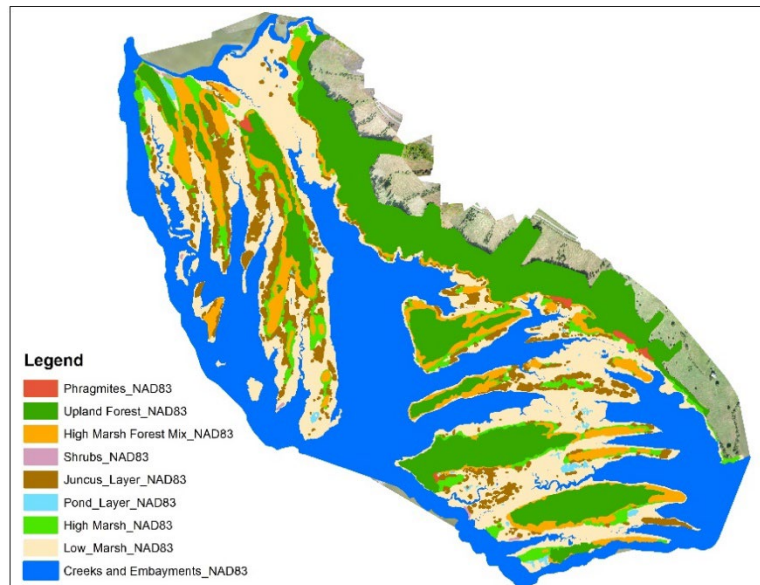


Figure 2.10. High resolution habitat map for the Catlett Island Reserve component. Base map year: 2016/2017; Data Sources: (1) VGIN VMBO 2017 True Color Ortho Imagery (1 ft pixel resolution), Date of Imagery Acquisition: 2/26-3/23/2017; (2) Habitat field data collected with Trimble Geo7x to subfoot (less 30 cm) accuracy collected in 2015/2016. Image credit: S. Lerberg.

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. Additional details of significant natural communities are provided by Erdle and Heffernan (2005b) and Perry and Atkinson (2009).

- *Species of Concern.* Flora surveys conducted to date do not indicate the presence of rare plant species. Breeding bald eagles have been documented in recent years with the last reported single nest occupation in 2016 (CCB 2021). Additional species of concern include diamondback terrapin, which utilize the Reserve as breeding and nesting grounds; migratory waterfowl (i.e., canvasback duck; *Aythya valisineria*) use the Reserve as overwintering grounds.
- *Representative Soils.* Frequently flooded salt marsh soils are represented by the Sulfaquant soil type, characterized by low slopes (0-2%), very poor drainage, and shallow water table depths (0-30 cm; 0-12 in). Upland forest ridge soils are represented by the Ochraquults-Haplaquelts complex soils series characterized by low slopes, somewhat poorly drainage, and water table depths on the order of 0-61 cm (0-24 in). Soils under the easternmost portion of Catlett Islands are dominated by large areas of Eunola fine sandy loam exhibit low slopes, are moderately well drained, and water table depths vary from 46-76 cm (18-30 in). Soils information was derived the USDA/SCS soil survey (USDA/SCS 1985).
- *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 yr B.P.) sites, and on the order of ten each of Middle Woodland (2,500-1,000 yr B.P.) and Late Woodland (1,000-400 yr. B.P.) sites. With respect to historic sites, numerous site occupations from the 17th through 20th centuries have been identified. Archaeological studies on the Islands and adjacent uplands are currently underway by the Fairfield Foundation.
- *Identified Management Issues.* Identified resource management issues on Catlett Islands and immediate surrounding area 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 palliatus*); (6) assessment of SLR rise and shoreline erosion on critical habitats and geomorphic features; (7) determination of water quality status for surrounding waters and assess the potential for SAV and oyster restoration; (8) assess impacts of HABS; (9) development of a petroleum/toxic material spill contingency and response plan; (10) development of a fire contingency plan; (11) assessment of increased development and public access pressures on natural resources; (12) enhanced survey of archaeological resources and development of an archaeological resource management plan; and (13) unauthorized public use of the Reserve which includes non-permitted collection of plants and animals, artifact collection, hunting and camping.

2.5.3 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 (Figure 2.9). The small subestuary of the York River is located on the southern side of the river, approximately 28 km (17 mi) upriver from VIMS and 38 km (24 mi) from the mouth of the York River (see Figure 2.1).

- **Ownership and Management.** YRSP contains 1034 ha (2554 ac; includes 44.5 ac Harrison tract acquired in 2003). All lands within the boundaries of York River State Park (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 (VDCR 2000b), are co-managed by the VDCR and VIMS in a manner consistent with the MOU between VIMS/W&M and the VDCR (Dated: December 22, 2021, Appendix E).

- **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 at Taskinas Creek are semidiurnal and display an average range of 0.90 m (3.0 ft). Mean monthly water temperature ranged from 10.6-22.1 °C for spring (Mar-May), 26.7-28.2 °C for summer (Jun-Aug), 11.7-24.6 °C for fall (Sep-Nov), and 5.2-7.4 °C for winter (Dec-Feb). Located within the meso-polyhaline region of the YRE, mean monthly salinity ranged from 8.3-8.6 psu for spring, 9.5-12.8 psu for summer, 11.1-12.7 for fall, and 8.7-9.6 psu for winter. Data sources: tidal range (SWMP TC CMON station, 2017-2020), temperature and salinity (SWMP TC CMON station, 2003-2020).

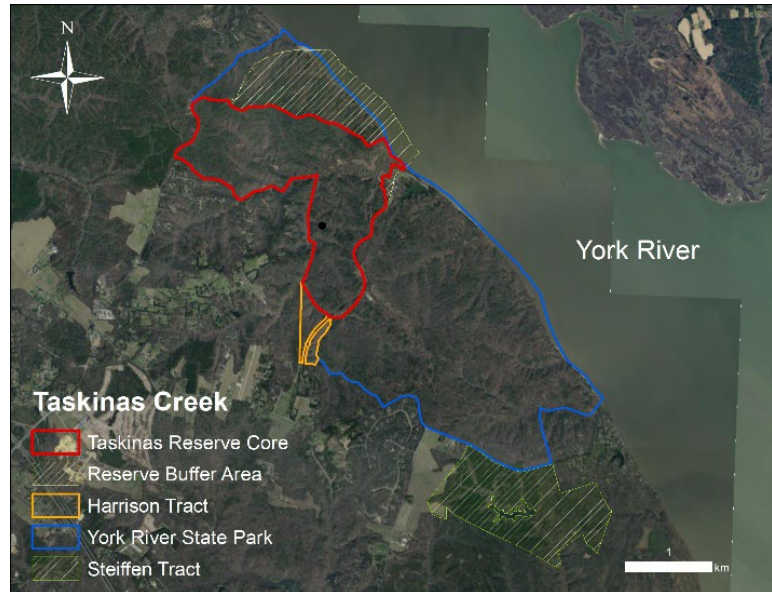


Figure 2.11. Aerial image of Taskinas Creek Reserve component delineating core and buffer areas, YRSP and selected state acquired tracts. Image credit: S. Lerberg.

- **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 2.9). The non-tidal portion of Taskinas Creek contains feeder streams that drain moderately to steep upland ravines. Upland communities include Piedmont, Coastal Plain Oak-Beech and Heath Forests and shrubs, particularly mountain laurel (*Kalmia latifolia*). Most ravine-bottom sites are influenced by calcareous soils and abundant groundwater emerging in braided streams and seeps; these support good examples of the Coastal Plain / Piedmont Basic Seepage Swamp community type. Better drained ravine bottoms with little or no seepage influence support relatively well drained floodplain forests dominated by tulip-poplar (*Liriodendron tulipifera*) and sweetgum (*Liquidambar styraciflua*). One rather anomalous ravine bottom supports vegetation that is best classified as Coastal Plain/Piedmont Acidic Seepage Swamp. This stand is underlain by sandier soils and supports such acidophiles as sweetbay (*Magnolia virginiana*) and sphagnum moss spp. Freshwater mixed wetlands are found in the upstream reaches of Taskinas Creek with plants including wild rice (*Zizania aquatica* var. *aquatica*), pickerelweed (*Pontederia cordata*), and arrow arum (*Peltandra virginica*). Additional Further details of significant natural communities are provided by Fleming et al. (2001), Myers et al. (2008a) and Perry and Atkinson (2009).

- **Species of Concern.** A population of rare mountain camellia (*Stewartia ovata*) (G4/S2), first discovered in 1990, was rediscovered within the Taskinas Creek component of the Reserve in 2006. Thirty two

plants were located in six subpopulation areas (Myers et al. 2008a). Breeding bald eagles have been documented in recent years with two occupied nests being reported in 2016 (CCB 2021).

- *Representative Soils.* Frequently flooded marsh soils are represented by Bohicket muck, characterized by very low slopes (0-1%), very poor drainage, and shallow water table depths (0-30 cm; 0-12 in). The soils of Taskinas Creek Reserve and surrounding region are weathered from unconsolidated sand, silt, clay, and gravel of Pliocene age. Underlying the mantle of sediments are local deposits of Lower Tertiary shells, shell marl, and limey sand that are frequently exposed on steep ravine slopes and stream bottoms at low relative elevations (usually < 15 m above sea level). Upland soils are represented by the Emporia and Craven-Uchee soil complexes characterized by elevated slopes of 6-10% and 20-50%, respectively, moderate to well drainage, and deeper water table depths; 91-137 cm (36-54 in) and 61-91 cm (24-36 in), respectively. Soils information was derived the USDA/SCS soil survey (USDA/SCS 1985).

- *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 et al., 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 are provided in the YRSP Resource Management Plan (VDCR 2000b). Note, VDCR has a current 2015 update to their original Master Plan which can be found at:

<https://www.dcr.virginia.gov/recreational-planning/document/mp4yrexecsum.pdf>

- *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 SLR and shoreline erosion on critical habitats and geomorphic features; (3) assessment as to origin and impact of nuisance and harmful algal blooms in upland water resources; (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 the trail system; and (8) unauthorized public use of the Reserve which includes non-permitted collection of plants and animals, artifact collection, and unleashed pets.

2.5.4 Sweet Hall Marsh

- *Location.* Located in King William County, Sweet Hall Marsh (37° 34' N; 76° 50' W) is situated in the tidal freshwater-oligohaline transitional zone of the Pamunkey River, one of two major tributaries of the YRE. Sweet Hall Marsh has historically represented the lower-most extensive tidal freshwater marsh located in this riverine system. Sweet Hall Marsh is approximately 23 km (14 mi) from West Point, where the Pamunkey and Mattaponi converge to form the York River (Figure 2.12). The site is 65 km (40 mi) upriver from VIMS and 75 km (47 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. CBNERR-VA/VIMS serves as the on-site manager of the Sweet Hall Marsh component of the Reserve and assures consistency with the Sweet Hall NERR Management Agreement last dated May 1, 2008 (Appendix F; currently working on updated MOU).

- *Physical Conditions.* Tides at Sweet Hall Marsh are semidiurnal and display an average range of 0.82 m (2.7 ft). Mean monthly water temperature ranged from 10.2-21.4 °C for spring (Mar-May), 26.2-28.9 °C for summer (Jun-Aug), 12.9-25.2 °C for fall (Sep-Nov), and 5.8-8.0 °C for winter (Dec-Feb). Located within the tidal fresh-oligohaline region of the YRE, mean monthly salinity ranged from 0.4-0.5 psu for

spring, 0.9-3.4 psu for summer, 2.5-4.1 for fall, and 0.4-1.5 psu for winter. Data sources: tidal range (SWMP SH CMON station, 2017-2020), temperature and salinity (SWMP SH CMON station, 2003-2020).

- *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. A 59 ha (145 ac) buffer consists primarily of upland 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. Further details of significant natural communities are provided by Myers et al. (2008b) and Perry and Atkinson (2009).



Figure 2.12. Aerial image of Sweet Hall Marsh Reserve component delineating core and buffer areas, and selected private partner-owned tract. Image credit: S. Lerberg.

- *Species of Concern.* 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 observed 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). Breeding bald eagles have been documented in recent years with the last reported single nest occupation in 2016 (CCB 2021).

- *Representative Soils.* Frequently flooded marshes are represented by Lanexa mucky silty clay loam soils, characterized by near level slopes (0-1%), very poor drainage, and surface (0 cm) to near surface water table depths. Upland maritime forest soils are represented by the Dragston fine sandy loam type with low slopes, somewhat poorly drainage, and water table depths of 30-76 cm (12-30 in). The uplands consist of a variety of soil series, representative series include Altavista loamy sand and Conetoe loamy fine sand, that exhibit slopes typically ranging from 0-4%, moderately well to well drained drainage classes, and water table depths >200 cm (>80 in). S soils information was derived the USDA/NRCS soil survey (USDA/NRCS 2007).

- *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 area include: (1) assessment and control of problem invasive plant species which may include the non-native common reed (*Phragmites australis*); (2) assessment of relative SLR 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.



CHAPTER 3 - RESERVE STRATEGIC ROADMAP

3.1 RESERVE VISION & MISSION STATEMENTS

NERRS Vision Statement: Resilient estuaries and coastal watersheds where human and natural communities thrive.

CBNERR-VA Mission Statement: Exhibit leadership in coastal zone management through innovative estuarine and coastal watershed science and education programs that promote natural resource stewardship and science-based solutions to complex socio-ecological challenges.

3.2 PILLARS OF OPERATION

The following five Pillars of Operation, listed in no particular order, represent CBNERR-VA's core values and orienting principles; they are the bedrock of the reserve's program development, and the lens through which the reserve approaches its roadmap toward vision achievement. CBNERR-VA's Pillars reflect: current need and future opportunity to establish and enhance related projects; capacity to foster related projects; and a communal investment and shared priority between Reserve staff and the communities and partners it serves. Goals that follow in Section 3.4 are framed by these foundational elements and reliant on the Reserve's internal growth with respect to each.

- *Five Programmatic Veins.* CBNERR-VA operates under a five programmatic organization structure, these are Research & Monitoring, Education & Outreach, Coastal Training, Administration, and Resource Management & Stewardship. The first three programs have been identified as national system-wide programs with specific niches. Administration and Stewardship, which encompasses Reserve operations and natural resource management, respectively, are applicable and inter-related across all programs of CBNERR-VA. Reserve goals and objectives, in many cases, cut across programmatic structure resulting in shared action responsibilities.
- *Responsible Conduct of Research.* Researchers have clear obligations to conduct research and dissemination of its results in a manner illustrative of integrity and high professional standards. Shared responsibilities among those conducting research include: (1) honesty in the development of information; (2) rigor and objectivity in the precise reporting of findings, taking care to avoid biases and errors; (3) provision of transparency in declaring interests; (4) adherence to all relevant Institute policies with respect to grant submission and management, acceptable laboratory and field practices, and safety policies and practices; and (5) treatment of others in a fair and equitable manner, including appropriate referencing and giving credit, including authorship where appropriate, to those that have made significant contributions.
- *Advisory Service & Technical Assistance.* CBNERR-VA recognizes that knowledge is power and seeks to empower others by sharing its knowledge of coastal and estuarine environments, related management practices and lived experience. In light of equitable and inclusive engagement, as well as meaningful communications, CBNERR-VA takes its responsibility as a conduit of information seriously. To this end, CBNERR-VA staff engage in a variety of technical assistance pursuits, advising on a myriad of topics, including status, trends, tools, opportunities and best practices, while serving

on a variety of local, regional and national workgroups and steering committees. CBNERR-VA strives to provide accessible technical assistance in a fair and just manner for all those who seek it, marketing and availing itself accordingly.

- *Communications.* CBNERR-VA recognizes that strong programs, reputation and trust are built on meaningful communications - both internally and externally. To this end, the reserve is committed to developing and maintaining channels of communication predicated on consistency, transparency and timeliness, among its staff, communities it serves, and partners with which it collaborates.
- *Diversity, Equity, Inclusion and Justice.* CBNERR-VA is committed to cultivating resilient coasts, requiring that it convene, listen to and elevate the lived experience and wisdom of Virginia’s coastal community members. Integrating local knowledge and perspective from diverse coastal voices while providing new opportunities to experience the coast and estuarine science in an equitable manner ensures that CBNERR-VA’s place-based understanding is holistic and inclusive. CBNERR-VA acknowledges that it continues to learn in this space, growing internally and externally. Its strength lies in allyship and engagement though it is not a leader by any means and as such, continues to seek learning and growth opportunities for its staff in this vein.

3.3 PRIORITY COASTAL MANAGEMENT ISSUES

CBNERR-VA’s Strategic Plan aligns with and complements the NERRS’s 2017-2022 Strategic Plan (NOAA/NERRS 2017) and the VIMS’s 2015-2020 Strategic Plan (VIMS 2015). The reserve system has identified climate change, water quality and habitat protection as national-level priority issues. VIMS areas of focus include increased understanding of human and global change impacts; improved coastal environment sustainability and resiliency; enhanced regional economy driven by research and discovery; and training of next generation marine science leaders.

CBNERR-VA will focus its efforts and investments in a collaborative manner with partners to address local needs while also having broader regional and national implications. Functional areas include:

- Enhancing and inspiring stewardship, protection, and management of estuaries, their watersheds and cultural connections through place-based approaches;
- Generation, application and transfer of scientific knowledge with respect to estuarine and coastal watershed resources to increase understanding, appreciation and betterment of coastal communities; and
- Advancement of environmental literacy and appreciation, allowing for better resource stewardship and science-based decisions that positively affect estuaries, their watersheds and communities.

3.4 RESERVE ACTION PLAN

The following section identifies primary goals and objectives for CBNERR-VA, grouped by functional area, over the five-year timeframe of this management plan.













Program Symbol Keys:

- | | |
|--------------------------------------|--------------------------------|
| Administration | Research & Monitoring Program; |
| Education & Outreach Program | Coastal Training Program; and |
| Stewardship and Resource Management. | |

Functional Area 1: Enhance and inspire stewardship, protection and management of estuaries, their watersheds, and cultural connections through place-based approaches.





Goal 1: Enhance resiliency of reserve habitats and their watersheds through increased understanding of their vulnerabilities and improved resource management and protection.

Objectives:

- 1) Update and implement Natural Resources Management Plans for individual reserve components. 
- 2) Develop vulnerability assessments of critical reserve habitats to understand risks from natural and man-made stressors in order to improve adaptation and mitigation planning.  
- 3) Transfer reserve and other science-based knowledge into resilience-related training and advisory service that support protection and restoration of coastal habitats and resilient communities.    
- 4) Support conservation and acquisition efforts that ensure representation and protection of the diverse ecosystems found within the YRE, its tidal tributaries and coastal watershed.  
- 5) Support enforcement of laws and regulations, including trespass, and development of emergency response plans pertaining to natural resource protection and management.   










Goal 2: Enhance protection and preservation of historical and archaeological sites and artifacts through increased understanding and improved resource management and protection.

Objectives:

- 1) Update Reserve strategic planning documents to meet site and artifact preservation and protection goals.  
- 2) Support enforcement of laws and regulations, including trespass, pertaining to historical and archaeological sites and artifact protection and management.  

Goal 3: Enhance individual and community connections to estuaries and coastal watersheds through visitation and experiential education.







Objectives:

- 1) Facilitate managed public access opportunities and enhance experiences through facilities, trails and information.   
- 2) Incorporate and demonstrate best practices in design, construction and renovation of facilities and amenities with emphasis on natural and nature-based (NNB) solutions and environmental sustainability.   
- 3) Support community science (e.g., Chesapeake Monitoring Cooperative [CMC]) and stewardship opportunities, along with other volunteer efforts, that contribute to reserve goals, programs and outreach.   

Functional Area 2: Generate, apply and transfer scientific knowledge of estuarine and coastal watershed resources to increase understanding, appreciation and betterment of coastal communities.





Goal 1: York River reserve components serve as catalysts for long-term, interdisciplinary and collaborative research to address contemporary challenges.

Objectives:

-  1) Assess the needs of decision-makers and stakeholders within the York River, the Chesapeake Bay and broader coastal systems to effectively target priority research topics and foster partnerships to encourage joint investigations with reserve components.
-  2) Develop, coalesce and disseminate physical site characterization (e.g., water quality summaries, habitat/land use inventories and maps), and sociodemographic and historic/archaeological information, and incorporate into a comprehensive research bibliography.
-  3) Test and support new methodologies, technologies and adaptive management strategies.
-  4) Use a permit system to coordinate and track research and related activities within reserve boundaries.
-  5) Promote reserves as living laboratories to the research community through a variety of communication (e.g., presentations, manuscripts, digital content) strategies.
-  6) Maintain long-term site management, security and research/monitoring oriented infrastructure.

Goal 2: Enhance systematic collection, preservation and dissemination of environmental and ecological observations essential to assessing, understanding, sustaining and improving quality of the YRE and other coastal systems.

Objectives:

-  1) Maintain and enhance aspects of the York River System-wide Monitoring Program (SWMP) designed to collect long-term data on water quality, weather, habitats, and land use/cover characteristics.
-  2) Expand spatial resolution of environmental and ecological observations to realize a network that spans from tidal tributary headwaters to offshore and from shallow littoral to deep channel waters.
-  3) Develop additional monitoring and investigative capacity to address emerging water quality (e.g., harmful algal blooms and ocean acidification) and quantity issues of concern.
-  4) Maintain and enhance aspects of the York River Sentinel Site Program (SSP) to collect long-term ecological data on critical habitats (i.e., underwater grasses, tidal marshes and marsh-forest ecotones).

- Res
Stw
 5) Encourage surveys and inventories of historical/archaeological resources within reserve boundaries.
- Res
Edu
Ctp
Stw
 6) Broaden utility and capacity of the CBNERR-VA Data Center supported data hubs (e.g. Virginia Estuarine and Coastal Observing System [VECOS], CMC Chesapeake Data Explorer) and contribute to regional observing system networks including the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) and the Chesapeake Bay Sentinel Site Cooperative (CBSSC).

Goal 3: Focus Reserve research efforts on chronic and event-driven environmental change impacts on critical habitats and development of adaptive capacity strategies to minimize stressor impacts.

Objectives:

- Res
Stw
 1) Advance understanding of tidal marsh and marsh-forest ecotone structure and function responses to acute and chronic changes in sea-level rise, subsidence, erosion and invasive species along the YRE salinity gradient.
- Res
Stw
 2) Advance understanding of underwater grass structure and function response to acute and chronic changes in environmental water quality conditions.
- Res
Stw
 3) Through field studies and model analysis, forecast habitat condition and test effectiveness of a range of adaptation and mitigation strategies.
- Res
Stw
 4) Examine how episodic events (e.g., inter-annual variations in hydrologic budgets, large-scale storm events), longer-term climatic changes, and man-made disasters affect estuarine water quality and material flux.

Goal 4: Communicate reserve research, environmental and ecological data, and products to scientific, management, decision-making and educational audiences.

Objectives:

- Ctp
Edu
Res
Stw
 1) Foster synthesis of long-term and spatially extensive data sets (i.e., water quality, and ecological status & trends reports) and support related regional and national level synthesis products, including a State of the York report synthesizing regional watershed data.
- Ctp
Stw
Res
 2) Communicate Reserve research through peer-reviewed and other publications, presentations at conferences (e.g., biennial York River Research Symposium) and organizational seminars, and through digital content.
- Edu
Ctp
 3) Incorporate Reserve monitoring data and research findings into education (e.g. Teachers on the Estuary [TOTE]), training programs (e.g. CTP), and products.
- Res
Stw
 4) Based on real-time data delivery, develop rapid assessment tools that support development and implementation of adaptive management responses (e.g., species alerts).







- 5) Serve in an advisory capacity to national, regional, state, tribal and local coastal resource management, research and education agencies, and organizations and interest groups.

Functional Area 3: Advance environmental literacy and appreciation, allowing for better resource stewardship and science based decisions that positively affect estuaries, their watersheds and communities.





Goal 1: Centered on Virginia’s estuarine and coastal resources, cultivate a local populace with positive environmental behaviors through increased K-12 grade student and teacher environmental literacy.

Objectives:

-  1) Provide Science, Technology, Engineering & Mathematics (STEM) based Kindergarten-12 grade (K-12) education programs that are consistent with state science performance standards and incorporate reserve generated science and data.
-  2) Provide in-service and pre-service teacher training consistent with NERRS TOTE criteria and state science performance standards.
-  3) Conduct multi-age environmental stewardship and Chesapeake Bay exploration summer camps.
-  4) Develop and make accessible education resources via traditional venues (e.g., resource boxes), the web (e.g., VECOS, CMC Data Explorer) and other formats (e.g., social media, story maps).





Goal 2: Coastal decision-makers (CDMs) and environmental professionals will understand, and effectively utilize and apply, science-based tools, information and planning approaches that support resilient estuaries and communities.

Objectives:

-  1) Deliver professional and technical training to coastal resource management and community planning decision-makers on Reserve and user-identified topics.
-  2) Facilitate stakeholder engagement, strategic partnerships and collaborative efforts that operate at the nexus of socio, ecological and economic resilience, leveraging reserve research and technical capacity.
-  3) Develop and deliver issue-based documents and other communications to support dissemination of scientific findings and recommendations to coastal decision-makers.
-  4) Develop and increase public access to databases (e.g., VECOS) and decision-support tools (e.g., water quality alerts, habitat restoration resources) and facilitate their application.



Goal 3: Increase general public awareness and ability to improve stewardship of estuaries, coastal watersheds and their communities.

Objectives:

-  1) Provide family-oriented experiences and lifelong learning opportunities (e.g., Discovery Labs, VIMS Marine Science Day and Estuaries Day) that generate a greater understanding and appreciation of Chesapeake Bay and coastal resources.
-  2) Facilitate the development of community science data collection programs through development of standardized methods, quality control data protocols and training opportunities.
-  3) Develop volunteer opportunities that contribute to reserve research, stewardship and education programs.
-  4) Develop and interpret on-site projects and activities that demonstrate NNB solutions and good stewardship principles (e.g., living shorelines).



Goal 4: Enhance opportunities for VIMS graduate students, staff and faculty members to communicate results of their research to decision-makers, teachers and students, and the broader general public community.

Objectives:

-  1) Promote participation in Reserve coastal training (e.g., topic relevant workshops), education (e.g., Virginia Scientists and Educators Alliance program) and public outreach programming (e.g., Discovery Labs, York River Research Symposium).
-  2) Reserve staff serve as outreach communication leads and/or broader impact advisors on sponsored research grants.

Goal 5: Train and empower the next generation of marine science leaders through early career development opportunities.

Objectives:

-  1) Promote high school student volunteer and mentorship opportunities in Reserve educational programming (e.g., Discovery Labs and Summer Camps).
-  2) Promote and support undergraduate and graduate student research and education opportunities through federal (e.g., NOAA/NERRS Margaret A. Davidson fellowship, and NOAA's Hollings Scholar and College Supported Internship Programs) and local VIMS/CBNERR-VA (e.g., Rouse-Bottom Fellowship, Conservation Internship, and Virginia Scientists and Educators Alliance) programs.



CHAPTER 4 - ADMINISTRATIVE & OPERATIONS

4.1 ORGANIZATION FRAMEWORK & MANAGEMENT AUTHORITIES

The primary goal of the CBNERR-VA administration is to support and enable its science, education, and stewardship programs to achieve success and fulfill the Reserve’s mission. The Administration and Operations Plan outlines the organizational relationships and framework that governs the Reserve, describes staff resources needed to fulfill the Reserve’s mission, and includes infrastructure elements critical to Reserve operations.

4.1.1 Organization Framework & Management Authorities

The administration of CBNERR-VA is achieved through a collaborative partnership between the U.S. Department of Commerce through the NOAA and the Commonwealth of Virginia through VIMS/W&M (see Figure 4.1). NOAA’s Office for Coastal Management (OCM), which is within the National Ocean Service (NOS), 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, OCM is responsible for ensuring that CBNERR-VA is managed according to the NERRS regulations (15 CFR 921) and its approved management plan. 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.

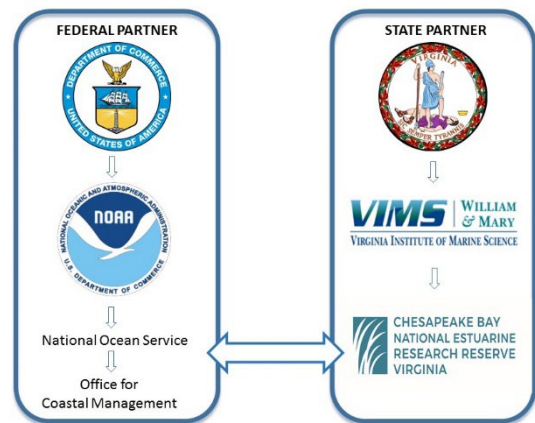


Figure 4.1. CBNERR-VA State-Federal partnership organizational & communication structure. Image credit: W. Reay.

Chartered in 1940, VIMS is currently among the largest marine research and education centers in the U.S. and is recognized worldwide for its expertise in estuarine and coastal marine science. The Institute’s 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 the graduate school in marine science for W&M. There are typically 100 graduate students at the Institute and over 50 faculty within four academic departments.

Administered on a daily basis by VIMS, CBNERR-VA is recognized as an Institute Research Center and has a direct report to the Dean/Director. CBNERR-VA is headquartered at the Institute’s Gloucester Point, Virginia main campus as is Virginia’s Sea Grant (VSG). All Reserve associated faculty and staff are employees of VIMS and therefore, W&M and the Commonwealth of Virginia. W&M Foundation and VIMS holds title to the Catlett and Goodwin Islands components of the Reserve, respectively, and the VIMS Foundation holds gifts donated to support Reserve programs.

4.1.2 Key Land Holding Partners

- *William & Mary.* The W&M Foundation, formerly W&M's Endowment Association, holds title to the Goodwin Islands (Jurisdiction: York County; Date Acquired (12/1/1984): GPIN #'s (V11c-2156-0114, W11c-0632-0835, and W11b-3167-3152) for the intent to advance and further the work of W&M and VIMS. VIMS hold title to Catlett Islands (Jurisdiction: Gloucester County; Date: April 20, 2012; Parcel ID: 44-87, 44-89, 44-90, 44-91, and 45-64). CBNERR-VA serves as the on-site manager of both Goodwin and Catlett Islands component of the Reserve and assures consistency with property agreements.
- *Virginia Department of Conservation and Recreation.* The Virginia Department of Conservation & Recreation (VDCR) is responsible for the management of state parks and natural area preserves, conservation of Virginia's plant and animal biodiversity, and nonpoint nutrient and soil management. VDCR holds title to the lands that comprise YRSP, of which includes the Taskinas Creek component of the Reserve. Additionally in 2020, VDCR acquired Timberneck Farm that comprises the immediate adjacent uplands to Catlett Islands. In 2021, this tract became the state's 40th park, Machicomoco State Park. VDCR's Division of Parks assists in the cooperative management of the Taskinas Creek and Catlett Islands reserve components through MOUs, last dated February 12, 2014 and October 18, 2019, respectively (see Appendices 2.4 and 2.3). DCR's Division of Natural Heritage also advises the Reserve on relevant natural resource management issues.
- *Tacoma Hunting and Fishing Club.* Sweet Hall Marsh is privately owned by the Tacoma Hunting and Fishing Club, Inc. CBNERR-VA serves as the on-site manager of the Sweet Hall Marsh component of the Reserve and assures consistency with the Sweet Hall Marsh National Estuarine Research Reserve Management Agreement last dated May 1, 2008 (see Appendix F).

4.1.3 Selected State & Federal Agency Partnerships

- *Virginia Department of Environmental Quality.* The Virginia Department of Environmental Quality (VDEQ) administers multiple programs with the goal of protecting and enhancing Virginia's environment along with the promotion of the health and well-being of the citizens of the Commonwealth. The Reserve is an active and voting member of the VCZMP's Coastal Policy Team, a network of state agencies and local governments sharing a broad range of responsibilities including restoring and protecting coastal habitats, improving resilience of coastal communities with an emphasis on nature-based solutions and enhancing public access (Program website: <https://www.deq.virginia.gov/Programs/CoastalZoneManagement.aspx>). Through the lower Chesapeake Bay Shallow Water Monitoring Program, CBNERR-VA is engaged with VDEQ Waters Program to monitor and assess tidal waters (Program website: <https://www.deq.virginia.gov/Programs/Water.aspx>). Additionally, CBNERR-VA is the lead facilitator for VDEQ Waters Program's York River & Small Coastal Basin (YR&SCB) Roundtable that provides a forum of information sharing and collaboration among water quality and conservation-minded stakeholders (Program website: <https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WatershedRoundtables.aspx>).
- *Virginia Department of Wildlife Resources.* The Virginia Department of Wildlife Resources (VDWR), formerly Virginia Department of Game and Inland Fisheries, is responsible for the management and regulation of inland fisheries, wildlife and recreational boating for the Commonwealth of Virginia. Specific to the Reserve, VDWR Conservation Police Officers enforce hunting, fishing and boating regulations as well as trespass issues as they pertain to the four Reserve components (Program website: <https://dwr.virginia.gov/conservation-police/>).

- *Virginia Marine Resources Commission.* Virginia Marine Resources Commission (VMRC) is responsible for the management and regulation of tidal commercial and recreational fin and shellfish fishing, and management and protection of subaqueous lands, tidal wetlands and dunes (program website: <https://www.mrc.virginia.gov/>). Specific to the Reserve, VMRC Marine Police enforce fishing and boating regulations (Agency web link: <https://www.mrc.virginia.gov/MP/>) and the Habitat Management Division manages and reviews project permit applications as they pertain to the four Reserve components.
- *Chesapeake Bay Program.* The Chesapeake Bay Program (CBP) is the regional partnership that directs and conducts the restoration of the Chesapeake Bay system. The partnership program includes watershed states (e.g., Virginia, Maryland, Delaware, West Virginia, Pennsylvania, New York), the District of Columbia, federal agencies (EPA serving as the lead), and academic and local organization partners to build and adopt policies that support Chesapeake Bay restoration. CBNERR-VA engages the CBP through implementation of the lower Chesapeake Bay Shallow Water Monitoring Program and advisory service on key CBP committees and workgroups (CBP website: <https://www.chesapeakebay.net>).
- *NOAA Chesapeake Bay Office.* NOAA's Chesapeake Bay Office (NCBO) is a critical partner in the Chesapeake Bay Program, leading CBP's fisheries, environmental literacy, habitat restoration and climate resiliency efforts. Specific to CBNERR-VA, the Reserve and NCBO work collaboratively to deliver the southern Bay Chesapeake Bay Interpretive Buoy System (CBIBS), experiential learning for K-12 grade students through the Bay Watershed Education and Training (BWET) program, meaning watershed educational experiences (MWEE's) training for teachers, and habitat restoration within the lower York River focus area (NCBO web site: <https://www.fisheries.noaa.gov/contact-directory/noaa-chesapeake-bay-office>).

4.1.4 Reserve Advisory Boards

CBNERR-VA has two standing senior level advisory boards that provide advice and guidance to the Education & Outreach and Coastal Training programs. The boards advise the Reserve on a myriad of facets including identifying collaborative opportunities, programming, and product development. Details of advisory boards are provided in the individual programmatic sections of this plan. The Reserve also creates ad hoc advisory committees to address specific needs as they arise.

4.2 FEDERAL CONSISTENCY & ENVIRONMENTAL COMPLIANCE

4.2.1 Federal Consistency

Every reserve in a state that has a federally approved CZMA program must include in the final management plan a determination that the reserve's plan is consistent to the maximum extent practicable with that program (15 CFR 921.4(b), .13 (a), and .30(b)). VCZMP's federal consistency determination is provided in Appendix B.

4.2.2 Environmental Compliance

The National Environmental Policy Act (NEPA), 42 U.S.C. 4231 et seq, and its implementing regulations, 40 CFR 1500 et seq, require federal agencies to undertake an assessment of the environmental effects of their proposed actions before making decisions. This Reserve Management Plan does not include changes to CBNERR-VA boundaries or add or significantly change allowable uses, uses requiring a permit, or restrictions on uses, and therefore qualifies for a A5 category exclusion; the NEPA determination is provided in Appendix C.

4.3 PROGRAM GOALS

CBNERR-VA's administrative goals are to provide support, guidance and administrative structure that allow for full implementation of Reserve programs. Basic administrative responsibilities include coordination and oversight of Reserve programmatic areas (research and monitoring, education and outreach, training and stewardship), providing fiscal and budget oversight, addressing human resource issues, maintaining and enhancing Reserve assets, and increasing the visibility and reputation of the Reserve. Administrative Program efforts contribute to the goals of this plan, and are detailed in the Reserve Strategic Roadmap, Section 3 of this plan.

4.4 CURRENT STAFFING, VOLUNTEERS & NEEDS

4.4.1. Current Staffing & Responsibilities

The Reserve Director, the Associate Director (also serves as the Research Coordinator) and Finance & Business Manager serve as the principal administration leads for CBNERR-VA. The Reserve's Administration Team, which assumes leadership responsibilities in the direction and function of the Reserve's integrated science, education, training and stewardship programs, includes principal administration leads, NERRS identified program coordinators (Education, CTP and Stewardship), and the Reserve's Marine Scientist Supervisor, and Environmental Data Center Manager. In addition to Reserve responsibilities, faculty and selected senior staff associated with CBNERR-VA maintain independent research/education programs that support additional staff providing the Reserve with additional knowledge, skills and capabilities applicable to its mission. Staff positions are funded through a variable combination of state, NOAA reserve operations awards, external sponsor grant funds and private donor support. While striving for long-term stability and potential expansion of staff and capabilities, variable year to year funding can lead to changes in staff numbers and responsibilities. The current CBNERR-VA organizational chart, as of June 2022, is provided in Figure 4.2 with a summary of primary responsibilities of CBNERR-VA staff is presented below. All Reserve staff are employees of W&M/VIMS.

Administration

- *Reserve Director* (70% state-funded, 30% sponsored programs; full-time; required faculty appointment). This position has joint responsibilities, including CBNERR-VA and as a faculty member to W&M/VIMS. Key CBNERR-VA responsibilities: serve as the NERRS manager sector point of contact; contribute to strategic planning and development of national policy for the NERRS; serve of the NERRA Board; provide overall guidance and coordination of Reserve operations and programs (science, stewardship and education); develop and administer Reserve operational grants and contracts along with associated progress reports and budgets; develop grants in support of Reserve priority areas; serve as a liaison with local, state and federal government agencies and non-governmental organizations; develop and maintain partnerships that enhance Reserve capacity; oversee land acquisition and capital construction projects; supervise staff; and VIMS certified trailerable vessel operator. W&M/VIMS academic department faculty responsibilities: maintain an independent, grant driven research program; author peer-reviewed publications; participate in the Institute's education program; and participate in Institute governance and advisory service.
- *Associate Director/Research Coordinator* (70% state-funded, 30% sponsored programs; full-time; required faculty appointment). This position has joint responsibilities, including CBNERR-VA and as a faculty member to W&M/VIMS. Key CBNERR-VA responsibilities: serve as the NERRS Research sector point of contact; contribute to strategic planning and research and monitoring program development of the NERRS; support the development and administration of Reserve operational grants and contracts

along with associated progress reports and budgets; develop grants in support of Reserve priority areas; serve as a liaison with the science community and primary contact to investigators working within Reserve boundaries; review research permit applications and coordinate relevant activities; interpret research and monitoring data results; work with other Reserve program leads to develop integrated programming; and supervise staff. W&M/VIMS academic department faculty responsibilities: maintain an independent, grant driven research program; author peer-reviewed publications; participate in the Institute’s education program; and participate in Institute governance and advisory service.

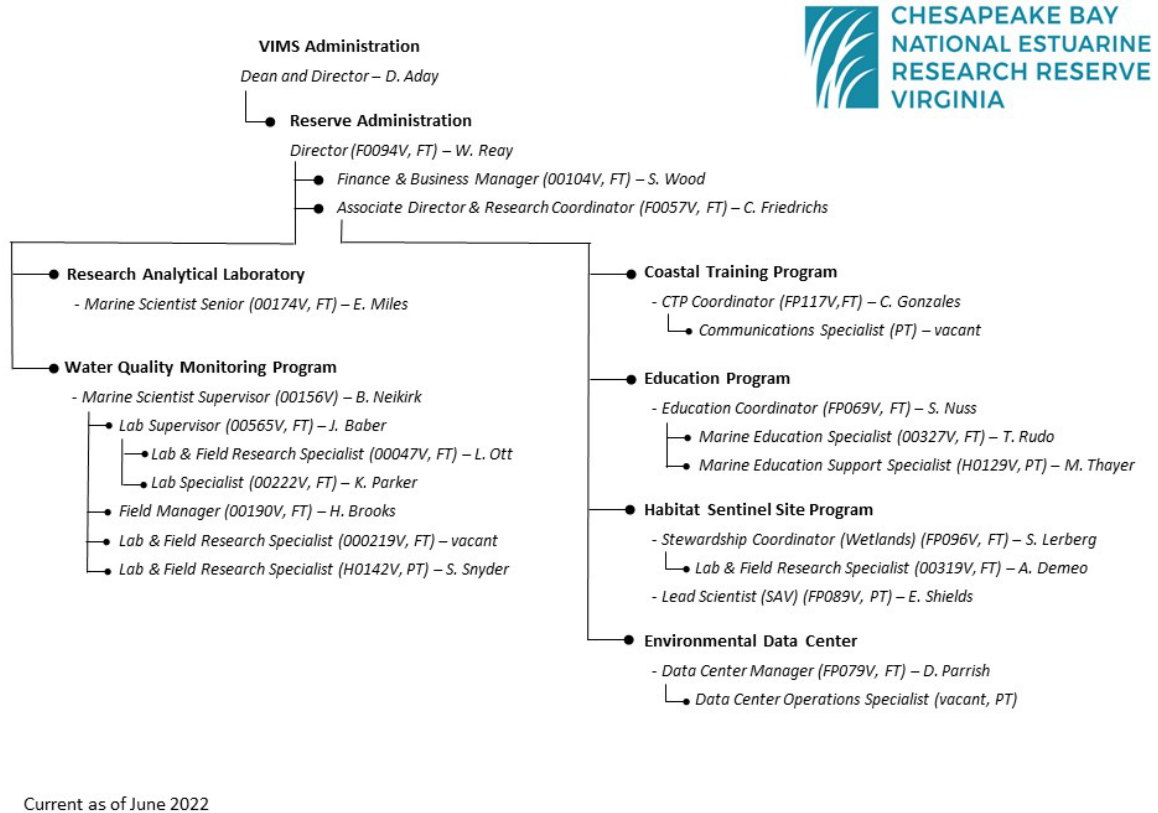


Figure 4.2. Reserve organizational chart. Image credit: W. Reay.

- **Finance & Business Manager** (85% state-funded; full-time). Key responsibilities: assist grant/award budget preparation; track grant expenditures and ensure all purchasing/contract actions follow state and federal guidelines and regulations; serve as the NERRS point of contact for grant and budget matters; provide direction and support on personnel matters and serve as the point of contact with W&M Department of Human Resources; serve as the point of contact with VIMS Offices of Sponsored Programs, Planning and Budget and Facilities; serve as Reserve principal purchasing agent; maintain equipment inventory; coordinate facilities use; and assist the Director with respect to grant reporting, meetings and daily office tasks.

Water Quality Research & Monitoring

- *Marine Scientist Senior* (70% state funded, 30% sponsored programs; full-time; 00174V): Key responsibilities: oversee CBNERR-VA Analytical and Nutrient Lab operations; conduct multi-medium sample analysis; serve as lead for Chesapeake Bay Interpretive Buoy (CBIBS) field and lab operations; field support for research and monitoring projects as needed; develop standard operating procedures for laboratory and field activities; develop and maintain SWMP nutrient data files; and VIMS certified trailerable vessel operator.
- *Marine Scientist Supervisor* (50% state funded, 50 % sponsored programs; full-time; 00156V). Key responsibilities: assist in the oversight of NOAA SWMP and VDEQ/CBP shallow water quality monitoring programs; coordinate field activities, vessels and vehicles between various groups of users; support shallow water habitat research studies; data analysis and preparation support of technical reports and presentations; supervise field and laboratory staff; and VIMS certified trailerable vessel operator.
- *Laboratory Supervisor* (100% sponsored programs funded; full-time; 00565V). Key responsibilities: perform quality control protocols on SWMP and VDEQ/CBP environmental data; develop associated metadata files; submit data to NOAA/NERRS Central Data Management Office (CDMO) and VECOS; provide oversight of CBNERR-VA Water Quality Lab; serve as a point of contact to CDMO and VIMS Analytical Lab; support general water quality laboratory operations as needed; and supervise and train water quality laboratory staff.
- *Lab and Research Specialist* (50% state funded, 50% sponsored programs funded; full-time; 00047V). Key responsibilities: maintain, calibrate and download laboratory and remote water quality instrumentation; troubleshoot water quality instrumentation issues; process multi-media samples; assist in quality assurance and control of data; provide initial data management; maintain equipment records; conduct chemical and supply inventories; procure needed items; support field operations as needed; and train other technicians and students.
- *Lab and Field Specialist* (100% sponsored programs funded; full-time; 00222V). Key responsibilities: maintain, calibrate and download laboratory and remote water quality instrumentation; maintain equipment records and troubleshoot instrument/equipment issues; process and maintain records/files of multi-media samples; support field operations of water quality monitoring; and support PI research programs as needed
- *Lab and Research Specialist* (100% sponsored programs funded; part-time; H0142V). Key responsibilities: provide lab and field support for shallow water quality monitoring program; maintain and calibrate laboratory and remote water quality instrumentation; and process multi-media samples.
- *Field Operations Manager* (100% sponsored programs funded; full-time; 00190V). Key responsibilities: provide field support for primary (NOAA/SWMP and VDEQ/CBP) water quality monitoring programs; provide field support for Reserve Sentinel Site Program (SSP) and other habitat research programs; provide direction, logistical and field support for natural resource management activities; assist in public access and site security tasks; serve as vessel safety officer and oversee vessel maintenance; and VIMS certified trailerable vessel operator.
- *Lab and Research Specialist* (100% sponsored programs funded; full-time; 00219V). Key responsibilities: provide lab and field support for primary (NOAA/SWMP and VDEQ/CBP) water quality monitoring programs; assist in PI research studies as needed; maintain and calibrate laboratory and remote water quality instrumentation; process multi-media samples; provide initial data management; and VIMS certified trailerable vessel operator.

- *Environmental Data Center Manager* (70% state funded, 30% sponsored programs; full-time; FP079V). Key responsibilities: oversee strategic planning, development, and management of Reserve Data Center; develop and maintain VDEQ/CBP shallow water monitoring and Chesapeake Monitoring Cooperative (CMC) databases; develop and maintain VECOS and CMC data web portals; generate water quality assessment including GIS-based products; data analysis, mapping and preparation support of technical reports and presentations; support PI research programs as needed; and supervise Data Center staff.
- *Environmental Data Center Operations Specialist* (100% sponsored programs; full-time; 00397V). Key responsibilities: maintain and modify as needed CMC Data Explorer data base and associated web application; facilitate delivery of data and related synthesis products for varied stakeholders, including annual grant submissions; oversee a range of data-related functions including data architecture, data quality and integrity, database management and security, and data distribution practices and policy.

Habitat Research & Management Program

- *Assistant Research Scientist* (50% state-funded, 50% sponsored programs; full-time; FP096V). Key responsibilities: serve as NERRS stewardship sector point of contact and as liaison with local/regional habitat management and restoration community; oversee stewardship strategic planning and program development; oversee Reserve wetlands SSP; coordinate and implement habitat/species of concern management, protection, and restoration programs; provide advice and technical assistance to resource managers and landowners; serve as GIS and geospatial survey technical and data management lead; analyze and interpret data with goal of developing resource management plans and other relevant information/scientific products; secure external funds to support the Reserve's Stewardship Program; work with CBNERR-VA program leads to develop integrated programming; supervise stewardship staff; and VIMS certified trailerable vessel operator.
- *Lab and Research Specialist* (100% sponsored programs funded; full-time; 00319V). Key responsibilities: conduct elevation and geospatial surveys; maintain and operate drones; provide GIS support; maintain weather and water quality station telemetry; provide field and lab support for Reserve SSP and water quality monitoring programs; support natural resource stewardship activities such as maintaining boundary signage and field infrastructure; support Reserve hunting program and public access; VIMS certified diver and trailerable vessel operator.
- *Lead Scientist* (100% sponsored programs funded; part-time; FP089V): Key responsibilities: oversee field and laboratory SAV studies; data management, analysis and interpretation; prepare proposals, technical reports and presentations; provide technical guidance; VIMS certified diver and trailerable vessel operator.

Education & Training

- *Education Coordinator* (25% state funded, 75% sponsored programs; full-time). Key responsibilities: serve as NERRS education sector point of contact; develop and implement K-16, teacher professional development, and community outreach education programs; support strategic planning and education program development of the NERRS; serve as a liaison with general education community; provide technical assistance to formal and informal education communities; translate and incorporate research and monitoring findings into education programs; develop Reserve educational materials; secure external funds to support Reserve education and community outreach programs; work with CBNERR-VA program leads to develop integrated programming; and supervise education staff.
- *Coastal Training Program Coordinator* (100% sponsored programs funded; full-time). Key responsibilities: serve as NERRS CTP sector point of contact; develop, market and implement coastal decision-maker training based on target audience needs assessments and Reserve priority issues;

support strategic planning and CTP development of the NERRS; serve as a liaison with professional training community; oversee and provide technical assistance to the YR&SCB Roundtable and other key stakeholder groups; provide guidance and contribute to enhanced and efficient Reserve communications; translate and incorporate research and monitoring findings into decision-maker training programs; develop Reserve technical and information products; secure external funds to support Reserve CTP; work with CBNERR-VA program leads to develop integrated programming; and supervise communication staff.

- *Marine Education Specialist* (75% sponsored programs funded, 25% private donor; full-time). Key responsibilities: 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.
- *Marine Education Support Specialist* (100% sponsored programs funded, part-time). Key responsibilities: support development and implementation of multi-age classroom and field based education programs; assist with educator training curriculum development and field based programs; conduct program evaluations and modify information products as needed; and assist in equipment and gear maintenance.
- *Digital Content and Social Media Specialist*. (100% sponsored programs funded, part-time). Key responsibilities: executing and enhancing the overall CBNERR-VA digital strategy (i.e., website, Facebook/Facebook Live, and Instagram/Instagram Live); maintaining and updating editorial calendars for team's review in advance of publishing; creating compelling content; identifying opportunities/stories; and working with the communications team on implementation to meet engagement goals.

4.4.2 Fellowship & Intern Programs

Several opportunities exist for fellowship and internship positions at CBNERR-VA including the Rouse Bottom Fellowship, the Margaret A. Davidson (Davidson) Fellowship, and CBNERR-VA Conservation Internships. Additionally, CBNERR-VA partners with NOAA's Undergraduate Hollings Scholar Program and Five Colleges Undergraduate Summer Internship; for additional information, see <https://www.noaa.gov/office-education/hollings-scholarship> and <https://www.fivecolleges.edu/marine>, respectively.

- *Rouse-Bottom Fellowship*. The CBNERR-VA Rouse-Bottom endowed fellowship provides financial support to undergraduate and graduate students engaged in research and long-term ecological data collection that can be directly used to better manage and protect the Reserve's natural resources. The Fellowship is typically awarded on an annual basis.
- *NOAA/NERRS Margaret A. Davidson (Davidson) Fellowship*. The NOAA sponsored Davidson Fellowship provides opportunities for graduate students enrolled in a master's or doctorate program to conduct management oriented research within CBNERR-VA reserve components. The primary goal of the two-year fellowship program is to build the next generation of leaders in estuarine science and coastal management. This is accomplished by affording graduate students the opportunity to conduct collaborative science within the NERRS, partake in professional development opportunities and receive national and local level mentoring to support professional growth. Additional information about the fellowship may be found at: <https://coast.noaa.gov/nerrs/research/davidsonfellowship.html>
- *CBNERR-VA Conservation Intern*. This CBNERR-VA sponsored internship provides high school graduates (who currently, or will be, enrolled in an undergraduate program), and undergraduates with summer opportunities to broaden their knowledge and exposure while contributing and enhancing ecological

resources of CBNERR-VA. Support activities include research, monitoring, habitat restoration and other basic stewardship oriented tasks, as well as opportunities to assist Reserve education and training programs.

4.4.3 Volunteers

A structured volunteer program would benefit CBNERR-VA program operations and provide opportunities for engaged citizens to foster a greater appreciation and knowledge of coastal resources. Volunteer opportunities could include both one-time task oriented activities, typically associated with restoration projects and cleanups, to longer-term participation in monitoring, stewardship and education program support. During the Management Plan implementation period, the Reserve's Administrative Team will assess, in a more comprehensive manner, Reserve needs that could benefit through one-time and ongoing volunteer service. Efforts would develop duty statements for each identified volunteer position; develop an orientation and task relevant training programs; develop communication, coordination and reporting protocols; and identify recruiting strategies. CBNERR-VA will utilize VIMS safety training programs and work through its Volunteer Program as appropriate.

4.4.4 Staffing Needs

While the Reserve does not anticipate a substantial increase in staff over the next five years, additional staff may become necessary to accomplish Reserve programmatic goals and/or expectations put forth by NOAA, the Commonwealth, and VIMS. Additional staff positions will be incorporated in the program as adequate funding becomes available and there remains a desire for selected current positions to transition from grant to state support. In addition to more permanent positions, university interns and institute docents may be used to support selected projects and Reserve needs. To meet current and anticipated future programmatic needs, the following additional positions and responsibilities have been identified.

- *Administrative Support Staff* (part-time). 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, part-time support to augment administrative capacity is needed. Key responsibilities would include: procurement; and other clerical and office management tasks.
- *Communications Specialist* (part-time). Recognizing effective communications is a cornerstone of an organization's success, CBNERR-VA's programmatic impact and visibility would be enhanced through increased messaging to diverse audiences. Additional part-time support to supplement ongoing external communication efforts by the CTP and Education & Outreach Program is warranted. Key responsibilities would include: prepare multi-media organizational, promotional, and informational products; develop professional and public relation strategies; design and maintain web pages; draft presentations, briefings, and correspondence; develop outreach campaigns; plan and execute multi-scale events; and facilitate and address information requests.
- *Resource Restoration & Conservation Specialist* (full-time). While several primary responsibilities are currently assumed by CBNERR-VA staff, there is a need for greater time and resource commitment to meet the natural resource management, conservation, and restoration needs of the Reserve. Specifically, this position would enhance Reserve capacity to better plan and implement projects through the federal Infrastructure Investment & Jobs Act of 2021. Key responsibilities would include: develop/update natural and cultural resource management plans; serve as a liaison to other resource management oriented agencies and organizations; develop and coordinate habitat restoration and

acquisition projects with key partners; coordinate and execute management prescriptions, emergency response, and other activities to protect and enhance species and habitats of concern; conduct and analyze flora, fauna and habitat inventories; pre and post habitat restoration site monitoring; and coordinate relevant volunteer programs.

4.5 SITE SECURITY, ENFORCEMENT, FIRE & RESCUE

4.5.1 Site Security & Boundary Maintenance

Operations management is a critical element of natural areas management, especially on lands where public recreational uses or commercial uses may conflict with the primary Reserve objectives of research, education and natural resource protection. Site security and boundary posting and maintenance represent two primary responsibilities. Site security is provided by the principal managing entities at each Reserve component, those being: CBNERR-VA for Goodwin Islands, VDCR and CBNERR-VA for Catlett Islands and Taskinas Creek, and Tacoma Hunt Club and CBNERR-VA for Sweet Hall Marsh. Boundary line and sign maintenance at Reserve components is the responsibility of CBNERR-VA.

4.5.2 Law Enforcement

Because VIMS and CBNERR-VA lack their own law enforcement and fire/rescue staff, and Reserve components are located in multiple governmental jurisdictions, it is necessary for the Reserve to partner with other agencies/entities when associated issues arise. Primary law enforcement responsibilities include enforcement of state, local and federal laws, protection of life and property, operation of retention centers, public education, and resolving conflicts. Contact information for relevant state and county law enforcement agencies, departments and offices assisting in Reserve operations is provided in Table 4.1.

Table 4.1. Law enforcement agency/department/office contact information. HQ denotes Headquarters.

Administrative District	Reserve	Phone
VA State Police (Division 5) (State Headquarters)	All Reserves & VIMS/CBNERR-VA HQ	757-727-7288 804-674-2000
VDWR Conservation Police	All Reserves VIMS/CBNERR-VA HQ	
York/Poquoson Sheriff's Office	Goodwin Islands	757-890-3630
James City County Police	Taskinas Creek	757-229-8729
Gloucester County Sheriff's Office	Catlett Islands & VIMS/CBNERR- VA HQ	804-693-3890
King William County Sheriff's Office	Sweet Hall Marsh	804-769-0999
VIMS	VIMS/CBNERR-VA HQ	804-694-7300

4.5.3 Natural Resource Regulation Enforcement & Response

With respect to natural resources, VDWR’s Conservation Police Officers and VMRC’s Marine Police serve as the principal law and regulatory enforcement agencies. Conservation and Marine Police Officers enforce laws related to hunting, fishing (recreational and commercial), boating, and offer assistance in a wide variety of enforcement activities (e.g., conduct search and rescue operations, investigate accidents and criminal activity). Other state and federal agencies share responsibilities related to water quality and habitat violations, as well as fauna stranding and event mortalities. Primary agency contact information for natural resource law and regulatory enforcements as well as other fauna responses is provided in Table 4.2. Note that details regarding regulation of hunting, fishing and other traditional uses, varies by Reserve component and are discussed in Section 8.

Table 4.2. Contact information for natural resource law and regulatory enforcement agencies, as well as those responding to fauna stranding and mortality events.

Administrative District	Reserve	Phone
Law Enforcement VDWR Conservation Police (Region 1) (State Headquarters) (Wildlife Crime Line) VMRC Marine Police (Middle Area) (State Headquarters) (Emergency & Violation Dispatch Center)	All Reserves	804-829-6580 804-367-1000 1-800-237-5712 804-695-1936 757-247-2200 800-541-4646
Water Pollution VDEQ VA Emergency Operations Center VDEQ (Tidewater Regional Office) US Coast Guard (Milford Haven)	All Reserves	800-468-8892 757-518-2000 804-725-2125
Wetland Violations VDEQ (Tidewater Regional Office) (Central Office) VMRC (Middle Area Office) VIMS US EPA (Region 3) US Army COE (Norfolk District)	All Reserves	757-518-2000 804-698-4010 804-695-1936 804-684-7000 215-814-2717 757-201-7500
Subaqueous Bottoms Violations VMRC (Middle Area Office) (State Headquarters)	All Reserves	804-695-1936 757-247-2200
Turtle & Mammal Strandings VA Aquarium & Marine Science Center	All Reserves	757-385-7575
Fish Kills VDEQ (Tidewater Regional Office) (Central Office) VMRC (Middle Area Office) (State Headquarters) VIMS	All Reserves	757-518-2000 804-698-4010 804-695-1936 757-247-2200 804-684-7000

4.5.4 Fire & Rescue

As with law enforcement, VIMS and CBNERR-VA relies on multiple governmental jurisdictions to provide fire and rescue services. Often law enforcement and fire & rescue work in a collaborative manner. Primary fire & rescue responsibilities include providing emergency medical and rescue services during a variety of incidents (i.e., fires, vehicle accidents, technical rescues, maritime emergencies, HAZMAT incidents, search and rescue, and emergency medical events), public education, and providing emergency medical, rescue and fire training. Contact information for relevant fire & rescue departments and offices is provided in Table 4.3.

Table 4.3. Fire & Rescue agency/department/office contact information.

Administrative District	Reserve	Phone
York County Fire & Rescue	Goodwin Islands	757-890-3600
James City County Rescue Squad James City-Bruton Volunteer Fire Department	Taskinas Creek	757-564-5223 757-566-1905
Gloucester Volunteer Fire & Rescue	Catlett Islands & VIMS/CBNERR-VA Headquarters	804-693-2148
King William Volunteer Fire & Rescue	Sweet Hall Marsh	804-769-4311

4.6 EMERGENCY RESPONSE

On the occasion when an emergency response is needed to protect public health and safety, infrastructure and natural resources, CBNERR-VA relies on a number of local, state and federal partners. Selected situations that may require an emergency response include hazardous material spills, severe weather and threats to public health. General contact information for state and county emergency response is provided in Table 4.4.

Table 4.4. State and county department and office contact information for emergency management services.

Administrative District	Reserve	Phone
VA Department of Emergency Management	All	804-267-7600
York County Emergency Management	Goodwin Islands	757-890-3600
James City County Emergency Management	Taskinas Creek	757-220-0626
Gloucester Emergency Management	Catlett Islands	804-693-1390
King William Fire & Emergency Services	Sweet Hall Marsh	804-769-4960
VIMS	CBNERR-VA Headquarters	804-684-7135

4.6.1 Hazardous Material Spills

As a Research Center of VIMS, CBNERR-VA operates under the Institute's Hazardous Materials Emergency Response and Security Plan (updated in 2018; the plan is available as an on-line resource <https://www.vims.edu/intranet/safety/programs/emrresp.php>). The plan is specific to the Gloucester Point campus where CBNERR-VA headquarters is located. Basic components of the plan include: (1) pre-emergency planning and coordination with outside parties; (2) personnel roles, lines of authority, and communication; (3) emergency recognition and prevention; (4) safe distances and places of refuge; (5) site security and control; (6) evacuation routes and procedures; (7) decontamination procedures, (8) emergency medical treatment and first aid; (9) emergency alerting and response procedures, (10) critique of response and follow-up; (11) personal protective equipment and emergency equipment; and (12) training.

With respect to spills in the coastal environment, VIMS and CBNERR-VA have developed response plans aimed at protecting or minimizing damage to natural resources of the Commonwealth or critical water-based infrastructure (web link: <https://www.vims.edu/intranet/safety/programs/emrresp.php>). Basic components of the Institute plan include: (1) personnel roles, lines of authority, and communication; (2) multi-agency spill response coordination; (3) spill survey; (4) spill containment equipment selection criteria; and (5) dispersant use criteria. CBNERR-VA provides additional detail as related to: (1) spill control room responsibilities; (2) maps depicting areas of critical interest; and (3) directory of experts to evaluate possible impacts; on-line resource available at <https://www.vims.edu/cbnerr/resources/index.php>. VIMS does have the capacity to support spill surveillance and containment along with natural resource damage assessments.

4.6.2 Severe Weather

The coastal region of the Commonwealth is susceptible to severe weather including tropical (hurricane season: June-November) and winter (Nor-easter season: September-April) storms and tornadoes. VIMS has developed a Heavy Weather and Local Disaster Plan (web link: <https://www.vims.edu/intranet/safety/programs/emrresp.php>). Basic elements of the plan include: (1) personnel roles, lines of authority, and communication; (2) storm-planning and actions including closures; and (3) post storm evaluation, clean-up and repair. Note: CBNERR-VA maintains a satellite phone at Reserve headquarters.

4.6.3 Threats to Public Health

Administered by VIMS, and being part of W&M, CBNERR-VA operates under the guidance and direction of the Governor's Office, followed by the President of W&M and the Dean/Director of VIMS. University/Institute goals for navigating a pandemic health threat include: (1) safeguarding the health of students, faculty and staff; (2) ensuring students complete their classes; (3) maintaining the university's critical research and other operations; and, (4) joining in the national effort to overcome the public health threat. The VIMS Emergency Management Team has developed a plan for initial response to, and phased expansion of, campus operations (web link: https://www.vims.edu/docs/vims_phased_expansion_plan_7_22_2020.pdf). The plan provides details related to health monitoring; employee and volunteer best practices and work guidelines; facility, vehicle and vessel use considerations; guidelines for research, teaching and advisory service activities; and protocols for potential contamination threats.

4.7 ARCHAEOLOGICAL, HISTORICAL & CULTURAL RESOURCES

The immediate region occupied by the four components of CBNERR-VA 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 policies as related to archaeological, historical and cultural resources are provided below:

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



CHAPTER 5 - RESEARCH & MONITORING

5.1 INTRODUCTION

Reserves are created to provide a stable platform for long-term research on estuarine conditions and relevant coastal management issues. The System-Wide Monitoring Program (SWMP) delivers standardized measurements of short-term variability and long-term changes in water quality, weather, biological systems, and maps land use and land cover characteristics across all reserves. Reserve-generated data meet Federal Geographical Data Committee (FGDC) standards and are available via the Reserve System's Centralized Data Management Office (CDMO). Reserves also serve as sentinel sites for observing how coastal habitats respond to changing water levels. This program is guided by the reserves' System-wide Monitoring Program Plan (NOAA/NERRS 2011), the Reserve Habitat Mapping and Change Plan (NOAA/NERRS 2015), and Sentinel Sites Guidance documents (NOAA/NERRS 2012 and 2016); web links to these plans be found on the CBNERR-VA research resources web page (https://www.vims.edu/cbnerr/resources/resources_research_monitoring.php).

The Reserve System also supports applied research through its Science Collaborative (NSC) program and the Margaret A. Davidson (Davidson) Graduate Fellowship program. The NSC funds competitive research projects that engage end-users in the project design and address system-wide NERRS research and management needs. The goal of the Davidson Fellowship is to build the next generation of leaders in estuarine science and coastal management. The fellowship provides opportunities for graduate students to conduct research within a reserve under the guidance of a mentor who also supports their professional development.

The Reserve System Strategic Plan (2017) outlines research objectives to maintain and expand biophysical and socioeconomic monitoring to track environmental change, increase the use of collaborative research to address decision-maker needs, and ensure that scientific, education, and management audiences can use the data, research results, and tools developed by the system.

5.2 PROGRAM CONTEXT

5.2.1 Geographic Scope

The Reserve's Research & Monitoring Program operates at both a local and regional level (Figure 5.1). The primary geographic focus area is the YRE, its watershed and adjacent small coastal basins, including Mobjack Bay. Primary efforts within this region are associated with SWMP and efforts as related to the emergent wetland and submerged aquatic vegetation (SAV) Sentinel Site Program (SSP). Additionally, CBNERR-VA permits, on average, 40 research and monitoring projects within the York River system by individual investigators. The Reserve is engaged more regionally in the southern Chesapeake Bay through its efforts associated with the VDEQ/USEPA Shallow Water Monitoring Program, the Chesapeake Bay Interpretive Buoy System (CBIBS), and the Institute's Water Quality Monitoring & Modeling and Elizabeth River Project Initiatives.

5.2.2 Priority York River Issues

- *Water Quality.* The YRE continues to suffer from chronic water quality issues (e.g., harmful algal blooms [HABs], low oxygen bottom water, reduced water clarity) and to varying degrees, oxygen consuming

consuming material (e.g., organic matter). Additionally, emerging issues such as estuarine and coastal water acidification are becoming of greater local concern. Greater insight into how episodic events (e.g., inter-annual variations in hydrologic budgets, large-scale storm events), longer-term climatic changes and man-induced activities (e.g., surface and ground water withdrawal, water and effluent discharge) affect variable source material flux (e.g., watershed runoff, atmospheric deposition, oceanic processes) and estuarine water quality response is warranted and required to establish effective mitigation goals.

- *Tidal Wetland Vulnerability & Resilience.* The YRE exhibits diverse emergent wetland communities distributed along gradients of salinity. Vulnerability to climate change is expected to vary between community types but there is limited information on how site variability (e.g., sea level rise, salt intrusion, sediment load) influences measures of vulnerability. Therefore, increased understanding and forecasting of marsh structure and function in response to climate stressors, across salinity regimes, is needed to inform adaptation and mitigation planning.

Vulnerability to climate change is expected to vary between community types but there is limited information on how site variability (e.g., sea level rise, salt intrusion, sediment load) influences measures of vulnerability. Therefore, increased understanding and forecasting of marsh structure and function in response to climate stressors, across salinity regimes, is needed to inform adaptation and mitigation planning.

- *Submerged Aquatic Vegetation Vulnerability & Resilience.* Highly valued seagrass beds within the YRE have undergone significant declines and research and monitoring are shedding light on the impacts of eutrophication, reduced water clarity, and elevated water temperature. But many questions still remain about plant physiology, mixed species interactions, seed and bed dynamics and resiliency, and restoration strategies. Therefore, additional information is needed to evaluate seagrass bed structure and function in response to changes under future climate and water quality scenarios.

- *Harmful Algal Blooms.* HABs have become more common in the YRE, and produced toxins can have harmful

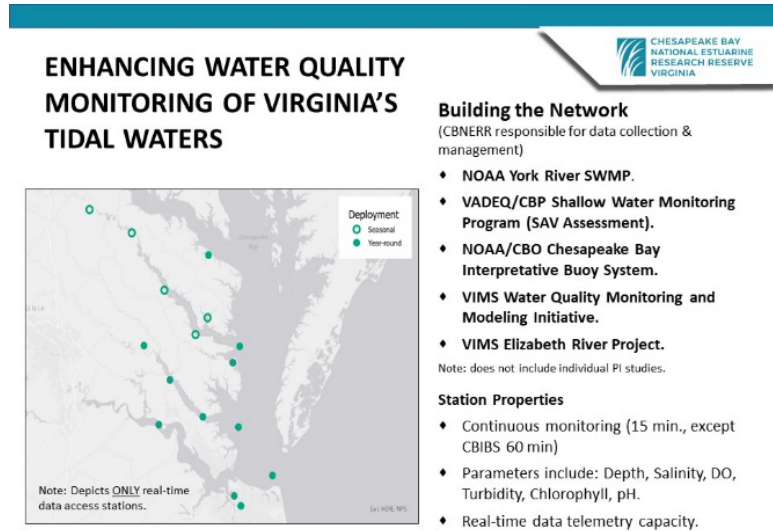


Figure 5.1. CBNERR-VA maintained real-time CMON water quality stations within the southern Chesapeake Bay region. Image credit: W. Reay.



Figure 5.2. Aerial image of harmful algal bloom off Goodwin Islands. Image credit: W. Vogelbein.

effects on shell and finfish, shallow water ecosystems and humans (Figure 5.2). Although a topic of active study, understanding of bloom initiation and dynamics, impacts on water quality, and toxin impacts on natural resources is limited. Therefore, synthesis of YRE observing network data and focused field and/or modeling studies are needed to provide guidance on reducing HAB occurrence and their detrimental effects.

- *Ecosystem Services*. There is a dearth of site-specific information on ecosystem services under different climate scenarios, and options for reasonable restoration approaches to mitigate the loss of these valuable services. Research that advances the identification, quantification, and valuation of ecosystem services (e.g., water quality, carbon sequestration, erosion control and critical habitat) under different environmental conditions and climate change scenarios, as well as research that explores ecosystem restoration strategies that mitigate current and anticipated stressors, is a site priority.

5.2.3 Program Alignment

- *Alignment with National Program*. CBNERR-VA's Research & Monitoring Program is aligned with the program priorities outlined in the 2017-2022 Reserve System Strategic Plan (NOAA/NERRS 2017). For example, in support of the Protecting Places Goal, CBNERR-VA's is actively engaged in conducting habitat vulnerability assessments to support the development of mitigation strategies, developing Reserve component-level habitat maps to evaluate landscape change, and serving as both reference and sentinel sites to enhance restoration planning, implementation and monitoring. In alignment with the Plan's Applying Science Goal, the Reserve is extensively engaged in monitoring and disseminating environmental (water & weather) information through its Environmental Data Center (web portal: Virginia Estuarine and Coastal Observing System - VECOS) and tracking the effects of episodic events, landscape changes and chronic impacts driven by climate change at the ecosystem level. Additionally, the Reserve addresses the needs of numerous stakeholders through its advisory service activities and disseminates its scientific contributions to scientific, resource management and educational audiences, both critical elements of the VIMS mission.

- *Alignment within CBNERR-VA Programs*. The Research & Monitoring Program will continue to support each Reserve programmatic sector in complementary ways with the goal of increasing issues awareness and access to relevant information products/tools. These efforts can serve as foundational elements in the development of strategies to protect and restore York River and associated small coastal basin water quality, ecosystems and human community resilience. As examples, SSP efforts and results have been integrated into the Education & Outreach Program to provide context for the Bay Watershed Education & Training (BWET) Program-funded 'Climate Education for a Changing Bay' high school curriculum and field exercises, supported summer camps activities, and through NOAA Hollings Scholar development of a 'Thin Layer Deposition' story map and lesson plan (<https://www.vims.edu/cbnerr/resources/index.php>). Collaborations with the Reserve's CTP have included significant input into NERRS-led conferences such as the York River Symposium and Marsh Summit as well as work on CTP led water quality improvement and habitat restoration community efforts, such as the YR&SCB Roundtable and a State of the York synthesis of status, trends and opportunities in the York River watershed.

5.2.4 Program Goals

Working in concert with all Reserve programmatic teams, CBNERR-VA Research & Monitoring Program efforts contribute to the three functional area goals of this plan detailed in the Reserve Strategic Roadmap, Section 3 of this plan.

5.3 PROGRAM CAPACITY

5.3.1 Staff

The Reserve maintains adequate staffing to deliver national, regional and local foundational programs. The CBNERR-VA Science Team is overseen by the Reserve Director and Research Coordinator/Associate Director with leads for various program elements including the Emergent Wetlands and SAV SSP, Lab and Field Research & Monitoring Operations, as well as the Reserve's Environmental Data Center. Supporting all this work includes a robust and qualified staff of Marine Supervisors, Marine Scientists, as well as Laboratory and Field Specialists. Additional support comes through graduate students, interns and volunteers. Detailed position descriptions are provided in Section 4.4 of this plan.

5.3.2 Fellowship & Intern Programs

Several opportunities exist for research oriented fellowship and internship positions at CBNERR-VA, including the Rouse Bottom Fellowship, the Davidson Fellowship, and CBNERR-VA conservation internships. Additionally, CBNERR-VA partners with NOAA's Undergraduate Hollings Scholarship and Five Colleges Summer Internship programs. In most instances, fellows and interns assist with education and other Reserve programmatic areas allowing for a unique cross-sector experience. Details regarding each student-based opportunity are provided in Section 4.4.2.

5.3.3. CBNERR-VA Environmental Data Center

The Reserve's Environmental Data Center maintains two water quality monitoring databases and associated web applications, including VECOS (<http://vecos.vims.edu>), containing more than 179 M water quality measurements, and the Chesapeake Monitoring Cooperative's (CMC) Data Explorer (<https://cmc.vims.edu/>), supporting community science throughout the Bay watershed, containing more than 640 thousand water quality measurements. In addition, the Environmental Data Center maintains multiple internal spatial and traditional databases supporting various research efforts across the program. The Center integrates these CBNERR-VA research assets involving code-based data solutions, automation, translations, visualizations, and statistical and spatial analysis.

5.3.4 Facilities, Infrastructure & Equipment

CBNERR-VA's principal research and monitoring laboratories are located in the Catlett-Burruss Research & Education Laboratory, a 5480 ft² facility located adjacent to Reserve headquarters on the VIMS Gloucester Point campus. Currently there exist four research laboratories (total area: 1405 ft²) and two storage areas (total area: 908 ft²) within this facility. These laboratories support the CBNERR-VA water quality monitoring and faculty and staff research programs. CBNERR-VA maintains a network of continuous water quality and level monitoring platforms, multiple weather stations, emergent wetland and SAV sentinel site supporting structures (marsh boardwalks and long-term habitat transects), and a vertical elevation control network. In addition, CBNERR-VA maintains a dedicated fleet of research vessels and vehicles, and has extensive capabilities to obtain water quality measurements (e.g., multi-parameter sondes, dataflow continuous mapping systems, flow and precipitation triggered remote samplers), and conduct geospatial (e.g., automatic/electronic levels and real-time kinematic GPS static and roving instruments) and aerial (e.g., fixed wing and multi-rotor drones) surveys.

As a research center of VIMS, the Reserve has access to unparalleled facilities and resources of one of the nation's premier marine research institutes focused on coastal and estuarine science. Selected VIMS facilities include the Seawater Research Lab, a storm-resistant >90 m (300 ft) research pier, the Field Operations office that maintains 40+ research vessels and a diving facility, and the Hargis Library.

Greater detail of VIMS and Reserve facilities, infrastructure and equipment supporting research and monitoring mission is provided in Section 11 of this plan.

5.4 PROGRAM DELIVERY

5.4.1 NERRS System-Wide Monitoring Program

Background Information

The NERRS SWMP supports environmental monitoring to develop quantitative measurements of short-term variability and long-term changes in water quality, weather, biological systems, and land-use / land-cover characteristics of NERRS estuaries and estuarine ecosystems for the purposes of informing effective coastal zone management issues of regional or local concern. The Reserve System-Wide Monitoring Program Plan (NOAA/NERRS 2011) describes SWMP and its role in supporting the NERRS mission and strategic goals, details the existing monitoring capacity in the NERRS, and outlines an implementation and development plan for the program. The program is designed to enhance the value and support the vision of the reserves as a system of national reference sites and focuses on three ecosystem characteristics, that include abiotic (weather & water), biotic, and watershed/land use classifications. Details for each, as related to the YRE, are provided below:



Figure 5.3. Location map of CBNERR-VA's CMON water quality and meteorological SWMP infrastructure; also included is NCBO buoy and USGS gauging stations. Image credit: W. Reay.

York River Meteorological Monitoring

CBNERR-VA maintains meteorological monitoring stations at the Sweet Hall Marsh (established September 1998) and Taskinas Creek (August 1997) Reserve components (see Figure 5.3). Weather measurements use standard protocols, parameters, and approaches to collect data. Measured parameters include air temperature, relative humidity, precipitation, photosynthetically active radiation (PAR), barometric pressure, wind speed and direction. Real-time delivery of meteorological data is available through NOAA's Hydrometeorological Automated Data System (HADS, hads.ncep.noaa.gov); National Weather Service (NWS) station identification labels are SHXV2 and YRSV2 for the Sweet Hall Marsh and Taskinas Creek stations, respectively. Real-time and quality assured downloadable data for the Taskinas Creek station is available through the NERRS CDMO (<http://cdmo.baruch.sc.edu>).

York River Water Quality Monitoring

CBNERR-VA maintains fixed continuous water quality monitoring (CMON) stations at the Goodwin Islands (established October 1997), Taskinas Creek (September 1995), and Sweet Hall Marsh (January 1999) components of the Reserve. Additionally, CMON stations include Gloucester Point (March 2003),

Clay Bank (January 2002) and White House (March 2003) within the YRE (see Figure 5.3). Abiotic water quality measurements use standard protocols, parameters, and approaches to collect data. YSI EXO2 multi-parameter water quality sondes measure water temperature, specific conductance, dissolved oxygen, pH, turbidity, chlorophyll fluorescence and water depth at 15-minute intervals. In addition, monthly nutrient (nitrate, nitrite, ammonium, phosphate, and total dissolved N & P) and chlorophyll a (Chla) samples are collected at all SWMP water quality stations and monthly diel samples at one (Taskinas Creek) SWMP water quality station. Data are FGDC compliant and available via the NERRS CDMO (<http://cdmo.baruch.sc.edu>). Real-time delivery of water quality data is available for selected stations through NOAA's HADS (hads.ncep.noaa.gov); NWS station identification labels are CVQV2, TCSV2, and GPTV2 for the Sweet Hall Marsh, Taskinas Creek and Gloucester Point stations, respectively. Quality assured downloadable data for Sweet Hall Marsh and Taskinas Creek stations is available through the NERRS CDMO (<http://cdmo.baruch.sc.edu>). Additionally, quality assured downloadable data for all six stations is available through the Reserve's VECOS data web portal (<http://vecos.vims.edu>).

- *Biotic Characteristics.* Biotic data collection uses standard protocols, parameters, and approaches to describe biological communities which is currently focused on critical coastal vegetated habitats but could eventually include measurements of benthos, plankton, nekton, and birds, reserve biota and biodiversity. CBNERR-VA is actively monitoring emergent (salt marshes, and tidally-influenced freshwater marshes) and SAV vegetation communities. Monitoring includes field survey methods for the assessment of estuarine submersed and emergent plant communities at a series of representative study sites within the NERRS. Specifically, monitoring efforts are designed to capture species composition, percent cover, stem density, and canopy height of emergent vegetation. In most cases, monitoring of biotic communities occurs in close association with the collection of abiotic data, and may be done in conjunction with high-resolution mapping to quantify the larger scale spatial extent of vegetative communities in the watershed. Monitoring activities follow the NERRS SWMP Biomonitoring Protocols (Moore, 2009). Permanent transects are established within the vegetated communities, and quadrats are sampled along these transects. Surveys of the emergent marsh and SAV are repeated periodically, along with associated elective abiotic monitoring activities (e.g., ground-water wells, pore-water sampling, grain-size analysis, sediment elevation table-marker horizons [SET-MH]). Biological monitoring data are collected and archived by CBNERR-VA. A standardized data template is used to submit vegetation monitoring data for archiving by CDMO. Currently, the NERRS Vegetation Monitoring Workgroup oversees the QA/QC of these vegetation monitoring data and ensures that data are compliant with SWMP criteria for data submissions (NOAA/NERRS 2020).

- *Watershed and Land Use Classifications.* Watershed and land use classifications use standard protocols, parameters, and approaches to establish a spatial reference frame that can be linked to national geodetic networks for reserve and watershed-scale spatial data products that track and evaluate changes in coastal habitats and watershed land use and land cover. The Coastal and Marine Ecological Classification Standard (CMECS) is used to define habitat classes which are ground-truthed for final maps. This element is guided by the Reserve System Habitat Mapping and Change Plan (NOAA/NERRS 2015) and is consistent with Phase III of SWMP. Data is compiled electronically along with additional data and metadata quality control by NERRS CDMO; data are FGDC compliant and available via the CDMO (<http://cdmo.baruch.sc.edu>). The Chesapeake Bay NERR Habitat Mapping Data Sharing Plan can be found at: https://www.vims.edu/cbnerr/resources/resources_research_monitoring.php.

5.4.2 Southern Chesapeake Bay Shallow Water Quality Monitoring Program

Working with key partners at VDEQ and the USEPA/Chesapeake Bay Program (CBP), CBNERR-VA is responsible for the collection, quality assurance, and assessment of the CBP's Shallow Monitoring Program within Virginia's tidal waters. Collected data are used to determine if nearshore waters meet or fail established water quality criteria based on SAV requirements. This program utilizes in situ monitoring techniques, including fixed CMON and dynamic surface mapping (DataFlow) to provide high resolution temporal and spatial measurements, respectively. Measured parameters include depth (CMON only), temperature, salinity, turbidity, chlorophyll fluorescence, dissolved oxygen, and pH. Data collection within Bay and tributary segments occurs on a rotating 3-year cycle over the critical SAV growing period throughout the Virginia portion of the Chesapeake Bay. CMON fixed station and monthly surface water quality maps and associated data are available via the [VECOS](http://vecos.vims.edu) (<http://vecos.vims.edu>). Maryland runs an analogous program with USEPA/CBP, led by Maryland's Department of Natural Resources.

5.4.3 Chesapeake Bay Interpretive Buoy System

In partnership with NOAA's Chesapeake Bay Office (NCBO), CBNERR-VA maintains the southern Chesapeake Bay Interpretive Buoy System (CBIBS) that provides real-time data streams to support a wide-range of needs and user groups within the Chesapeake Bay region. Four buoys are typically deployed in Virginia's estuarine and coastal waters: Stingray Point (SP) off the mouth of the Rappahannock River, York River Spit (YS) off the mouth of the York River, Jamestown (J) near Jamestown on the James River, and First Landing (FL) off Cape Henry near the mouth of Chesapeake Bay. The buoys are equipped to measure real-time meteorological (wind speed and direction, air temperature, barometric pressure, relative humidity), near-surface water quality (water temperature, conductivity, dissolved oxygen), waves (significant and maximum heights, direction, and period), acoustic doppler current profiles (ADCP), and buoy location data streams (Figure 5.4). Buoy-related data are available through a NOAA-maintained website (<http://buoybay.noaa.gov>), through smart phone applications, or by voice via a toll-free phone number. The data are currently integrated into NOAA's National Data Buoy Center and National Weather Service (NWS), private industry partners (Weatherflow), and the Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS). Links to buoy quality-assured data are provided through VECOS (<http://vecos.vims.edu>) and Maryland's Eyes on the Bay (<http://eyesonthebay.dnr.maryland.gov/>) web portals.

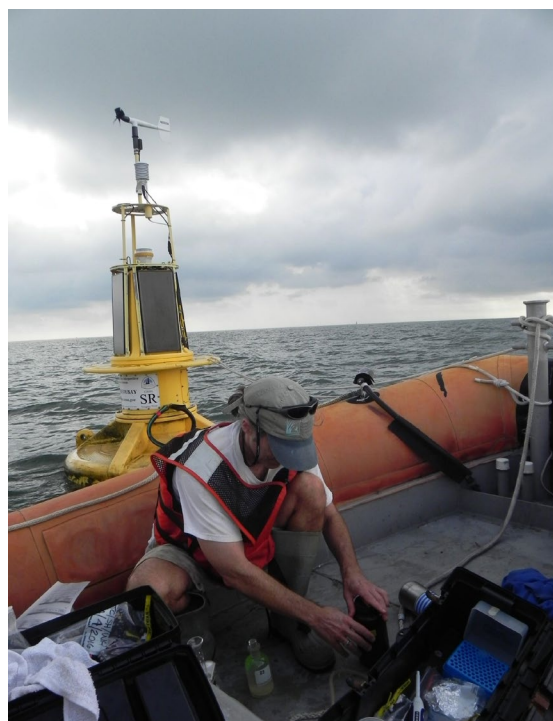


Figure 5.4. CBNERR-VA staff conducting routine servicing of a Chesapeake Bay Interpretive Buoy (CBIBS). Image credit: W. Reay.

5.4.4 Virginia Estuarine & Coastal Observing System

The Virginia Estuarine and Coastal Observing System (VECOS; <http://vecos.vims.edu>) is a website designed and maintained by CBNERR-VA to distribute water quality and meteorological data from Virginia's tidal tributaries, coastal embayments, and the southern Chesapeake Bay. Quality-assured archived data are provided from a variety of monitoring programs conducted by the Reserve, including high resolution mapping of surface water quality (DATAFLOW), high-frequency measurements of water quality taken every 15 minutes from fixed, shallow water CMON stations (COMMON), and continuous measurements taken from deeper waters along multiple depths (Profiler). Real-time data delivery is available for selected stations. VECOS also provides links to external monitoring programs, including high-frequency water quality and meteorological monitoring at deep water locations in the Chesapeake Bay as part of CBIBS, meteorological monitoring locations specific to the York River watershed, and long-term routine water quality sampling, typically taken 12-20 times per year since 1985 through the USEPA/CBP.

5.4.5 Chesapeake Monitoring Cooperative

The CMC was formed as a partnership between multiple nonprofits (e.g., Alliance for the Chesapeake Bay, Alliance for Aquatic Resource Monitoring, and the Izaak Walton League of America) and the multi-agency CBP, with the purpose of providing technical, programmatic, and outreach support in order to integrate volunteer-based water quality and macroinvertebrate monitoring data into a centralized data hub – the Chesapeake Data Explorer. CBNERR-VA, through its Environmental Data Center, assumed a leading development role of the Chesapeake Data Explorer and is responsible for maintenance of its database and web portal (chesapeakemonitoringcoop.org/services/Chesapeake-data-explorer/).

5.4.6 Tidal Water Quality Monitoring & Modeling Initiative

Recognizing a need for enhanced water quality modeling and monitoring in Virginia's tributaries, Bay and coastal waters, VIMS initiated a linked program to provide quality assured, near and real-time water quality information to inform Bay restoration efforts, aid a flourishing aquaculture industry, and support the development and implementation of innovative water quality models in support of enhanced water quality assessments. Working in collaboration with Institute modelers and regional restoration and industry partners, CBNERR-VA serves as an Institute lead responsible for implementation of the Tidal Water Quality Monitoring and Modeling Initiative.

5.4.7 Coastal Habitat Sentinel Site Initiative

CBNERR-VA monitors and conducts research projects in its four Reserve components with the aim of detecting and understanding the effects of climate related stressors on critical estuarine habitats. Reserve focus habitats include tidal marshes, the marsh-upland forest ecotone, and SAV communities. Specific goals of the CBNERR-VA SSP Plan are: (1) assess current conditions of target vegetation communities and relevant physical parameters; (2) document changes in marsh, forest ecotone and SAV vegetative communities in response to primary climate changes drivers (i.e. sea level, salinity, temperature); (3) assess vulnerability of these vegetative communities based on changes in climatic conditions; (4) develop and test mitigation strategies designed to protect or enhance habitat resiliency; (5) use a study design that is both locally relevant and comparable to other sentinel sites across the nation; and (5) synthesize, translate, and communicate findings to target audiences for use in decision-making. Details on Reserve efforts can be found in the CBNERR-VA SSP Plan (<https://www.vims.edu/cbnerr/resources/cbnerr-va-sentinel-site-plan-for-website.pdf>, Lerberg 2018).

5.4.8 Examples of CBNERR-VA Supported Research Projects

- Coastal Habitat Restoration. Utilizing Section 306A funds, CBNERR-VA, in partnership with NCBO and VCZMP, aims to advance nearshore resiliency through support of climate-adaptive nearshore natural and nature-based (NNB) restoration projects in Virginia’s Middle Peninsula. This effort supports the continued facilitation of a nearshore habitat restoration community of practice via the YR&SCB Roundtable Nearshore Habitat Steering Committee; the creation of detailed and permit-ready design plans for one climate adaptive NNB nearshore restoration project; development of a resource inventory for identifying priority restoration sites in the relevant geography; development of restoration site selection criteria to prioritize projects; and restoration practitioner capacity building through related workshops. Notably, the recent USACE Chesapeake Bay Comprehensive Plan (USACE 2019) identified the York River system pertaining to this effort as a priority area for NNB resiliency and critical habitat (e.g., tidal wetlands, oyster reefs, SAV) restoration ([USACE, Comprehensive Plan and Restoration Roadmap](#)).

- Chesapeake Bay Regional Subsidence Study. Building on a multi-year planning effort, 2019-2021, CBNERR-VA supported a multi-agency working group (NOAA/National Geodetic Survey (NGS), USGS, Virginia Tech, Old Dominion University, Hampton University and Maryland Geological Survey) focused on measuring and better understanding the processes and spatial variability in land subsidence rates throughout the Chesapeake Bay watershed. Utilizing the Reserve’s local vertical control network, CBNERR-VA was able to bring the majority of its reserve components into the study.

- Elizabeth River Project. The Elizabeth River Project (ERP; <https://elizabethriver.org>), based on government, business and community partnerships, strives to restore the Elizabeth River (located in the Hampton Roads) through emphasis on habitat restoration, community education, ‘River Star’ recognitions, and support of open space and parks. CBNERR-VA, through the VIMS Elizabeth River Initiative, maintains real-time CMON stations at the ERP’s teaching barge (Elizabeth River) and future site of its education center (Lafayette River); data are ingested into VECOS. Water quality data are currently being used in ERP education programming and research projects conducted by summer interns.

- Lynnhaven SAV Restoration. The Lynnhaven River SAV pilot restoration study is a joint effort by VIMS, CBNERR-VA, USACE and the City of Virginia Beach to understand the nature of multi-species (eelgrass and widgeongrass) SAV transplant success in a critically important and highly urbanized subestuary of Chesapeake Bay. Because of the strong linkage between SAV species and water quality, CBNERR-VA conducted two complementary approaches, the use of CMON and DataFlow, to document temporal and spatial variations in water quality and assess conditions with respect to the effectiveness of seeding restoration. Based on study results and degree of transplant success, decision-makers will be able to move forward with larger scale, multi-species restoration efforts in a more informed manor.

5.4.9 York River Synthesis & Other Supporting Information Products

Acknowledging that increased issue awareness and access to relevant information products and tools are foundational elements required to develop appropriate strategies to protect and restore the YRE and associated small coastal basins’ water quality, ecosystems and human communities, CBNERR-VA has placed an emphasis on communicating Reserve research findings to watershed stakeholders. In addition to traditional formats (i.e., peer-reviewed manuscripts, technical reports and presentations), new approaches are necessary to bolster access and use of reserve scientific findings. Ongoing efforts, in conjunction with Reserve training and education programs, will include synthesis of local long-term and spatially extensive data sets (e.g., water quality and ecological status and trends reports), and support of

related regional and national level synthesis products, development of innovative tools and visualizations, hosting of relevant and focused conferences or webinars (e.g., biennial York River and Small Coastal Basins Symposium), and development of digital content.

5.4.10 Advisory Service & Technical Assistance

Advisory service and technical assistance are core elements of VIMS's and CBNERR-VA's mission. Reserve staff provide a high level of advisory service and technical assistance to federal, state and local governments and a variety of non-governmental and hybrid (government and non-government) organizations. A principal mechanism to provide this service includes membership and participation on key committees and workgroups. With respect to research and environmental monitoring, selected example targeted committee, workgroup, and board membership includes:

- *Mid-Atlantic Coastal Ocean Observing System (MARACOOS)*. MARACOOS, spanning from Cape Cod to Cape Hatteras, is a Regional Association of the U.S. Integrated Ocean Observing System (IOOS). MARACOOS provides observations, distinctive knowledge, and critical technological abilities, and applies these towards the development of products to meet regional and local needs. VIMS is an operational partner and the Reserve's Associate Director serves on the MARACOOS Board of Directors. Organization web link: <https://maracoos.org>.
- *Chesapeake Bay Sentinel Site Cooperative (CBSSC)*. Representing a network of ecosystem-based study sites within the Chesapeake Bay region, the CBSSC measures impacts of sea level rise on emergent wetlands and integrates science findings to improve planning, management, and restoration decisions. VIMS and CBNERR-VA are organization members and the Reserve's Director and Stewardship Coordinator serve on the CBSSC Management, Science and SET Teams. Organization web link: <https://chesapeakebayssc.org>.
- *Chesapeake Bay Program*. As a partnership of federal and state agencies, local governments, non-profit organizations, and academic institutions, the CBP has led and directed the restoration of the Chesapeake Bay since 1983. The Reserve's Associate Director serves on the CBP Modeling Workgroup; the Reserve's Associate Director and Environmental Data Center Manager both serve on the CBP Integrated Trends Analysis Team and the CBP Criteria Assessment Protocol Workgroup, along with the Reserve's Marine Scientist Supervisor. Organization web link: <https://www.chesapeakebay.net>.

5.5 NEEDS & OPPORTUNITIES

Additional research needs and opportunities identified by local stakeholders where the Reserve could serve a leading role over the next five years include enhancement of observing systems, real-time advisory service, critical habitat resiliency & mitigation strategies, ecosystem services, and technology and methods advancement.

- *Enhanced Observing Systems*. In addition to current efforts focused in the YRE and rotational three-year shallow water bay segment water quality monitoring, there is an expressed need to broaden the capacity of VECOS and increase contributions to regional observing systems and restoration efforts. Three areas of interest include: (1) spatial expansion to more fully realize a network that spans from tidal tributary headwaters to offshore; (2) from shallow littoral to deep channel waters; and (3) the development of additional monitoring and investigative capacity to address emerging HABs and estuarine acidification issues of concern.

- *Real-Time Advisory Service.* Accurate, reliable, accessible and timely information are hallmarks vital to effective decision-making. Based on real-time data delivery and served through VECOS, CBNERR-VA is in position to develop rapid assessment tools that support development and implementation of adaptive management responses. Examples include: (1) species-habitat alerts such as potential regional wide cold-stun mortality of recreational and commercial important finfish or temperature stress on SAV communities; (2) water quality and habitat response to episodic events such as large-scale tropical storms, interannual variations in hydrologic budgets and salinity regimes (i.e, droughts, high streamflow); and (3) enhancement of Tidewatch, VIMS's visual coastal flooding web portal, via incorporation of Reserve and local government tidal gauges.

- *Enhanced Habitat Resiliency & Mitigation Strategies.* Driven by results of critical habitat vulnerability assessments and modeling analysis, the Reserve is poised to test new methodologies, technologies and adaptive management strategies in support habitat protection, mitigation and creation strategies. With respect to SAV, eelgrass (*Zostera marina*) has become chronically stressed in the Chesapeake Bay due to elevated water temperatures, resulting in large-scale declines and a conversion from historically stable, dense meadows to low-density ephemeral ones. Eelgrass populations in North Carolina appear to be more resilient to warming water temperatures and may offer comparative resilience trait research (i.e., genetic, reproductive and metabolic) opportunities to support restoration strategies.

Chesapeake Bay tidal marshes are threatened by multiple stressors (i.e., accelerating SLR, edge erosion, barriers to upland migration, invasive species) and without active management will be significantly degraded in coming decades. Based on field and modeling studies along with marsh health assessments, CBNERR-VA is in position to consider development and adoption of strategies aimed at conserving and restoring marshes and their important ecosystem functions. Protection, mitigation and creation strategies could include: (1) protection and management (i.e, canopy thinning, invasive species control) of adjacent upland ecotones as to allow for enhanced marsh transgression; (2) channel modification to enhance marsh drainage within interior regions; (3) enhanced vertical elevation of the marsh platform through supplemental sediment supply; and (4) shoreline erosion protection.

- *Ecosystem Services.* There is a dearth of site-specific information on ecosystem services under different climate scenarios, and options for reasonable restoration approaches to mitigate the loss of these valuable services. Research that advances the identification, quantification and valuation of ecosystem services (e.g., water quality, carbon sequestration, erosion control and habitat) under different environmental conditions and climate change scenarios, as well as research that explores ecosystem restoration strategies that mitigate current and anticipated stressors, is a site priority.

- *Technology and Methods Advancement.* Over the past decade, there has been increased interest in using emerging technology and automated methods into routine Reserve operations. One promising technology available to CBNERR-VA is unmanned aerial systems (UAS), commonly termed drones. Demonstrated values of interest to the Reserve include geospatial mapping of coastal habitats for basic monitoring and specific impact assessments, wildlife monitoring, and water quality monitoring including HABs and other pollutant tracking efforts. With respect to data management, CBNERR-VA will continue to invest resources in tailoring and automating quality control protocols for data management and integration. Additionally, consolidating and integrating data from a variety of sources and collection methods (automated vs. manually collected; variable spatial and temporal resolution) can be problematic but necessary in order to address more complex and greater spatial scale management questions and solutions. The Reserve's Environmental Data Center is poised to make progress on these and other yet to be identified issues in the coming 5 years.

5.6 RESEARCH POLICIES & PERMITS

Research opportunities at the four Reserve components are available to qualified scientists affiliated with academic institutions (university, college or school), non-academic research institutions (e.g., research laboratory, independent museum, and professional society), non-profit organizations, private profit organizations, and local, state or federal government agencies. A CBNERR-VA research permit must be submitted and approved prior to any work conducted within Reserve components (available at <https://www.vims.edu/cbnerr/research/permits/index.php>). In addition, research activities within the Taskinas Creek component and the upland regions adjacent to Catlett Islands require the submission and approval of a natural areas research permit through VDCR (available at <https://www.dcr.virginia.gov/natural-heritage/natural-area-preserves-research-permit>). Potential researchers are encouraged to contact the Reserve for site information and previous related research conducted within the Reserve, and for guidance and coordination among permitting entities prior to submission of a permit or proposals to funding agencies. Supporting information, including the Reserve's Research Bibliography and Site Profile, is provided on the Reserve's research resources page (<https://www.vims.edu/cbnerr/resources/index.php>). Large-scale manipulative research projects are generally discouraged; however, manipulative research projects that do not significantly alter or impact reserve resources may be acceptable. Investigators not adhering to permit requirements risk revocation of the permit. Researchers are expected to provide the Reserve with a copy of the final project report and other relevant publications resulting from the research conducted at CBNERR-VA.



CHAPTER 6 - EDUCATION AND OUTREACH

6.1 INTRODUCTION

The reserve system seeks to enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation. The reserve system increases estuary literacy among students, teachers, and the public through the K-12 Estuarine Education Program (KEEP) and Conservation Action Education programs. Reserves integrate research and monitoring into their educational and outreach efforts, providing a multi-faceted, locally focused approach aimed at engaging the community.

The KEEP helps educators bring estuarine science into the classroom through hands-on learning, experiments, fieldwork, and data explorations using grade-appropriate lessons, activities, and videos (Figure 6.1). Reserves also offer teacher development programs that

use established coastal and estuarine science curricula aligned with state and national science education standards. Teachers on the Estuary (TOTE) workshops give teachers the opportunity to explore coastal habitats and conduct field investigations, learn how to integrate local and national monitoring data into the classroom, and gain hands-on experience using estuary education resources.

Conservation Action Education programs focus primarily on fostering and modeling behavioral change that leads to resource conservation and advances the mission of the reserve. Such programs are specifically designed with the intention of creating behavior change and/or fostering wise stewardship of estuaries. The ultimate goal is to help audiences make personal choices and collective actions that help them conserve, protect and restore our estuaries and their associated watersheds. Target audiences include, but are not limited to, residents of the watershed and surrounding communities, watershed residents and recreational users of the reserve. Participants in the reserve's Coastal Training Program (CTP) and K-12 audiences are not included in this category.

The Reserve System Strategic Plan (NOAA/NERRS 2017) outlines education objectives designed to increase the public's awareness of and participation in stewardship activities; improve educators' and students' understanding and use of the Reserve System and NOAA resources for place-based and inquiry-based learning; and grow and motivate the next generation of coastal professionals through access to programs and facilities that facilitate research, resource management, and educational opportunities.



Figure 6.1. Discovery field trip to Goodwin Islands as part of student 'Bay Experience' program. Image credit: S. Nuss.

6.2 PROGRAM CONTEXT

6.2.1 Setting & Context

The primary goal of the CBNERR-VA Education & Outreach Program is to increase awareness, understanding, appreciation, and responsible-use of the Chesapeake Bay estuary through various informal and formal education programs for K-12 and college audiences, educator 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 Education & 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. CBNERR-VA's Education & Outreach Program strives to enhance student's, teacher's, and the public's awareness, understanding, and appreciation of estuaries by pursuing the following approaches:

- (1) Hands-on, investigative field experiences, curriculum, and informational material tailored to the needs and abilities of a broad range of audiences with an emphasis on applied estuarine science topics;
- (2) Multiple-exposure opportunities to all audiences with particular emphasis on K-12 students;
- (3) Professional development opportunities for in-service and pre-service teachers on Meaningful Watershed Educational Experiences (MWEEs) and other priority areas related to the Chesapeake Bay;
- (4) Assist graduate students, interns, and volunteers in translating research content to educational products such as lesson plans and programs;
- (5) Link the education program to CBNERR-VA and VIMS's research, environmental monitoring, and stewardship programs;
- (6) Address local, regional, and national coastal issues emphasizing the interrelationships of coastal habitats and human activities; and
- (7) Promote a sense of stewardship and individual responsibility, through citizen's participation and engagement in public outreach programs.

CBNERR-VA's education and public outreach programs reach a variety of localities dependent on the program structure and targeted audience. Teacher professional development opportunities are available to teachers state-wide. K-12 programs and outreach programs are typically available to: Middlesex County, Mathews County, Gloucester County, York County, New Kent County, James City County, City of Williamsburg, City of Newport News, City of Hampton, City of Norfolk, and City of Virginia Beach. CBNERR-VA educators offer programs outside of this geographic scope dependent on staff and funding availability. Demographic and socioeconomic data for geographic areas of influence can be found in Tables 2.1 and 2.2, respectively, of this plan.

In 2020, the Education & Outreach Program transitioned 100% of its programming and related offerings to the digital landscape. Accordingly, the need for, and use of, physical facilities gave way to an emphasis on equipment and software that would enable virtual access to education programs. Moving forward, education programs will reflect the needs and opportunities required in this new landscape of virtual learning. While a transition back to in-person offerings will enable experiential education, some

programs will continue to be offered virtually or through a hybrid approach beyond the scope of the COVID-19 pandemic.

6.2.2 Priority Issues

The Education & Outreach Program aligns key CBNERR-VA priority issues with education programs, and includes these topics where applicable while meeting the needs of our student and educator audiences. Priority issues include: water quality, habitat degradation, direct and indirect impacts as a result of global climate change, degradation of ecosystem services, and application of SWMP data (see Section 2.4 for greater detail). The 2020 CBNERR-VA K-12 Needs Assessment (https://www.vims.edu/cbnerr/docs/education_docs/2020cbnerrneedsassessment.pdf) has also identified several priority areas for the education program to provide to K-12 students and educators, these are: field experiences, teacher professional development, and local environmental data.

6.2.3 Priority Audiences

The Reserve prioritizes formal education programs for K-16 student and educator audiences, followed by public outreach. While education programs are focused within Gloucester, Mathews, and York counties, they are made available to other audiences. Teacher professional development and summer camp opportunities typically draw participants from local counties, but have included state-wide and out-of-state participants. K-16 classroom visits and field experiences are more limited to local school districts due to geographic distances restricting travel availability and time constraints. Typically, secondary science students (middle and high school) as well as teachers, are the priority audience for most education activities, although some programs are offered for elementary students and teachers. The public outreach programs typically reach a wide variety of audiences, ranging from preschool students to retirees.

6.2.4. Program Alignment

- *Alignment with the National Program.* CBNERR-VA's Education & Outreach Program is aligned with the program priorities outlined in the 2017-2022 Reserve System Strategic Plan (NOAA 2017), specifically creating volunteer programs, communicating research and monitoring trends to teachers and students, and the entire Educating Communities goal. As of 2020, the CBNERR-VA education program does not participate in the Community Education Framework due to the prioritization of K-16 student and teacher programs rather than community outreach-type programs. The Reserve utilizes NOAA's Office of Education's Strategic Plan (<https://www.noaa.gov/education/explainers/2021-2040-noaa-education-strategic-plan>) in developing priority areas for grant-funded projects and TOTE workshops including a science-informed society and workforce development.
- *Alignment within CBNERR-VA Programs.* The Education & Outreach Program supports several programmatic goals and functions of the Reserve. Selected examples include the incorporation of the Reserve's research and monitoring data into education programs, professional development programs (e.g. TOTE), and associated products. Whenever possible, educators work with members of the research and stewardship sectors to include relevant and authentic science methods into education programming such as the development of educational lesson plans on the climate's impact on seagrass production and the Reserve's recent work with thin-layer placement as a marsh restoration technique. These lesson plans were incorporated into the education program during K-12 student and teacher programs, and published manuscripts have been made available nationwide. Additional examples of program alignment with issues of concern include critical habitat response and mitigation to environmental

change and water quality assessment to address aquatic life and societal needs; see Research & Monitoring, CTP, and Stewardship sections within this plan for greater detail.

6.2.5 Program Goals

Working in concert with all Reserve programmatic teams, CBNERR-VA Education & Outreach Program efforts contribute to the three functional area goals of this plan and are detailed in the Reserve Strategic Roadmap, Section 3 of this plan.

6.3 PROGRAM CAPACITY

6.3.1 Staff

The Reserve maintains adequate staffing to deliver national and local foundational programs. Typically, Reserve staff include two full-time and one part-time educator; detailed position descriptions are provided in Section 4.4 of this plan. Note the implementation of field-based marine science programs presents many challenges and safety concerns, and requires certified, trained, and experienced staff in order to meet the appropriate standard of care when working with students outside a classroom environment.

6.3.2 Education & Outreach Program Advisory Board

CBNERR-VA's Education & Outreach Advisory Board is a senior level advisory board providing advice and guidance on a number of key factors. Roles and responsibilities of the Advisory Board include: (1) program guidance and vision; (2) review of strategic planning documents; (3) review of existing and planned education and training material and programs; and (4) identifying collaborative opportunities and key partnerships. The Advisory Board is composed of individuals representing governmental agencies, academic institutions, local public-school districts, and nongovernmental organizations with primary K-12, college, and general public education responsibilities. The Reserve Education Coordinator serves as the Advisory Board's chairperson. Membership to the Advisory Board is through a one-year voluntary appointment. The Reserve also creates ad hoc advisory committees to address specific education and public outreach needs.

6.3.3 Fellowship & Intern Programs

The Reserve has succeeded in creating a several-year partnership with the NOAA Hollings Scholar Program, bringing in undergraduate assistance for a 10-week period each summer. Interns assist with education and other Reserve programs such as unique cross-sector partnerships. The Reserve's Education & Outreach Program works with W&M undergraduates through the EcoAmbassador program to provide support for the Discovery Lab series, while allowing undergraduates the opportunity to build public outreach and communication skills.

6.3.4 Partnerships

The Reserve's Education & 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, experiential niche that remains in high demand. The Reserve has fostered partnerships to provide the region with additional wide-ranging opportunities while leveraging limited staff and resources. Brief overviews of education and outreach programs provided by VIMS and other local partners are provided below.

- *VIMS Outreach, Advancement and Public Relations Department.* The VIMS Outreach, Advancement and Public Relations Department focuses on public outreach and education programs including VIMS Marine Science Day, an Institute-wide open house program. The Department is responsible for the production of the Institute's web page, informational press releases, social media, and TV/radio segments. In addition, the Outreach Department develops and maintains informational displays in public areas and local venues (e.g. fairs and festivals) and provides public tours of VIMS and the Institute's aquarium. CBNERR-VA news, events, and programs are supported by these offices, including support for garnering private donor funds for programs such as the VIMS Summer Camps and the Discovery Labs.
- *VIMS Marine Advisory Program & Virginia Sea Grant.* The VIMS Marine Advisory Program (MAP) manages a number of education programs with CBNERR-VA in order to leverage limited funds for programs such as TOTE, Virginia Scientists and Educators Alliance (VASEA), and pre-service teacher training opportunities. Formal programs offered by VIMS MAP include 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, and special events for selected other audiences. Virginia Sea Grant (VSG) manages an on-line ocean science resource center (The Bridge) and the website for the Mid-Atlantic Marine Education Association (MAMEA).
- *VIMS Center for Coastal Resources Management.* The Center for Coastal Resources Management (CCRM) develops and supports integrated and adaptive management of coastal zone resources. Education and outreach programs include VIMS Teaching Marsh tours and professional development for the Virginia Master Naturalist program.
- *VIMS Eastern Shore Laboratory.* The VIMS Eastern Shore Laboratory (ESL), located in Wachapreague, Virginia 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 and the VIMS Marine Life Day.
- *William & Mary School of Education.* The W&M School of Education provides undergraduate and graduate degree programs to prepare educators to be leaders in their educational institutions. The School of Education partners with other schools and institutions to provide professional development for practitioners, address issues of inequity, and develop solutions to educational challenges. The School of Education partners with VIMS and CBNERR-VA to offer hands-on summer camp opportunities (Camp Launch) for gifted, underserved students as well as train pre-service teachers in outdoor learning pedagogy.
- *Virginia's Department of Conservation & Recreation.* Virginia's Department of Conservation & Recreation administers two state parks within the mid and lower portions of the YRE. York River State Park (YRSP) is located in James City County and Machicomoco State Park in Gloucester County, VA. The parks offer interpretative facilities along with trail systems, water access, limited camping, and organize special events such as Earth and Estuaries Day festivals. Select trails and facilities are Americans with Disabilities Act (ADA) handicap accessible. Park staff offer a wide range of education and outreach activities for all ages as well as guided canoe trips and hikes. YRSP staff provide organizational support for the Virginia Master Naturalist Historic Rivers chapter which provides education, outreach, and service dedicated to the beneficial management of natural resources and areas within the Commonwealth.

- *Local, State and Federal Government Partners.* CBNERR-VA works closely with and through existing local/regional educational programs that complement the priorities of the Reserve and the broader NERRS. Selected partners include the Virginia Resource Use Education Council (VRUEC) and the Virginia Department of Education (VDOE). The Reserve is a member of the VRUEC and previously had educators serve in leadership roles. CBNERR-VA participates in regular meetings, strategic planning, and grant development for projects supporting environmental literacy statewide. VDOE serves as a partner and sometimes funding agency for TOTE workshops, but also regularly interfaces with Reserve education staff on statewide environmental education initiatives. CBNERR-VA serves in an advisory role with VDOE, most recently assisting in the review process for new state science standards.

- *Local, State, and Federal Non-Governmental Partners.* As with local and regional governmental entities, the Reserve works closely with non-governmental organizations to deliver environmental education programs and offer advisory services. Selected partners include the Oyster Reef Keepers of Virginia, Friends of the Dragon Run, Virginia Association of Environmental Educators, No Child Left Inside Coalition, Hampton Roads Alliance for Environmental Educators, National Network for Ocean and Climate Change Interpretation (NNOCCI), and the Three Rivers Environmental Educators. When possible, CBNERR-VA 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.

6.3.5 Volunteers

The CBNERR-VA Education & Outreach Program works in partnership with the VIMS Outreach Department to provide volunteer docents with training opportunities in research, monitoring, and education activities specific to VIMS and CBNERR-VA. Reserve volunteers consist mostly of high school students who volunteer as Junior Counselors during the week-long summer camps and Discovery Lab programs. Due to this partnership, CBNERR-VA does not currently require a dedicated volunteer coordinator.

6.3.6 Facilities, Infrastructure & Equipment

The Reserve's Catlett-Burress Research and Education Laboratory, located on the VIMS Gloucester Point campus, provides a headquarters for both field and laboratory activities for a broad range of age groups. Group sizes are limited based on the 32-seat laboratory space. Supporting resources include vessel use, canoe rig, on-site natural space, and use of VIMS facilities through partnerships.

6.4 PROGRAM DELIVERY

The Chesapeake Bay Agreement of 2014, established a resolution that every student should have a 'meaningful Chesapeake Bay experience' in elementary, middle, and high school. Therefore, for the foreseeable future, field-oriented programs remain a core aspect of environmental education in Virginia. The Reserve has used its unique access to VIMS faculty, professional staff, and resources to create programs (e.g., field experiences and in-class programs) that incorporate unique place-based estuarine and biological science.

6.4.1 K-12 Programs

- *Field-Based Programs.* CBNERR-VA K-12 grade field-based programs introduce a wide variety of estuarine environments and support aspects of the MWEE. MWEEs are learner-centered experiences, focused on investigations on local environmental issues that lead to informed action and civic

engagement (see Figure 6.2 for MWEE model). Programs typically entail 2-6-hr wading field trips focused on specific themes such as oyster restoration, shallow water habitats, and finfish and shellfish investigations. Examples of specific themes include the 'Oyster Restoration' and the 'Exploring Chesapeake Bay Habitats' field trip. The oyster program provides students with the opportunity to investigate a restored oyster reef and release juvenile oysters the students raised during the school year. The 'Exploring Chesapeake Bay Habitats' field trip highlights the ecology of a variety of coastal habitats (e.g., underwater grasses, intertidal marshes, and sand flats).

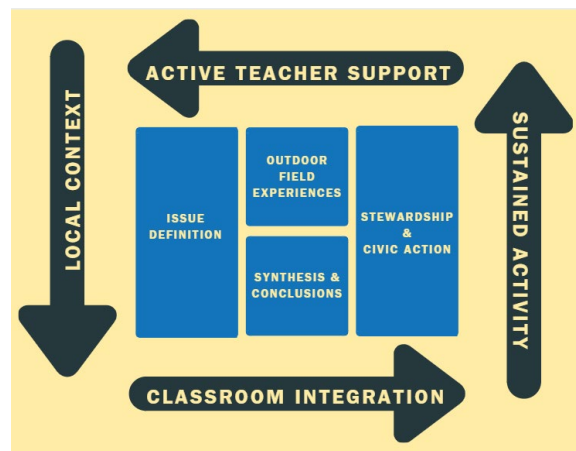


Figure 6.2. Meaningful Watershed Educational Experiences model. Image credit: NCBO.

- *Curriculum and Class-Based Programs.* The Reserve builds and extends the educational impact of all field experiences through the use of pre and post-field trip study. Education staff provide advisory assistance to K-12 school teachers by referring them to appropriate programs and educational resources. When possible, CBNERR-VA offers direct assistance for in-class activities, or offers resources for teachers to check-out and utilize in their classroom on their own.
- *State Park Programs.* The Reserve's education program partners with two local state parks, York River State Park and Machicomoco State Park, both associated with Reserve components, to extend and assist with education programs as needed. Reserve educators have formed partnerships with interpreters on each site, and have contributed to park exhibits such as signage, aquariums, monitoring data displays, and two Chronolog stations (<https://www.chronolog.io/>). The Chronolog stations were installed in 2021 to provide community science opportunities through crowd sourced time-lapse photography that can monitor environmental changes. Education staff also provide advisory assistance to interpreters, sharing training and professional development opportunities, and resources whenever applicable.
- *Multi-day Summer Camps.* The Reserve's Education & Outreach Program conducts multi-day courses during the summer in order to provide year-round opportunities for students. These programs are week-long, and some include overnight stays at the VIMS ESL. These camps expose participants to the York River watershed, wetlands, SAV beds, and key Bay flora and fauna species through field trips, group activities, games, and crafts. 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. Website: https://www.vims.edu/cbnerr/education/summer_programs/index.php.
- *Camp Launch.* CBNERR-VA offers additional summer courses for high school students through Camp Launch, a program for gifted ninth and tenth grade students from underserved populations focused on advanced instruction in Science, Technology, Engineering, and Mathematics (STEM), writing, academic self-efficacy, and personal development. In partnership with W&M, CBNERR-VA hosts these week-long programs, exposing participants to marine science careers, field work, and research projects, and increasing the diversity, equity, and inclusion of underrepresented students in marine science. Website: https://education.wm.edu/centers/cfge/precollegiate/camp_launch/index.php.
- *Online Learning.* Throughout the COVID-19 pandemic, CBNERR-VA transitioned programming to

continue to reach audiences through virtual offerings. These programs included both existing programs that were brought into the digital space (i.e. Discovery Labs and classroom visits) and new programs (i.e. virtual field experiences, Storytime, and the creation of videos and a YouTube page). These resources reached a wider geographic range than traditional field offerings, and the technologies and skills gained by educators during this time will continue to be included, to some extent, in future programming.

6.4.2 College & University Programs

- *Field-Based Programs.* One-day field trips targeting college groups are designed to enhance awareness and understanding of the estuary and emphasize the interrelationships of coastal habitats and human activities. Field 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. Currently, CBNERR-VA does not promote Field Marine Science programs to colleges/universities. However, if there is a formal request and staff are available, CBNERR-VA will provide support.

6.4.3 Professional Teacher & Informal Educator Development Programs

K-12 teachers and community leaders are a priority audience for the Reserve's Education & Outreach Program. Summer teacher-training workshops, conducted by Reserve staff, provide teachers with novel insights 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 (e.g., oyster habitat cages) that can be done with their students, or classroom activities that build estuarine literacy. Efforts are made to have all teacher training material accessible online. Website: https://www.vims.edu/cbnerr/education/teacher_training/index.php.

- *Teachers on the Estuary (TOTE).* TOTE focuses on MWEEs, in support of the state's commitment to the Chesapeake 2014 Agreement. In addition to classroom training about the structure and purpose of MWEEs, teachers receive immersive field experiences to provide pedagogical models they can modify and administer to their own students (Figure 6.3). Topics include a MWEE overview, field research methods, classroom curricula, laboratory activities, and professional sharing and reflection opportunities.

- *Pre-service Teacher Training Opportunities.* Providing professional development for pre-service teachers, or post-secondary students in a university teacher preparation program, is an effective, but underutilized audience to increase MWEEs statewide (McDonald & Dominguez, 2010). Chances of MWEE implementation increase when focusing on training pre-service teachers before they are ingrained in the formal classroom. CBNERR-VA offers pre-service teacher training opportunities to students at W&M's School of Education, and is proposing to increase its reach to universities throughout the VSG network.



Figure 6.3. Teachers participate in lab activity during Teachers on the Estuary (TOTE) workshop. Image credit: S. Nuss.

- *Graduate Student Training.* The Reserve's Education & Outreach Program provides training opportunities for graduate students on translating their research to secondary science students (middle and high school). The Virginia Scientists and Educators Alliance (VASEA), currently in its fifth cohort of students, provides graduate students with the opportunity to create a K-12 lesson plan based on their current research. VASEA lesson plans are widely shared with educators nationally through education conferences and online. Additionally, Reserve staff work with VIMS graduate students on building skills to improve their science communication skills through events such as Discovery Labs, summer camp, and fellowship and mentorship opportunities within K-12 education. Graduate students with these skills can also assist faculty at VIMS with broader impact efforts for their labs.

- *Estuarine Aquarium Keeping.* The Reserve offers one-day teacher workshops on Aquarium Keeping in the Classroom for teachers who wish to maintain estuarine aquariums in their schools. Estuarine aquariums provide teachers an opportunity 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. This opportunity also gives teachers an outlet 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. Website: https://www.vims.edu/cbnerr/docs/education_docs/EstAquKeepwriteup.pdf.

6.4.4 Public Outreach Programs

- *Discovery Labs.* Beginning in 2007, the Reserve has offered a family oriented, hands-on discovery lab approximately 7-8 times a year focused on a specific marine science topic. Discovery Labs include an expert presentation, research and management issues as related to a specific topic, and relevant kids' activities. Website: https://www.vims.edu/cbnerr/education/public_programs/index.php.

- *Festivals and Exhibits.* CBNERR-VA reaches general audiences (e.g., families, adults, non-formal settings) through the design, development, and exhibition of interactive displays and activities at selected fairs and festivals, including VIMS Marine Science Day. These stations include a beach seining program and hands-on learning stations that have a wide variety of live estuarine animals to view under microscopes and in aquaria.

6.4.5 Advisory Service & Technical Assistance

Advisory service and technical assistance are core elements of VIMS's and CBNERR-VA's mission. Staff provide a high level of advisory service to federal, state and local governments and a variety of non-governmental and hybrid (government and non-government) organizations. A principal mechanism to provide this service includes membership and participation on key committees and workgroups. With respect to the Education & Outreach Program, selected targeted committee, workgroup, and board membership includes:

- National Marine Educators Association (NMEA). NMEA is a dedicated, influential, member-based organization of classroom teachers, informal educators, university professors, scientists, and more from around the world working together to advance the understanding and protection of our freshwater and marine ecosystems. CBNERR-VA educators serve on the NMEA board, as well as participating with the regional mid-Atlantic chapter (MAMEA) as an active member and current board member.

- Chesapeake Bay Program (CBP) Education Workgroup. The CBP Education workgroup provides a forum for cross-jurisdictional coordination and support on all aspects of environmental education. Emphasis is placed on: (1) increasing MWEEs and other place-based, outdoor education; (2) supporting training for teachers and environmental education professionals in content, pedagogy, and outdoor-

learning techniques related to environmental topics; (3) encouraging green infrastructure and operations on school grounds; and (4) supporting federal, state, and regional environmental literacy planning. The CBNERR-VA Education Coordinator serves on the CBP Education workgroup.

- Virginia Resource-Use Education Council (VRUEC). The VRUEC is a consortium of state and federal natural resource and education agencies, and colleges of education and resource management supporting environmental literacy across the Commonwealth of Virginia. VRUEC sponsors courses in conservation and natural resources for hundreds of educators, and the Education Coordinator serves as one of two representatives from VIMS on the Council.

6.5 NEEDS & OPPORTUNITIES

The initial K-12 Environmental Education Needs Assessment for the Hampton Roads, Virginia region was completed in 2010 (https://www.vims.edu/cbnerr/_docs/education_docs/CBNERR%20k-12%20NEEDS%20ASSESS%20FINAL.pdf, McGuire 2012). An updated Needs Assessment, conducted in spring 2020, supported CBNERR-VA's work with teachers and local schools (https://www.vims.edu/cbnerr/_docs/education_docs/2020cbnerrneedsassessment.pdf). Takeaways included continual professional development for teachers (2-day workshops as preference), including lab and field collection activities, and using real-time data. Majority of teacher respondents also reinforced the need for experiential field experiences and support for those experiences at local schools. Takeaways included continual professional development for teachers (2-day workshops as preference), including lab and field collection activities, and using real-time data. Majority of teacher respondents also reinforced the need for experiential field experiences and support for those experiences at local schools. Virtual learning will continue to be a part of the Education & Outreach Program, in varying capacities, and continued professional development for staff, as well as resources, will be needed.

6.6 MONITORING & EVALUATION

Classroom visits and field experiences are evaluated through teacher satisfaction surveys sent out at the end of each school quarter. These evaluations are also used to evaluate staff performance, and also to make improvements to programs on an as needed basis. Summer camp programs are evaluated through parent satisfaction surveys as well as student pre and post-tests to gather information on knowledge and skills gained through participation. All TOTE workshops are evaluated using the NERRS exit survey as well as the follow up survey which takes place 6 months to a year after the workshop. Grant-funded projects may include an external evaluator. The 2020 Needs Assessment will need to be revised every five years to maintain current with the needs of our K-12 teacher audience. All evaluation data is used to revise and improve education programs on a continual basis, and are incorporated into manuscripts whenever possible, including collaborative evaluation projects on summer camps with NOAA Hollings Scholars.



CHAPTER 7 - COASTAL TRAINING

7.1 INTRODUCTION

The Coastal Training Program (CTP) provides up-to-date scientific information and skill-building opportunities to coastal decision-makers on relevant coastal management issues. Target audiences may vary for each reserve, but generally include local elected or appointed officials, managers of both public and private lands, natural resource managers, coastal and community planners, and coastal business owners and operators. They may also include such audiences as farmers, watershed councils, professional associations, recreation enthusiasts, researchers, and more.

The place-based nature of reserves makes them uniquely positioned to deliver pertinent information to these audiences. Each reserve conducts an analysis of the training market and assessment of audience needs to identify how best to deliver relevant training on priority issues to their area.

Partnerships are integral to the program's success. Reserves work closely with a host of local partners, as well as several NOAA programs, to determine key coastal resource issues and the appropriate target audiences and expertise needed to deliver relevant and accessible programs. The Reserve System Strategic Plan (NOAA/NERRS 2017) outlines coastal training objectives designed to ensure that coastal decision-makers and environmental professionals understand and effectively apply science-based tools, information, and planning approaches that support resilient estuaries and coastal communities.

7.2 PROGRAM CONTEXT

7.2.1 Setting & Context

The overarching goal of the CBNERR-VA CTP is to provide science-based information to improve decision-making as related to coastal resources. To accomplish this, the Reserve's CTP provides training and technical assistance to targeted stakeholders. CTP training opportunities are intended to help coastal decision-makers (CDMs) understand the link between behaviors, environmental health and quality of life in their coastal communities. Training topics at CBNERR-VA are user driven and place-based, from resource management and digital tools for community planning, to social science and risk communications. Technical assistance has historically included participation on community and resource-focused workgroups, committees and other decision-making or advisory bodies. Resources tailored to CDMs have included symposium proceedings, fact sheets, resource lists, and training and work aids.

Building on the program's successes and lessons learned, CBNERR-VA's Coastal Training Plan, outlined below, provides guiding principles and program objectives for addressing near-term priority training needs. The plan synthesizes reserve management goals and priorities identified in results of formal and informal needs assessments of target audiences. Program priorities and training methods defined in this document may be adjusted during the duration of the Reserve's management plan to respond to changing training markets, audience needs and/or emerging issues relevant to CBNERR-VA and its target communities.

7.2.2 Socioeconomic Context and Geographic Scope

While the Reserve's CTP geographic scope is regionally broad, including coastal Virginia and the Chesapeake Bay region, its target geography, like that of the Reserve, is the York River watershed and its adjacent small coastal basins, referred to as the CBNERR-VA Focal Area (see Figure 2.4). This geographic region is the focus of efforts led by the YR&SCB Roundtable. Further, within this geographic region, the Middle Peninsula has been distinguished as a USACE Priority Subwatershed and a recently selected NOAA Habitat Focus area.

Detailed information on the Reserve's ecological and socioeconomic setting are provided in Sections 2.2 and 2.3, respectively. Notably, within the CBNERR-VA Focal Area, 31.8% of the population 18 years and over has a Bachelor's degree or higher, while 13.8% of those 25 years and over have a Graduate or professional degree (U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates). With respect to profession, 10.2% of Virginia's Coastal Zone county population over 16 years old is employed in the public administration industry – a target audience of the CTP program (U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates).

7.2.3 Priority Issues & Training Needs

Formal needs assessments in 2005 and 2012, post-event evaluations, and ongoing contact with CDMs, have enabled data collection on all aspects of training, including topical interest, training format and delivery styles. The formal assessments identified local government and private sector needs to ensure that ensuing training topics aligned with user-driven priorities. Ongoing, informal assessments of CTP stakeholders have augmented formal methodologies, allowing ground-truthing, corroboration and the identification of synergies with CBNERR-VA program priorities.

Considering the synergies between user identified topic areas through formal, historical needs assessments, informal and ongoing related data collection, and Reserve capacity and technical expertise, CBNERR-VA's CTP near-future efforts will concentrate on four target topic areas (and their synergies): (1) climate change, including sea level rise (SLR) and coastal resilience; (2) water quality and watershed management; (3) coastal community development and land use planning; and (4) communications and management. Following are descriptions of the conditions that position these topic areas as priorities.

- *Climate Change and Coastal Resilience.* Inclement weather and natural disasters are occurring in greater frequency and severity in association with a changing climate. Since 1980 in the U.S. alone, 298 weather and climate disasters have reached or exceeded \$1 billion in costs, accounting for more than \$1.975 trillion in related damages (NOAA/NCEI, 2021). In Virginia, damage from Hurricane Isabel (2003) was estimated at \$1.85 billion (Beven & Cobb, 2004). As climate change proceeds and conditions worsen, its impacts will likely expand in size and scope, exacerbating a slew of compounding stressors with their own negative impacts to land, sea and people - including SLR.

Warming waters contribute to SLR and result in, for example, land loss from erosion, wetland loss from inundation, and repetitive tidal flooding. Repetitive tidal flooding, often characterized as nuisance flooding, is one of the most significant hazards faced in coastal Virginia. Occurring during high tides, and exacerbated by storm events, repetitive flooding inundates roads and overwhelms stormwater drainage systems, damaging infrastructure and causing public disruptions. Current estimates indicate that U.S. coastlines experience more than twice as much repetitive tidal flooding as they did in 2000, and that by 2050, most coastal communities will experience between 25 and 75 days of repetitive tidal flooding a year (NOAA Tides and Currents, 2021).

According to the Commonwealth of Virginia Hazard Mitigation Plan (CVA 2018 Not listed in reference section), coastal flooding can also occur when strong onshore winds push water from an ocean, bay or

inlet onto the land, conditions exacerbated in coastal Virginia by hurricanes, nor'easters and other large coastal storms that result in storm-surge, wind-driven waves and heavy rainfall. Flooding from overland flow, ponding and inadequate storm water drainage contribute to coastal flooding as well. Further exacerbating flooding is the regional trend toward subsidence. Specifically, the focus CTP geography (the CBNERR-VA Focal Area) exhibits one of the highest relative SLR rates in the nation (see Section 2.4.1 for details on rates and processes). SLR has widely-recognized economic, social and environmental implications. Examples of impacts pertaining to coastal resilience in rural coastal Virginia include destruction and devaluation of property, saltwater intrusion in agricultural fields, and diminished access to roads and emergency services. Managing flooding through a combination of natural and nature-based (NNB) solutions is a practice with significant support in the Commonwealth, while strategic relocation is a conversation that is gaining increasing steam; both are addressed in Virginia's Coastal Resilience Master Plan (Commonwealth of Virginia, 2021).

- *Water Quality and Watershed Management.* CBNERR-VA's expertise in water quality monitoring stems from its experience leading efforts in Virginia's tidal waters since 1995. Its priority programs contribute to regional and national initiatives, and help inform a myriad of stakeholders, from aquaculture practitioners (Tidal Water Quality Monitoring & Modeling Initiative) and recreational anglers (Chesapeake Bay Interpretive Buoy System [CBIBS]), to regulatory agents (Southern Chesapeake Bay Shallow Water Quality Monitoring Program) and researchers (NERRS System-Wide Monitoring Program). Regional water quality efforts are focused on the protection and restoration of the Chesapeake Bay, with the Commonwealth's priorities on participation and contribution in the Chesapeake Bay Program (CBP), as well as implementation of monitoring and regulating activities under the Chesapeake Bay Preservation Act and the Clean Water Act. Presently guiding Virginia's water quality efforts in this vein are the mandated 2010 EPA Chesapeake Bay Total Maximum Daily Loads (TMDLs), Virginia's 2019 Phase III Watershed Implementation Plan (WIP), and the two-year, USEPA required, Chesapeake Bay Nutrient and Sediment Reduction Milestones.

As a priority program of the Reserve, CBNERR-VA is well positioned to provide capacity and technical expertise on abiotic and biological water quality related data collection and delivery. The CTP Coordinator acts a liaison in this respect, connecting CBNERR-VA water quality experts to relevant stakeholders, providing access to CBNERR-VA's associated platforms and data (i.e. Virginia Estuarine and Coastal Observing System [VECOS]) and communicating on behalf of the water quality program on issues related best practices and monitoring. One such CTP effort operating in this vein is coordination of the YR&SCB Roundtable, a forum focused on water quality and quantity issues (e.g. Harmful algal blooms [HABS], TMDL constituents), as well as implementation of the WIP III. This transdisciplinary forum engages stakeholders from a variety of sectors, levels of government and jurisdictions across the York River watershed and associated small coastal basins in the common pursuit of improved understanding and greater support for water quality and measurable reductions in nonpoint source pollution, as well as habitat restoration and protection. CBNERR-VA recognizes that all watershed stakeholders are CDMs and is poised to leverage its water quality expertise and assets as it leads integrated management efforts toward more holistic (socio, economic, environmental) watershed resilience.

- *Coastal Community Development and Land Use Planning.* Throughout the CTP target geography (the CBNERR-VA Focal Area; see Figure 2.4), and among coastal counties, population is growing (see Table 2.2). Faster in discrete population centers than in areas like Rural Coastal Virginia, though even while modest, some localities along the rural coast of Virginia are seeing some population growth. Prior needs assessments (2012) and informal, iterative surveys indicate that CDMs regard this coastal community

development and related land use planning as one of the most pressing issues facing the resources and health of the Chesapeake Bay.

Coastal development itself contributes to habitat loss and destruction, erosion that results in sedimentation, polluting runoff and increased flood risk. Loss of conterminous US coastal wetlands has been calculated to occur at $80,160 \text{ ac}\cdot\text{yr}^{-1}$ (Dahl & Stedman, 2013), negatively impacting communities that had received its natural protection from coastal storms and surge. In fact, the leading driver of flood risk to coastal populations by 2030 has been identified as coastal development (WRI, 2020). Identifying wetlands and their associated ecosystem services, like flood mitigation, are two examples of ways in which CBNERR-VA's CTP program is socializing integrated frameworks and methodologies to support the most informed and sustainable decisions of CDMs engaged in development.

Yet, decisions on coastal development and land use planning weigh a myriad of factors; among them, those predicated on the social sciences, e.g. social vulnerability and decision-making, market trends and analysis. Integrating these components in an effective manner for the most comprehensive planning requires meaningful strategy. Thus, complementing CTP programming focused on the socio, economic and environmental aspects of development is that which emphasizes the processes and sciences that are used to integrate them.

- *Communications and Management.* Meaningful communication and strategic planning contribute to the most effective and informed CDM. Translating science to shape policy, marketing programs toward behavior change, socializing best practices and regulations - all require a fundamental knowledge of communications and a plan for achieving related goals. Knowing one's audience, be it internal or external, and how to effectively - and equitably - reach them through outreach and engagement requires situational and cultural awareness. Depending on the circumstance, it may require a knowledge of available outreach platforms and the digital landscape (e.g. social media, video conferencing), or perhaps a familiarity and comfort with facilitation, public presentation, networking or written narrative. In some circumstances, it also necessitates an ability to navigate conflict and disruptive behaviors. Regardless, communications are often the means to an end, one which can be most effectively achieved through purposeful planning. Planning frameworks provide alternative ways of approaching a problem, solution, threat or question necessitating action, and offer CDMs the opportunity to identify and meet related goals in measured, comprehensive and sustainable manners. CBNERR-VA's CTP program offers a variety of courses in planning and process development toward this end.



Figure 7.1. Participants in the field during a Perennial Stream Identification training, 2019. Image credit: C. Gonzalez.

7.2.4 Priority Audiences

CDMs comprising the CTP target audience are grouped below.

- (1) 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;
- (2) Federal, state, tribal, regional and local agency staff within departments that provide oversight and advise on land use planning, coastal resources, inland fisheries and wildlife, and environmental protection;
- (3) Non-profit organizations, including conservation commissions, land trusts, chapters of environmental organizations, and watershed associations;
- (4) Academics providing technical and advisory services;
- (5) Business enterprises and organizations, such as aquaculture operations, recreation outfitters, commercial fisheries organizations, realty associations, building and development associations, commercial property owners associations, marine trade and construction businesses, chambers of commerce and tourist boards;
- (6) Contractors and consultants, including environmental consultants and engineers, and infrastructure providers; and
- (7) Civic, user and interest group leaders, including Rotary clubs, Master Naturalists and property owner associations.

While each of these audiences may engage with the CTP's priority issue areas to varying degrees, no priority issue area is specific to a particular audience; rather, all audiences engage with each priority issue area to some degree. By providing training and technical assistance to all levels of government, and across multiple jurisdictions and sectors, the CTP will effectively promote interdisciplinary interaction and collaboration on priority issues. As priority issues evolve and emerge, the CTP will continue to identify appropriate, and possibly new, target audiences. Appendix G details CTP's four topic areas and their respective target audiences.

7.3 PROGRAM DELIVERY

7.3.1 CTP's Three Pillars of Program Delivery

CTP delivery occurs through three main avenues: capacity building, technical assistance and community engagement. These established avenues, the "pillars" of CTP program delivery, guide both methods and goals of program content. While complementing one another, they are provided in combination to support CDM professional development, offer CDMs advisory service and bolster CBNERR-VA integration into local and regional communities (Figure 7.2). All are applicable across professional sectors, jurisdictions, and levels of government, and can be applied in both internal and external contexts

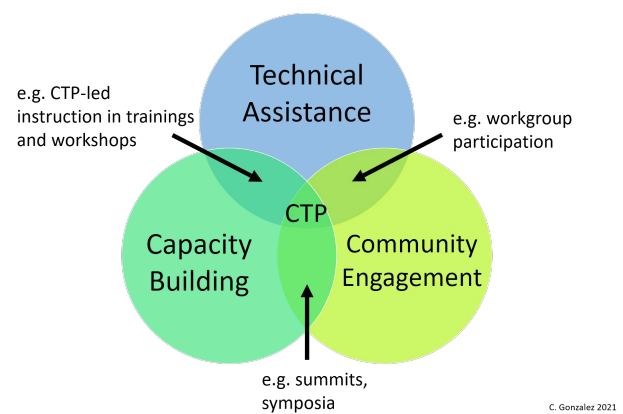


Figure 7.2. Schematic depicting CTP's three pillars of program delivery. Image credit: C. Gonzalez.

relative to the CBNERR-VA team. For a comprehensive look at the intersection between the three pillars, CTP’s four topic areas, and planned programming and partners (see Appendix G).

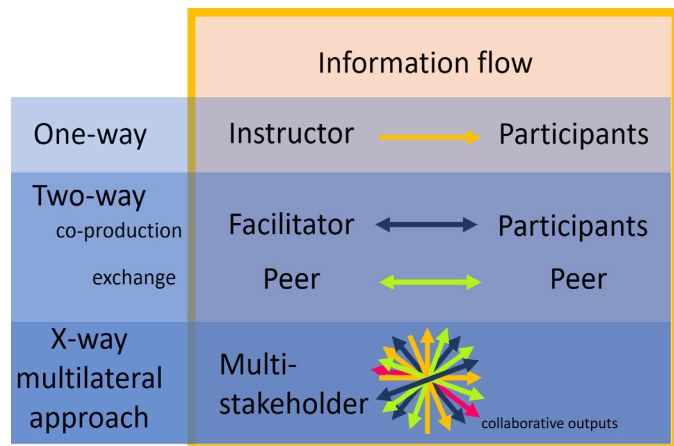
The Capacity Building Pillar, at its most basic, is representative of professional development opportunities, though is fundamentally focused on knowledge exchange and empowered decision-making. Exchange may include experiential components, and can be uni- or multi-directional (see Figure 7.3), with examples of each as follows.

7.3.2 Professional Development Opportunities & Formats

- *Thematic Trainings.* Trainings are end user-informed, and enable access to highly coveted content for decision-makers. Formats are typically uni-directional (one-way, instructor/presenter to participants) and include synchronous presentations, in-person, remote and hybrid, by experts and seasoned professionals, accompanied by lab and/or field opportunities, if not virtual study. Certification and/or education credits may accompany these offerings, which typically reach 25-30 participants per training.

- *Topical Workshops.* The CTP program convenes and/or facilitates user-informed workshops to meet the needs of its target audiences. This method of multi-directional (two-way, facilitator and participant co-production) program delivery is driven in part by stakeholder engagement, which serves as an extension, or application, of training content. Workshops may focus on, for example, restoration topics while engaging those in a regional community of practice through presentations and discussion. Certification and/or education credits may accompany these offerings, which typically reach 25-30 participants per workshop.

- *Technical Conferences, Symposia & Summits.* A second multi-directional type of exchange (X-way, multilateral approach) combines unidirectional delivery and facilitated co-production alongside peer-to-peer exchange in a comprehensive forum typically inclusive of collaborative outputs. The CTP program may convene and/or facilitate these forums as needs for discussion and multi-stakeholder input surface. Notably, these forums often allow for community engagement, representing therein work at the nexus of multiple CTP pillars. Hundreds of participants may take part in these offerings. One example of a forum CBNERR-VA convenes regularly to fill a gap in regional discourse is the YR&SCB Symposium, an effort intended to allow for the presentation and discussion of quality, rigorous and objective science, as well as science-based education and management relating to the York River watershed and its adjacent coastal basins. Occurring biennially, the forum convenes regional academics and practitioners around topics relevant to CDMs while encouraging best practices in science communications and translation for community accessibility.



C. Gonzalez 2021

Figure 7.3. Information flows in CTP’s knowledge exchange framework. Image credit: C. Gonzalez.

7.3.3. Advisory Service & Technical Assistance

The provision of advisory service, or technical assistance, is a core element of VIMS's and CBNERR-VA's mission. In contrast to capacity building, this pillar of program delivery is focused on meeting and filling more immediate needs and gaps. The nature of the assistance itself, is predicated on technical subject knowledge and lived experience, obligating the principal focus of the service to change with respect to that which CTP staff are versed in and have the acumen and/or authority to provide. Presently, CTP staff are equipped to advise and lead on the following: facilitation and coordination, communications (including but not limited to: science translation, delivery, marketing and virtual engagement), social science methodologies, planning processes, grant writing, and diversity, equity, inclusion and justice (DEIJ) in the coastal zone. Technical assistance overlaps with capacity building where the information exchange centers on these practices and is CTP led.

As a service provider, CBNERR-VA's CTP is poised to serve federal, state, regional, local and tribal governments, as well as a variety of non-governmental and hybrid (government and non-government) organizations, though CTP assistance is not limited to these sectors and strives to be accessible to all those that are mission relevant. Accordingly, technical assistance may manifest in both informal and formal manners though common to each is its provision at the request of an external actor. One avenue of the CTP's provision of informal assistance is the Office Hours program, instituted in 2021 for those CDMs seeking easily accessible, personalized and timely feedback. Meanwhile, a principal mechanism of formal advisory service is through CTP staff membership and participation on, if not leadership of, mission-relevant committees and workgroups. Notably, participation on, and/or leadership of, local and regional workgroups can facilitate community engagement, the crux of CTP's third program delivery pillar. The following reflect examples of this formal service.

- *York River & Small Coastal Basin Roundtable.* The YR&SCB Roundtable provides a forum for information sharing and collaboration among water quality and conservation minded stakeholders within the York River, Mobjack Bay and Piankatank River watershed areas. CBNERR-VA reinvigorated the roundtable in 2019 with the goal of supporting the Commonwealth's efforts to protect water quality and conserve coastal natural resources for the betterment of its communities. Basic elements/activities led by CBNERR-VA's CTP in support of the YR&SCB Roundtable include strategic planning and implementation in coordination with the roundtable's four steering committees (Science, Nearshore Habitat Restoration, Business Advisory and Education/Outreach). The Reserve's CTP Coordinator serves as the supporting grant lead and lead facilitator of the roundtable's membership. Organization web link: <https://www.vims.edu/cbnerr/roundtable/index.php>.
- *Coastal Policy Team.* Virginia Coastal Zone Management Programs (VCZMP) Coastal Policy Team, a network of Virginia state agencies and local governments, administers enforceable laws, regulations and policies that protect coastal resources and foster sustainable development. The Coastal Policy Team facilitates cooperation among agencies, providing regular forums for discussion and information exchange, and resolution of cross-cutting coastal resource management issues. CBNERR-VA takes part in this forum as an active voting entity. CTP leverages this forum to conduct program assessment and provides technical assistance to its members.
- *Virginia's 1st District Advisory Environmental Council.* Facilitated by Virginia's 1st District congressional representative and staff, the Council provides a forum for updates and information exchange among stakeholders focused on environmental issues in the Commonwealth's First District, advising programs and policies affecting coastal Virginia and the Chesapeake Bay. The Reserve's CTP Coordinator and Director participant on the Council.

7.3.4. Community Engagement

CBNERR-VA’s CTP program recognizes that meaningful and equitable capacity building and advisory service cannot be delivered without understanding end-users, and that this understanding is cultivated through direct engagement. Moreover, ensuring that CBNERR-VA is recognized in the communities it seeks to serve as a credible and reliable source of objective and rigorous coastal science and related technical assistance, necessitates building rapport and, ultimately, trust with target audience members. CTP staff thus regard community engagement as a key tenant of program delivery.



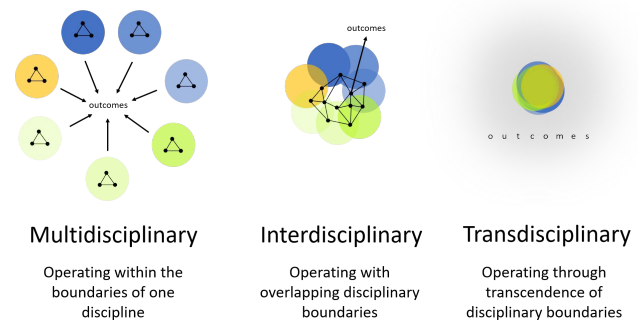
Figure 7.4. Watershed mapping exercise with YR&SCB Roundtable, 2019. Image credit: C. Gonzalez.

Central to CTP’s pillar on community engagement is the premise of meeting people where they’re at, an outcome of the oft repeated mantra, “nothing for us, without us.” Showing up to, and being a consistent part of, community-driven engagement, if not the community itself, fosters the relationships necessary to cultivate trust, cooperation and partnerships. Accordingly, CTP staff frequently act as community liaisons and relationship managers, brokering connections on behalf of CBNERR-VA. Meanwhile, their engagement can aid in the delivery and promotion of CBNERR-VA science and technical assistance, increasing awareness of the Reserve’s capacity and role as a regional provider and civic leader in coastal management.

7.3.5 Principles of Program Delivery

Program priority issues and delivery methodologies may be adjusted over the duration of this management plan, and those subsequent to it, in response to changing training markets, audience needs and/or emerging issues relevant to CBNERR-VA and its target communities. However, the following six principles will continuously guide CTP program delivery through its three pillars:

- (1) Accessibility: services and cooperation for all those who seek it, including current and future CDMs; corresponding marketing to avail itself accordingly;
- (2) Transdisciplinary perspective: training methodology and collaborative approaches designed to address issues from a unified perspective, beyond the siloed frameworks of traditional disciplines and inclusive of socio-ecological and economic considerations (see Figure 7.5);
- (3) Relevancy: delivery of accurate, timely and relevant scientific information, tools and educational



C. Gonzalez 2021

Figure 7.5. Schematic detailing collaborative strategies among disciplines; CTP aims for transdisciplinary methodologies and approaches. Image credit: C. Gonzalez.

resources; acknowledgement of contemporary circumstances and issues directly applicable to participants, using place-based examples where possible; peer-to-peer information exchange;

(4) Respect and Inclusivity: operation in environments where innovation is encouraged and ideas may be critiqued, though the people behind them are always welcomed;

(5) Decision-driven: program delivery is geared toward informed and empowered decision-making, be that of CDMs, or of CBNERR-VA itself; and

(6) Adaptability: content is malleable and always user-driven, adapting to meet the needs of target audiences.

7.3.6 Marketing Strategy

The 2005 and 2012 CBNERR-VA Market Analyses provided information on optimal marketing strategies for CTP programming. Given past assessments and subsequent qualitative information gathered from CDMs, the Reserve's CTP continues to market training offerings and technical assistance through a combination of email invitations, partner list-serves, social media platforms, the CBNERR-VA website, and invited presentations. Notably, CTP staff regularly update their inventory of partner list-serves to include an ever-growing list of relevant organizations and affinity groups. Strategies employed to increase appeal include, but are not limited to, offering continuing education credits for those seeking to fulfill professional development requirements, as well as enhancing accessibility through free or subsidized trainings, virtual platforms and the option of asynchronous timelines.

7.3.7 Program Alignment

- *Alignment with National Program.* CTP priority issues and pillars of program delivery align with, and support, the 2017-2022 Reserve System Strategic Plan (NOAA/NERRS 2017) in multiple respects. For example, in support of the Protecting Places Goal, CBNERR-VA's training regimen offers CDMs place-based information on coastal protection and restoration. These opportunities, oftentimes experiential in nature, have the potential to enhance connections to estuaries. The strategic plan's Applying Science and Educating Communities goals are manifested in all three pillars of CTP delivery. For instance, training on data visualization and analysis tools are offered in the vein of Capacity Building, increasing awareness of the utility of CBNERR-VA research and monitoring data. Meanwhile, as part of its Technical Assistance role with the YR&SCB Roundtable, CTP is working with watershed stakeholders to coordinate the delivery of water quality data and outreach within the watershed, educating practitioners and communities alike on the state of their watershed's health. CTP continues to develop partnerships and collaborations through its Community Engagement pillar of program delivery; each represents an opportunity to transfer science through relevant platforms toward applied ends – including increased stewardship and action.

- *Alignment within CBNERR-VA Programs.* Through mutually beneficial collaborations and project syntheses, the CTP will support each Reserve programmatic sector in complementary ways. Restoration will be the focus of its work, for example, with the Stewardship sector. In the recent USACE Chesapeake Bay Comprehensive Plan (USACE 2019), the Commonwealth of Virginia identified the York River, Piankatank River and Mobjack Bay as a priority area for natural and nature-based (NNB) shoreline resiliency projects. NNB shoreline resiliency projects would include wetland, oyster reef, living shoreline and SAV restoration efforts. Once implemented, related restoration projects could promote coastal community resiliency by reducing waves and shoreline erosion, thereby protecting human health and safety and enhancing quality of life, while providing habitat for Chesapeake Bay species of ecological and economic concern. Additional benefits could include water quality improvement and support of a

developing blue-green economy. An increasing awareness and implementation of NNB restoration projects in local communities has inspired forums of related discussion and training opportunities. To this end, the CTP supports the Stewardship sector by providing nearshore habitat restoration-focused trainings and workshops that convene an ongoing, place-based community of restoration practitioners.

Similarly, the CTP works with the Education and Research sectors to enhance the content and visibility of their respective outputs through relevant delivery methods, including trainings (e.g. Digital Tools for CDMs), summits (e.g. YR&SCB Symposium) and community outreach (e.g. State of the York). Notably, these examples of program alignment are not exhaustive; for the most comprehensive representation of the ways in which the CTP aligns with and complements the CBNERR-VA sectors, see Chapter 3's goals and objectives.

7.4 CTP PLAN RELATED GOALS, OBJECTIVES & ACTIONS

7.4.1 CBNERR-VA Program Goals

Working in concert with all Reserve programmatic teams, CBNERR-VA CTP efforts contribute to Reserve goals in all three of the Reserve's Functional Areas, as detailed in Chapter 3 of this plan. Each of these overarching Reserve goals is supported by sector-specific CTP goals. Below, each CTP-relevant Reserve objective is detailed alongside the CTP sector-specific objective that supports it (section 7.4.2.)

7.4.2 CTP Sector Specific Goals

In addition to the Reserve Management Plan, the CTP is also guided by a separate national CTP strategic plan (CTP Plan) that integrates the reserve's management plan goals and objectives with additional priorities identified through formal and informal needs assessments of CTP target audiences. CBNERR-VA CTP Plan goals and objectives over the next five years are provided below in alignment with the three-pillar approach of program delivery. Corresponding Reserve Objectives (ROs), by Functional Area (FA) and goal (G), accompany CTP objectives.

Pillar 1: Capacity Building

Goal: Knowledge exchange toward functional autonomy, if not expertise, on coastal and watershed priority issues for informed and empowered decision making.

Objectives:

- Provide targeted training, workshops, conferences and other development opportunities for CDMs, experiential when possible and showcasing, if not integrating, CBNERR-VA estuarine science, management and/best practices where appropriate.
 - Supports: (FA:1, G:3, RO:1 and RO:2); (FA:2, G:4, RO:2 and RO:3); (FA:3, G:2, RO:1); (FA:3, G:2, RO:4); (FA:3, G:3, RO:2 and RO:4); (FA:3, G:4, RO:1 and RO:2); and (FA:3, G:5, RO:2)
- Communicate CBNERR-VA science and best practices to governmental and non-governmental entities through trainings, providing information, and detailing acquisition avenues, for improved decision-making.
 - Supports: (FA:1, G:1, RO:3); (FA:2, G:2, RO:6); (FA:2, G:4, RO:2 and RO:3); (FA:3, G:1, RO:4); (FA:3, G:2, RO:3); (FA:3, G:2, RO:4); (FA:3, G:3, RO:4); and (FA:3, G:4, RO:2)
- Facilitate forums that gather CDMs in knowledge exchange, idea generation, and discussion of challenges and opportunities, while fostering collaborations and strengthening relationships within peer (coastal practitioner) networks toward increased social capital in the CDM sector.

- Supports: (FA:3, G:2, RO:2)
- Identify and procure funding that supports additional capacity and programming for CDMs.
 - Supports: (FA:3, G:3, RO:3); and (FA:3, G:4, RO:2)

Pillar 2: Technical Assistance

Goal: Accessible and equitable service provision to meet immediate needs and fill gaps in coastal resource management.

Objectives:

- Provide formal and informal technical assistance through leadership and coaching that aligns with staff background and lived experience, presently including but not limited to: stakeholder engagement, facilitation, communications, planning and process development, and project management.
 - Supports: (FA:1, G:1, RO:5); (FA:1, G:2, RO:1); (FA:3, G:1, RO:4); (FA:3, G:2, RO:2 and RO:3); (FA:3, G:3, RO:3); and (FA:3, G:4, RO:2)
- Serve in an advisory capacity to national, regional, state, tribal and local coastal resource management, research and education agencies, organizations and interest groups.
 - Supports: (FA:2, G:4, RO:5); (FA:3, G:2, RO:3); and (FA:3, G:4, RO:2)
- Communicate CBNERR-VA science and best practices to governmental and non-governmental entities in its capacity as an authoritative source.
 - Supports: (FA:1, G:1, RO:3); (FA:2, G:2, RO:6); (FA:2, G:4, RO:2 and RO:3); (FA:3, G:1, RO:4); (FA:3, G:2, RO:3); (FA:3, G:2, RO:4); (FA:3, G:3, RO:4); and (FA:3, G:4, RO:2)
- Connect CDMs to CBNERR-VA experts and capacity where expertise or need sought does not lie immediately within scope of CTP.
 - Supports: (FA:1, G:1, RO:3); (FA:2, G:1, RO:5); (FA:3, G:2, RO:2); and (FA:3, G:4, RO:2)
- Coordinate support of, and connections to, existing social, environmental and economic information and data for organizations that may benefit from related access.
 - Supports: (FA:2, G:1, RO:2); (FA:2, G:2, RO:6); (FA:3, G:2, RO:2); (FA:3, G:2, RO:4); (FA:3, G:3, RO:2); and (FA:3, G:4, RO:2)
- Develop information products and technical resources to meet audience needs and fill gaps in existing products.
 - Supports: (FA:3, G:1, RO:4); (FA:3, G:3, RO:2 and RO:4); and (FA:3, G:4, RO:2)
- Provide quality, rigorous, objective science on the state of the watershed through a regularly released, State of the York and Surrounding Small Coastal Basins outreach product.
 - Supports: (FA:2, G:4, RO:1 and 3)

Pillar 3: Community Engagement

Goal: A mutual understanding with end-users that facilitates mutual gains - benefits for both CBNERR-VA and the communities it serves, including awareness of, and credibility for, CBNERR-VA and its science, the provision of its science to communities, and coastal community empowerment.

Objectives:

- Representation, if not active participation, at a variety of engagement opportunities across jurisdictions, disciplines and sectors to aid in CBNERR-VA's community integration, learn of the

priority issues and challenges faced on the ground, and garner target audience trust.

- Supports: (FA:2, G:4, RO:5)
- Communication of CBNERR-VA's reserve amenities and resource utility, as well as its capacity for partnering and providing advisory services toward the increased awareness of, and access to, the technical assistance and service capabilities of CBNERR-VA.
 - Supports: (FA:2, G:1, RO:5); and (FA:3, G:2, RO:2)
- Communication of CBNERR-VA science in service of governmental and non-governmental entities, toward the establishment of the Reserve as an experienced and authoritative source of information and for improved decision-making.
 - Supports: (FA:2, G:1, RO:2; FA:2, G:2, RO:6; FA:2, G:4, RO:2 and RO:3; FA:3, G:1, RO:4; FA:3, G:2, RO:3; FA:3, G:2, RO:4; FA:3, G:3, RO:4; FA:3, G:4, RO:2)
- Identification and pursuit of mutually beneficial synergies, including those aligned with CBNERR-VA's mission; development of new partnerships and communities of practice that amplify shared project impact beyond a single organization's capacity.
 - Supports: (FA:1, G:3, RO:3; FA:2, G:1, RO:1; FA:2, G:1, RO:5; FA:3, G:2, RO:2; FA:3, G:3, RO:2; FA:3, G:4, RO:1)
- Coordination of a biennial forum for the exchange of quality, rigorous and objective science and science-based education and management relating to the state of the York River watershed and its small coastal basins; accessible to all CDMs and community members alike.
 - Supports: (FA:2, G:4, RO:2 and RO:3; FA:3, G:4, RO:1)
- Cultivation and fostering of holistic coastal community resilience through the introduction and socialization of community engagement in transdisciplinary (see Figure 7.5) approaches.
 - Supports: (FA:3, G:3, RO:2 and RO:3); and (FA:3, G:5, RO:2)

Overarching CTP Sector-Specific Goal: Program development and delivery toward informed and empowered decision-making as related to local and regional coastal resource management, including that of CDMs as well as CBNERR-VA.

Objectives:

- Foster CDM understanding, skills and motivations to make decisions in light of their relationship to natural systems, communities and future generations.
 - Supports: (FA:2, G:4, RO:3); (FA:3, G:2, RO:3); and (FA:3, G:2, RO:4)
- Regularly assess the science-based knowledge, skill gaps and needs of CDMs for the most effective, timely and relevant program delivery.
 - Supports: (FA:2, G:1, RO:1)

7.5 PROGRAM CAPACITY

7.5.1 Staff

CBNERR-VA maintains adequate staffing to deliver national and local CTP foundational programs. However additional dedicated CTP staff capacity would be needed to meet the full range of local and regional CDMs needs. Currently, a full-time CTP Coordinator oversees the program, with additional support being provided by Reserve administrative and programmatic staff and interns; detailed position descriptions are provided in Section 4.4 of this plan. CBNERR-VA CTP operations are primarily supported

by the Reserve’s operational grant from NOAA and, to a lesser degree, by external grant support and minimal training program registration fees.

7.5.2 Coastal Training Program Advisory Board

CBNERR-VA’s CTP Advisory Board is a senior level advisory board that provides advice and guidance on a number of key factors. Roles and responsibilities of the Advisory Board include: (1) program guidance and vision; (2) review of strategic planning documents; (3) review of existing and planned training, tools and information products; and (4) identification of collaborative opportunities and key partnerships. The CTP Advisory Board is composed of individuals representing governmental agencies, academic institutions, local governments and regional planning districts, and nongovernmental organizations with resource management, community planning, capacity building and technical education responsibilities. The Reserve CTP Coordinator serves as the Advisory Board’s chairperson. Membership to the Advisory Board is through a one-year voluntary appointment. The Reserve also creates ad hoc advisory committees to address specific needs as they arise.

7.5.3 Fellowship & Intern Programs

The CTP Coordinator offers the Margaret A. Davidson (Davidson) Fellow sector support through professional development opportunities, including engagement in relevant forums and introduction to stakeholder networks. The CTP Coordinator is primed to host and mentor high school and college interns endeavoring to gain career experience and grow their professional network. Compensation will always be made available, and will focus on equitable and mutually beneficial outcomes.

7.5.4 Partnerships

CBNERR-VA values collaboration and operation at the nexus of collective strengths toward the most effective and comprehensive outputs. To this end, it recognizes the establishment and relationship of mutually beneficial partnerships as a key element of its operations. The CTP’s third pillar of program delivery, Community Engagement, reflects these priorities. As site liaisons and relationship managers, CTP staff work to identify partners, facilitate collaborations and maintain healthy relationships. The following represent key partners in CTP’s three-pillared program delivery:

- *NOAA Chesapeake Bay Office*. Established by Congress in 1992, NOAA’s Chesapeake Bay Office (NCBO), applies science and engages communities to tackle problems and challenges facing the Chesapeake Bay. CBNERR-VA works in collaboration with NCBO on multiple fronts toward enhanced management of Chesapeake Bay waters. The partnership primarily focuses on the Middle Peninsula geography, which has been identified as a prime location for nearshore habitat restoration and NNB feature implementation. Specifically, NCBO partners with CBNERR-VA in its YR&SCB Roundtable efforts through its membership and active roles on the Board and steering



Figure 7.6. A community of practice takes shape at a restoration workshop in concert with NCBO, 2019. Image credit: C. Gonzalez.

committees; as lead of the group's Habitat Restoration Steering Committee, NCBO serves as convener for a regional community of practice of restoration professionals that work intimately with CBNERR-VA.

- *Virginia Institute of Marine Science*. Serving as a Research Center and administered by VIMS/W&M, CBNERR-VA 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 mandated role in advisory service affords access to a diversity of estuarine and coastal expertise at the institute that relates directly to priority CTP issues. In addition to the scientific acumen, VIMS has additional research and advisory centers (e.g. Center for Coastal Resources Management, Marine Advisory Service and Virginia SeaGrant), facilities and equipment that can be leveraged for various CTP training programs. VIMS staff have partnered with CTP in training content delivery, the production of virtual offerings and the provision of necessary infrastructure.
- *Chesapeake Bay Sentinel Site Cooperative*. The Chesapeake Bay Sentinel Site Cooperative (CBSSC), one of five sentinel site cooperatives within the national NOAA Sentinel Site Program (SSP), is a group of ecosystem-based study sites across the Chesapeake Bay. As a collective, the CBSSC works together to measure the impacts of SLR in the Bay; apply scientific findings produced at sentinel sites to help communities prepare for coastal flooding and other effects of changing climate conditions; and partners with coastal managers, decision-makers, and community liaisons. CBNERR-VA's CTP has worked through CBSSC in the application and promotion of the Reserve's wetland science, together hosting, for example, a regional symposium (Marsh Resilience Summit, 2019) and nationally-promoted training (Surface Elevation Table (SET) 101, 2019). Moreover, the CTP has collaborated with CBSSC in an exploration of knowledge gaps and training needs related to coastal agriculture (Coastal Farming Challenges, 2020-2021). Future endeavors with this partner are anticipated to advance community resilience studies within the region.
- *Middle Peninsula Planning District Commission*. The Middle Peninsula Planning District Commission (MPPDC) is charged with promoting the orderly and efficient development of the physical, social and economic elements of the district. The district consists of six counties (Essex, Gloucester, King and Queen, King William, Matthews, Middlesex) and three (Tappahannock, Urbana, West Point) townships. As this regional coordinating body represents a large portion of the CBNERR-VA Focal Area (Figure 2.4), staff are not only a prime target and informant of Capacity Building and Technical Assistance efforts, they are instrumental in all manners of CTP's Community Engagement pillar. CBNERR-VA's CTP looks to MPPDC as a source of information on needs relevant to the communities and localities it serves, and for direction on community engagement.
- *Virginia Coastal Zone Management Program*. VCZMP facilitates cooperation among a network of Virginia state agencies and local governments, providing regular forums for discussion and information exchange, and resolution of cross-cutting coastal resource management issues. This state coordinating body represents a large portion of CBNERR-VA's target audience; as such, VCZMP staff are prime informants of Capacity Building and Technical Assistance efforts that reach this audience, and instrumental in implementing CTP's Community Engagement pillar among the CDMs community in Virginia. CBNERR-VA's CTP looks to VCZMP for assistance in identifying CDM needs, in the promotion of its offerings and Reserve science/science-based outputs, and for assistance in the identification of new funding and partnerships to bolster Reserve capacity.

- *York River and Small Coastal Basin Roundtable*. YR&SCB Roundtable member organizations represent a variety of sectors and geographies from within the York River watershed and its adjacent coastal basins, headwaters to tidewaters (Figure 7.7). Members, each considered a CTP partner, include a myriad of professionals (e.g. government officials, non-profit practitioners, private industries), academics, decision-makers, residents and change agents. These members work with their own, respective constituencies, each representative of the target communities CTP endeavors to reach. Roundtable partners help the CTP drive decision-making that prioritizes the health of the watershed, and inspires related action and behavior change within it (e.g. community science, or restoration efforts); they are key components of CTP’s Community Engagement delivery strategy and are thus prime recipients of Capacity Building and Technical Assistance efforts.

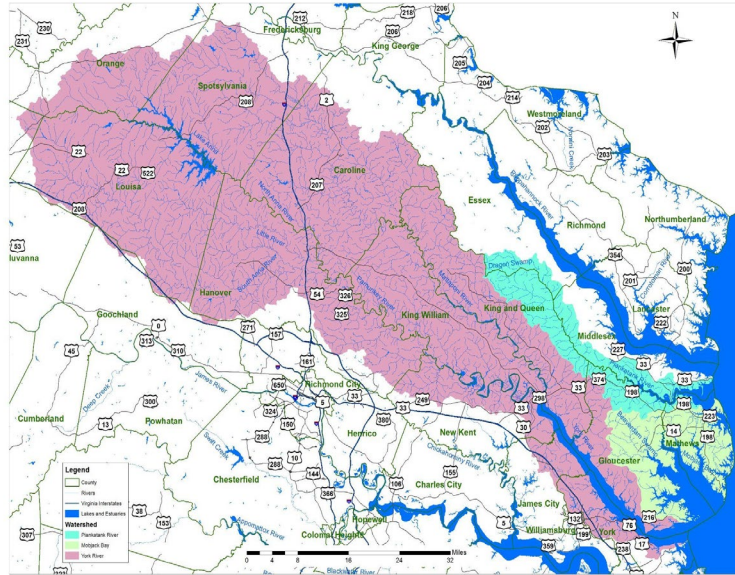


Figure 7.7. The York River watershed and its adjacent small coastal basins. Image credit: VDEQ.

7.5.5 Facilities, Infrastructure & Equipment

Principal CTP facilities include the training classroom (capacity: 30) located within CBNERR-VA Headquarters and the teaching laboratory located in CBNERR-VA’s Catlett-Burruss Research and Education Laboratory (capacity: 100); both facilities are on the VIMS Gloucester Point campus. As a research center of VIMS, the Reserve has access to the facilities and resources of one of the nation’s premier marine research institutes. VIMS facilities available to the CTP include multiple meeting spaces in Davis Hall (capacity: 19-84), the McHugh Auditorium (capacity: 254), Watermen’s Computer Lab and the Hargis Library, in addition to access afforded by the Field Operations team that maintains 40+ research vessels. Greater detail of VIMS and Reserve facilities, infrastructure and equipment is provided in Chapter 11 of this report.

In 2020, CTP transitioned 100% of its programming and related offerings to the digital landscape. Accordingly, the need for, and use of, physical facilities gave way to an emphasis on equipment and software that would enable virtual access to CTP offerings. An array of video conferencing platforms, email marketing software, and online collaborative tools were employed to engage CTP audiences, each demonstrating proven utility and efficacy. Addressing CDM needs in the most effective and meaningful manner moving forward will necessitate utilizing both physical and virtual spaces in combination with one another, and in complement to each other, toward the holistic provision of accessible hybrid programming.

7.6 NEEDS & OPPORTUNITIES

7.6.1 Digital Delivery Formats

As mentioned directly above, CTP transitioned 100% of its programming and related offerings to the virtual world in 2020. Moving forward, its needs and opportunities will continue to reflect those that surfaced in this new landscape. Specifically, while a transition back to in-person offerings will enable effective experiential education and the most meaningful community engagement, many CTP offerings, including the provision of advisory service, can be effectively held in concert with, if not strictly dedicated to, virtual engagement. CBNERR-VA anticipates leveraging this hybrid approach and the opportunities afforded by virtual engagement well beyond the scope of the COVID-19 pandemic or the present management plan. As such, anticipated needs in this vein include additional professional development so that staff are able to maintain abreast of relevant technologies and best practices, in addition to increased access to the technologies themselves.

7.6.2 New Partnership Opportunities

While opportunities with new partners continually surface for the CTP, it regards the below collaborators as those showing exceptional promise in program delivery:

- *The Virginia Coastal Policy Center.* The Virginia Coastal Policy Center (VCPC) at W&M Law School provides science-based legal and policy analysis of ecological issues affecting the state's coastal resources, providing education and advice to a host of Virginia's decision-makers, from government officials and legal scholars to non-profit and business leaders. VCPC works with scientists, local and state political figures, community leaders, the military, and others to integrate the latest science with legal and policy analysis to solve coastal resource management issues. VCPC activities are inherently interdisciplinary, drawing on scientific, economic, public policy, sociological, and other expertise from within the university and across the country. VCPC serves in an advisory capacity, engaging in a host of information exchanges and collaborative partnerships that CBNERR-VA CTP has leveraged and will be seeking new ways to do so in the future.
- *Mid-Atlantic Resilience Exchange.* Mid-Atlantic Coastal Zone Management programs and NERRS partners have exchanged ideas and information regarding resilience planning, best practices and lessons learned, problem-solving, and identification of opportunities to strengthen efforts through coordination and collaboration. Joint categories of interest include: resilience planning; nature-based solutions; retreat; engaging underserved communities and advancing social equity and justice; and improved data access. CBNERR-VA anticipates that NOAA/OCM will continue to support this regional collaboration.

7.7 MONITORING & EVALUATION STRATEGIES

Evaluating the efficacy 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, and to see if the training services are resulting in the implementation of techniques and information.

Presently, training and technical assistance are monitored and evaluated using both qualitative and quantitative methods informed by guidance in the NERRS CTP Performance Monitoring Manual (NOAA/OCM, 2020). Qualitative evaluation is consistently and continuously collected, namely informally, through the CTP Coordinator. This information is augmented by the formal qualitative analysis of informational interviews as part of any comprehensive needs assessment. Post-event evaluations are distributed to all training event attendees either as physical surveys, or through the use

of an electronic format, such as *Google Forms*. These survey instruments represent the bulk of quantitative evaluation data on CTP and help determine overall satisfaction with training content and training effectiveness, as well as inform future training needs. Six month evaluations are conducted on selected trainings to evaluate CTP impacts beyond single training events. Qualitative and quantitative results are holistically assessed and used to gauge the efficacy of information delivery through CTP offerings, in addition to determining how and where training material is used, and whether it will help guide decision making, inspire related improvements and/or increase efficacy.

Program Performance Measures are described and evaluated using the CTP Logic Model and 2020 CTP Performance Monitoring Manual, with results submitted to NOAA OCM semi-annually through the Performance Monitoring Database.



Chapter 8 - RESOURCE MANAGEMENT & STEWARDSHIP

8.1 INTRODUCTION

Protected and flourishing natural coastal resources is central to the NERRS vision and a foundational element for a successful place-based program such as the reserve system. As such, reserves must exercise stewardship responsibilities focused on protection, management and restoration of their natural resources which often require developing and implementing a variety of adaptive strategies that integrate aspects of resource management, research and monitoring, technical assistance and community engagement. In addition to providing long-term protection of the 1.3 million acres encompassed within the NERRS, the reserve system delivers broader impacts through serving as a model of achievable and sustainable resilience-based natural resource management in a changing world.



Figure 8.1. Establishing vertical control of monitoring infrastructure along a saltmarsh transect. Image credit: W. Reay.

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: (1) developing natural resource management plans, (2) monitoring and protecting species of concern, (3) controlling and eradicating invasive species, (4) habitat restoration and monitoring, (5) enhancing reserve boundaries through land acquisition and conservation easements, (6) managing public access, and (7) providing technical assistance. 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 (SLR). 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.

8.2 MANAGEMENT FRAMEWORK

CBNERR-VA includes four Reserve components that incorporate 1,244 ha (3,072 ac) of coastal lands. The lands are owned by four entities including W&M Foundation (Goodwin Islands), W&M/VIMS (Catlett Islands), Virginia Department of Conservation & Recreation (VDCR; Taskinas Creek) and Tacoma Hunting and Fishing Club (Sweet Hall Marsh). CBNERR-VA is the principal managing entity Goodwin and Catlett Islands and shares management responsibilities with land owners/managers at Taskinas Creek and Sweet Hall Marsh. CBNERR-VA works closely with State and Federal natural resource agencies in protecting Reserve resources; a summary of federal and state laws applicable to natural resource management is provided in Appendix H.

8.3 APPROACH

CBNERR-VA strives to use the best available information and techniques for the purpose of maintaining, protecting and restoring the diverse habitats and associated flora and fauna found within Reserve boundaries. Policies and guidelines are intended to explain the general rationale for managing natural communities, species of concern, clarify restrictions on public use and visitation, and to state principles and ideas that guide management of Reserve natural areas. Adapted from the natural area preserve management guidelines developed by the VDCR, Division of Natural Heritage (VDCR 2000a), CBNERR-VA natural area management guidelines are provided in Appendix I.

Stewardship actions occur at the watershed, reserve, and habitat scales and apply the five key strategies of research, assessment, protection, restoration 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:

- (1) Conduct and promote site-based and watershed research and monitoring that informs management of Reserve and other coastal resources;
- (2) Update Reserve component specific Natural Resource Management Plans;
- (3) Implementation of management actions;
- (4) Managed public access (see Section 9); and
- (5) Support activities as related to Reserve boundary protection and critical lands acquisition and protection (see Section 10).

8.4 PROGRAM DELIVERY

8.4.1 Natural Resource Management Plans

Management to protect and maintain natural resources and biological diversity at CBNERR-VA's four components will require ongoing actions and assessments to ensure that resources are conserved. The complexity of ecosystems and a shortfall of staff time and funds usually precludes a full understanding of the effects of ongoing biological change and a sufficiency of management actions to direct and monitor that change. By taking an active and adaptive management approach, using and building on an existing baseline of inventory data, and by monitoring trends in natural communities and/or species populations following management actions, it is likely that successful stewardship of natural resources will be attained.

As a first step towards the adaptive management process objectives, CBNERR-VA and the VDCR/ Division of Natural Heritage initially developed Natural Resource Management Plans for all four CBNERR-VA components. These plans which are available as an on-line resource - https://www.vims.edu/cbnerr/resources/resources_res_nat_res_mgt_plans.php.

- Goodwin Islands (Erdle and Heffernan 2005a);
- Catlett Islands (Erdle and Hefferman 2005b);
- Taskinas Creek (Myers et al. 2008a);
- Sweet Hall Marsh (Myers et al. 2008b).

These 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), natural resource inventories derived from field surveys and research findings based on review of literature. The

plans identify stewardship oriented research needs, data gaps as well as provide management recommendations and strategies for each Reserve component. These plans serve as the Reserve's principal guide to protect, manage and restore natural resource management within Reserve boundaries and allow Reserve staff to develop plans to address the most pressing needs. These plans have an intended timeline of approximately 5-10 years and are scheduled for update over the duration of this Management Plan. Primary activities required for plan updates include data collection and interpretation including natural resource inventories, habitat mapping and change analysis, habitat vulnerability assessments, identifying and prioritizing management needs and actions, land protection strategies, and appropriateness of public access (see Section 9 for greater detail).

- *Natural Resource Inventories.* Natural resource inventories provide baseline data for long-term monitoring and management and allow for comparisons between existing and desired conditions. Selected focus areas for inventories include: (1) ecological resources documenting type, quality and diversity of plant and animal communities; (2) natural heritage resources such as rare, threatened, or endangered plant and animal species, and rare or regionally significant natural communities; (3) hydrologic based resources such as water bodies, aquifers, wetlands and flood hazard areas; and (4) land resources including topography and slope, soils and surficial geology.
- *Habitat Mapping & Change Analysis.* Habitat mapping provides baseline information on habitat distribution and quality, and along with resource inventories form foundational information required to inform management and conservation within Reserve boundaries and the broader regional level. Habitat classification standards (e.g., Coastal & Marine Ecological Classification Standard [CMECS]) are used to define habitat classes which are ground-truthed for final maps. This effort is guided by the Reserve System Habitat Mapping and Change Plan SOPs and is consistent with Phase III of SWMP. It is expected that habitat maps and classifications will be updated over 10 year time frames thus allowing for habitat change analysis designed to increase understanding of land use and environmental stress impacts on critical habitats, and support habitat vulnerability assessments.
- *Habitat Vulnerability Assessments.* CBNERR-VA will use a number of approaches to conduct vulnerability assessments of identified critical habitats (i.e. emergent tidal wetlands, SAV), focusing on key elements of exposure to multiple stressors, sensitivity to stressors, and adaptive capacity to reduce or eliminate potential impacts (Glick et al. 2011; see Figure 8.2). The toolbox of methods to assess species and habitat vulnerability, with emphasis on climate change, include 'coarse-filter' approaches that use indices to qualitatively categorize vulnerability and 'fine filter' approaches based on modeling (often spatially-explicit) to determine where and how species/habitats may be vulnerable; see Johnson (2014) for greater details and extensive case study examples. Examples of 'coarse filter' approaches include Nature Serve's Climate Change Vulnerability Index (CCVI; Young et al. 2011) and NERRS Marsh Resilience to Sea Level Rise indices (MARS; Raposa et al. 2016). Twenty species in Virginia (Kane et al. 2013), supporting Virginia's Wildlife Action Plan, the Marsh Equilibrium Model (Morris et al. 2002), and Sea Level Rise Affecting Marshes Model (SLAMM; <http://www.warrenpinnacle.com/prof/SLAMM/>), represent examples of 'fine filter' model approaches used within Virginia. Climate Change Vulnerability Assessment Tool for Coastal Habitats (CCVATCH; Plunket et al. 2015) represents an additional NERRS developed 'coarse filter' approach where a facilitated expert elicitation process is used to assess potential climate change impacts.
- *Management Issues & Recommended Actions.* Based on results of resource inventories, habitat change analysis, vulnerability assessments and other relevant information, habitat/species protection needs (including data gaps and monitoring) and management actions can be developed. Examples of management actions include: (1) breeding and nesting grounds protection; (2) non-native and nuisance species control; (3) periodic habitat maintenance (i.e. fire management); (4) visitor management;

(5) development of hazardous material spill plan; (6) control of unauthorized artifact collection; (7) site security, signage and boundary maintenance; (8) implementation of hunting management plans; (9) land acquisition and protection; and (10) restoration needs.

- **Land Protection Strategies.** Long-term threats to Reserve resources include continuing degradation from human-induced and environmental stressors, and increasing habitat fragmentation in nearby lands having potential harmful effects on Reserve core areas. To mitigate some of these impacts and adequately protect and conserve resources located in core regions of the four Reserve components, it may be necessary that additional land be purchased or conservation easements be acquired. Based on results of habitat change analysis, vulnerability assessments and other relevant information, additional land protection needs and identified target areas will be developed (greater details are provided in Section 10).

- **Public Access.** CBNERR-VA 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. 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. Details of public access and allowable uses is provided in Section 9.

8.4.2 Restoration Science, Plan Development & Implementation

Coastal and estuarine ecosystems are degrading, both in terms of health and geographic extent, due to a myriad of anthropogenic and climate induced stressors. Ecological restoration offers the opportunity to renew and restore natural structural and functional elements of degraded, damaged, or destroyed ecosystems. The NERRS Restoration Science Strategy Framework (NOAA/NERRS 2002) provides guidance on how the NERRS can contribute to the successful restoration of estuarine and coastal ecosystems. Identified strategic focal areas include: (1) project planning; (2) development and testing of innovative technologies and methods; (3) pre and post-monitoring; (4) serving as local reference sites; (5) information transfer; (6) constituent building; (7) regional science coordination; and (8) policy development. Additional guidance is provided by NOAA's RESTORE Act Science Program (NOAA RESTORE Science Program 2015). While CBNERR-VA has not directly engaged in ecosystem restoration within its boundaries, it has contributed through scientific investigations on target species physiological environmental requirements (i.e., SAV temperature, salinity and light thresholds), aggregated site selection tools (see [Restoration Resources website](#)), Virginia [water clarity standards assessment](#), and

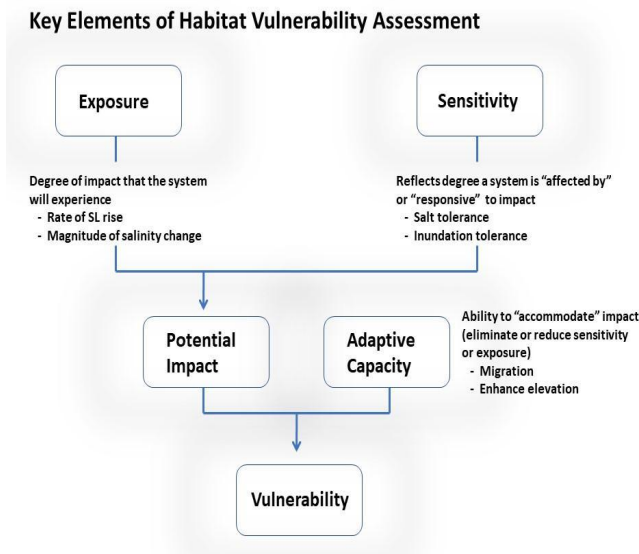


Figure 8.2. Key elements to assess habitat vulnerability to natural, anthropogenic and climate change related stressors. Adapted from Glick et al. 2011. Image credit: W. Reay.

regional restoration efforts outside Reserve boundaries. It is a desire of CBNERR-VA to play a greater role in all strategic focal areas as outlined in the NERRS Restoration Science Strategy Framework.

- *Restoration Science.* Reserve research priorities to guide restoration science efforts include: (1) advance understanding of SAV, tidal marsh, and marsh-forest ecotone structure and function responses to acute and chronic changes in sea-level, water quality, erosion, and invasive species along the salinity gradient of the YRE; (2) continue evaluation of sediment thin layer placement (TLP) and 'marsh mat' effectiveness on marsh vertical accretion rates; (3) using the Marsh Equilibrium Model, develop decision support tool to assess required sediment and in-situ soil development required to maintain marsh platform elevation under varying sea level, water quality, and wetland community type; (4) investigate the transplant potential of North Carolina heat tolerant SAV species (e.g., eelgrass) to Goodwin islands; and (5) increase understanding of harmful algal bloom (HAB) and water clarity controlling factors within tributary and coastal waters.

- *Restoration Planning & Implementation.* CBNERR-VA is and will continue to be actively engaged in technical assistance, as well as water quality and biological monitoring and assessment, in support of habitat restoration planning and ongoing restoration efforts. Reserve efforts include: (1) use of Reserve components as reference sites to aid in assessing restoration project success; (2) continued water quality assessments for Piankatank River oyster reef and Lynnhaven River SAV restoration projects; (3) Middle Peninsula small tidal creek dredge planning assistance through bathymetric surveys and identification of beneficial sediment depositional sites; (4) advancing a habitat restoration community of practice and related project planning through the YR&SCB Roundtable; (5) continued support of the NOAA's Habitat Focus Area in the Middle Peninsula, an effort currently being led by NCBO and key partners (i.e., CBNERR-VA & VCZMP); (6) funding exploration for planning and construction of CBNERR-VA Headquarters' shoreline protection project (see Section 11 for greater details); (7) facilitation of planning discussions and future implementation of shoreline protection and marsh enhancement at the Reserve components; and (8) use of NOAA COAST (Coastal Observations and Applications Study Team) "coastal knowledge hub" in the Middle Peninsula to supplement monitoring in the York River watershed and identify potential mitigation/restoration strategies.

8.4.3 Resource Inventory & Mapping

- *Species Inventory & Habitat Mapping.* Species inventories and habitat maps serve as essential elements to guide resource management, conservation and restoration efforts within the Reserve and inform broader regional efforts. To date, the baseline (image year: 2017) wetland habitat map and aerial statistics have been produced for Goodwin and Catlett Islands. Maps and supporting information products will be completed in 2022 for the remaining Reserve components, Taskinas Creek and Sweet Hall Marsh. With respect to SAV, annual Chesapeake Bay distribution maps (including species composition) are developed from aerial multispectral digital imagery by the VIMS SAV program (Program website: <https://www.vims.edu/research/units/programs/sav>); distribution maps are available from 1978. Related responsibilities are shared among the Research & Monitoring Program and stewardship associated staff and include: (1) continued ground-truthing field surveys using randomized spot checks; (2) high resolution aerial surveys using drone technology to provide supporting information; and (3) continued SAV biomonitoring at Goodwin Islands.

- *Sentinel Site Initiative & Biomonitoring.* Reserve components serve as sentinel sites for detecting and understanding the effects of water quality and climate related stressors on critical estuarine habitats; focal habitats at CBNERR-VA include SAV, tidal marshes and the marsh-upland forest ecotone. Initiative related responsibilities are shared among the Research & Monitoring and Stewardship Program associated staff. Primary field associated efforts follow standard NERRS habitat monitoring protocols

and include: (1) annual peak growing season measurements of marsh surface sediment accretion and elevation changes (method: surface elevation table & marker horizons); (2) multi-year monitoring of marsh vegetation community types and biomass; (3) marsh groundwater dynamics and pore water salinity; (4) monthly (peak growing season) monitoring of SAV community species composition, estimates of % cover, and biomass; and (5) routine surveying activities to maintain local vertical control networks.

- *Archeological Resources*: While historically somewhat overlooked, CBNERR-VA is committed to enhancing its support for the study and conservation of archaeological resources. Specifically, CBNERR-VA aims 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. Recent collaboration with the Fairfield Foundation at CBNERR-VA's Catlett Islands has positively energized CBNERR-VA's stewardship efforts related to cultural resources. Our goal is to continue this collaboration with a focus on other Reserve components which are expected to yield significant prehistoric and historic resources. These collective efforts are related to CBNERR-VA's goal to "develop, coalesce and disseminate sociodemographic and historic/archaeological information, and incorporate into a comprehensive research bibliography."

8.4.4 Species & Habitat Management

- *Invasive & Nuisance Species*. 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 be a practical option for some invasive species already well-established at Reserve components (such as *Phragmites* at Goodwin Islands), minimizing the spread of established invasives and preventing new invasive species from becoming established within Reserve components is a viable objective. Additionally, overabundance of some native species is often incompatible with a broad array of resource management objectives and control of burgeoning native animal populations may be necessary. Identified responsibilities over the course of this management plan include: (1) mapping and ground-truthing of invasive plant species; (2) coordinate a spraying plan with VDCR and spot treat small invasive species patches to prevent an outbreak; and (3) estimate 'species of concern' predator populations on Goodwin Islands and develop a predator population control strategy.

- *Species of Concern Protection*. As a result of previous natural resource management plans, the Reserve has initiated elements of its terrapin management plan, with plans to sustain and expand efforts across Reserve components. Additionally, CBNERR-VA has a desire to support conservation and protection efforts to additional target species or groups; possibilities include waterfowl, wading birds, secretive marsh birds and colonial waterbirds. This new effort will include partnership development (i.e., W&M/VCU's Center for Conservation Biology) and volunteer opportunities. Identified responsibilities include: (1) sustained terrapin nesting site protection at Goodwin Islands and extension to Catlett Islands; (2) ground-truthing key colonial waterbird use, including heron rookeries at the Goodwin and Catlett Islands; and (3) initiate the NERRS sponsored and volunteer based monitoring program for secretive marsh birds (i.e., rail and bittern species).

8.4.5 Site Security & Infrastructure Maintenance

- *Boundary Maintenance & Signage*. Signage is critical to guide general public visitor use so as not to interfere in Reserve research and monitoring activities, and to protect critical habitats. As needed, Reserve components will be properly marked with signage, examples include: (1) boundary markers; (2)

interpretive signage to increase understanding and awareness; (3) seasonal closures of sensitive and critical habitats for breeding and nesting; and (4) identification of active research and monitoring activities and infrastructure.

- *Maintain Field Infrastructure.* In order to achieve science, education and stewardship programmatic goals, construction and maintenance of field-oriented site infrastructure is required. Examples of infrastructure support include: (1) maintenance/repair of existing continuous weather and water quality monitoring station platforms, including telemetry related components; (2) maintenance of existing SETs, elevation control benchmarks, and monitoring wells for long-term marsh studies; (3) maintenance/repair of existing elevated boardwalks to aid access and minimize habitat disturbance; and (4) predator exclusion fencing.

8.4.6 Public Access & Volunteer Opportunities

- *Community Science & Volunteer Opportunities.* Increased efforts will focus on community science programs to conduct biological monitoring of key species, groups of species (i.e., colonial waterbirds, secretive marsh birds, horseshoe crabs, terrapins), and habitats that are not being adequately addressed by current Reserve activities. This effort will be facilitated through support of existing partner monitoring programs, development and use of standardized methods, quality control data protocols and training opportunities. In addition to community science programs, an increase in volunteer opportunities for more traditional stewardship activities (i.e., site maintenance and clean-ups) will be emphasized over the period of this plan.

- *Waterfowl Hunting Management.* In efforts to support traditional use, CBNERR-VA allows managed waterfowl hunting at selected Reserve components. Activities to support this public use include: (1) obtaining hunting blind licenses from Virginia Department of Wildlife Resources (VDWR); (2) siting, constructing, and maintaining design approved hunting blinds; (3) issuance of Reserve hunting permits; and (4) working with VDWR Conservation Officers to enforce permit conditions, and applicable state and federal migratory bird regulations and laws.

8.4.7 Advisory Service & Technical Assistance

- *Advisory Service & Technical Assistance.* Advisory service and technical assistance are core elements of VIMS's and CBNERR-VA's mission. Stewardship associated staff will provide, as requested, advisory service and assistance to federal, state and local governments and a variety of non-governmental and hybrid (government and non-government) organizations. A principal mechanism to provide this service includes membership and participation on key committees and workgroups.

- *Reserve Permit Review.* With respect to internal operations and in collaboration with science-oriented staff, Stewardship staff will participate in review of research and multi-use (i.e., education, training, public-related activities) permit applications and activity monitoring to assure compliance.



CHAPTER 9 - PUBLIC ACCESS & VISITOR USE

9.1 INTRODUCTION & GENERAL POLICIES

CBNERR-VA is responsible for the long-term management of its Reserve components in order to protect the ecological integrity of the natural system and support its science and education missions. To serve the interest of the local community and general public, Reserve components are managed on a site-specific basis allowing varying levels of traditional use and public access that do not conflict with Reserve goals. Reserve use and access policies reflect applicable state laws and regulations, agreements with private landowners and public lands managers, available infrastructure, and overall habitat health. Current traditional and public access uses within individual Reserve components are provided in Table 9.1 with specific guidelines for individual components provided in following sections.

In cases where uses are not compatible, for example wildlife watching concurrent with waterfowl hunting, the Reserve and property managers will strive to minimize conflicts through spatial and temporal separation strategies and facilitated negotiations. If adverse traditional use and public access impacts are observed, the causative 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 use and access regulations. CBNERR-VA 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. A map of public access points is provided in Figure 9.1.

9.2 CURRENT PUBLIC ACCESS RULES & GUIDELINES

9.2.1 Goodwin Islands

CBNERR-VA maintains a limited-use public access policy for the Goodwin Islands component of the Reserve. In accordance with that policy, the islands are managed exclusively for research and education while allowing for specific public 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:

- Fishing, crabbing and collection of shellfish is allowed if in accordance with applicable state laws and regulations;
- Hunting within marsh and upland regions is not permitted;
- Waterfowl hunting from floating blinds require a Reserve issued permit and must be in accordance with applicable federal and state laws and regulations;
- Collection of plants, animals, minerals, or artifacts is prohibited;
- Public access is limited from dawn to dusk;
- Camping and building of any type of fire is prohibited;
- Visitors must obey posted signs that may be placed seasonally to protect sensitive species, habitats and/or research study sites;
- Beach areas can be used for beachcombing;
- Access to marsh and forest areas requires a Reserve permit;
- Bicycles, off-road vehicles, and horses are prohibited; and
- Dogs or other domestic animals accompanying visitors must be kept on a leash at all times.

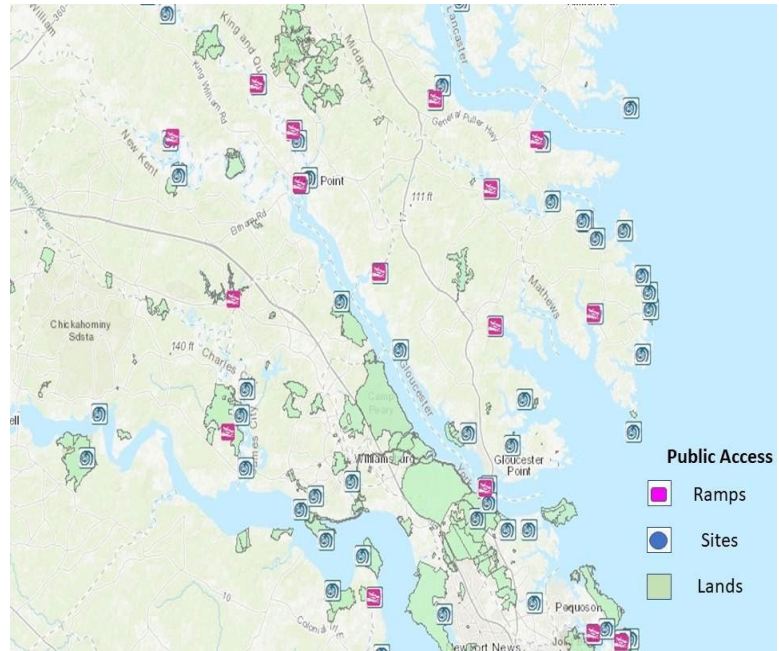
Table 9.1. Traditional and general public use activities by Reserve component.

Activity	Goodwin Islands	Catlett Islands	Taskinas Creek	Sweet Hall Marsh
Upland hunting			✓	
Waterfowl hunting	✓	✓		
Freshwater fishing			✓	
Saltwater fishing	✓	✓	✓	
Fishing pier			✓	
Wildlife viewing	✓	✓	✓	✓
Hiking trails		✓	✓	
Bike trails		✓	✓	
Equestrian trails			✓	
Canoe/kayaking	✓	✓	✓	✓
Canoe/Kayak launch		✓	✓	
Picnic area		✓	✓	
Restrooms		✓	✓	
Parking		✓	✓	
Camping		✓		
Visitor/Interpretive Center		✓	✓	
Access for mobility impaired		✓	✓	

9.2.2 Catlett Islands

Catlett Islands are accessible by shallow draft boats and limited land access through the newly designated Machicomoco State Park. A canoe/kayak launch provides direct access to the Islands via Poplar Creek with additional public boat launches/ramps available within the bordering Timberneck and Cedarbush creeks. CBNERR-VA maintains a limited-use public access policy for the Catlett Islands component of the Reserve. In accordance with that policy, the islands are managed exclusively for research and education while allowing for specific public uses. Allowable uses include, wildlife viewing; fishing, crabbing and collection of shellfish (if in accordance with applicable state laws and regulations); and waterfowl hunting from floating blinds or Reserve maintained blinds (Reserve issued permit

required and must be in accordance with applicable federal and state laws and regulations). Given the sensitivity of the emergent wetlands and extensive installed monitoring infrastructure, general access to marshes is not allowed at this time. In anticipation of increased public presence with the opening of Machicomoco State Park, which adjoins the uplands at Catlett Island reserve component, a MOU between VDCR and the VIMS/CBNERR-VA provides key responsibilities for each party and identified areas for better cooperation and in anticipation of increased visitor use and nature resource conflicts when the park opened (see Appendix D).



9.2.3 Taskinas Creek

The Taskinas Creek component of the Reserve lies within the boundaries of York River State Park (YRSP) which encompasses 1026 ha (2536 ac).

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 48 km (>30 mi) of self-guided hiking, biking and equestrian trails; there are nine multi-use, five mountain bike and five bridle trails; a hiking and multi-use trail guide can be found on the YRSP home website (<https://www.dcr.virginia.gov/state-parks/york-river>). YRSP and/or park concessionaires charge 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 YRE and includes a 360 ft constructed fishing pier, a parking area, a boat launch and dock, and restrooms; parking and launch fees are required at all times. A floating kayak and canoe launch is also available and provides direct access to Taskinas Creek. YRSP is a day use park and no overnight facilities are currently 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 from April thru October. Deer hunting is only allowed in season (November/December) during special controlled hunts. During the hunts, the Park is closed to all other visitors.

The effort to increase visitation and visitor participation through various recreational activities and

Figure 9.1. Map depicting public access points, including trailerable vessel ramps, sites and lands within the York River system, including the Mattaponi and Pamunkey Rivers. Map source: VCZMP Coastal Geospatial and Educational Mapping System (GEMS).

opportunities within YRSP 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 (see <https://www.dcr.virginia.gov/recreational-planning/document/mp4yrexecsum.pdf> for most current update (2015) of York River State Park Master Plan). Additional information can be found at the park's website (<https://www.dcr.virginia.gov/state-parks/york-river>); phone and email are 757-566-3036 and yorkriver@dcr.virginia.gov, respectively.

9.2.4 Sweet Hall Marsh

Sweet Hall Marsh is privately owned and general public access is not permitted. Hunting and trapping privileges are the exclusive rights of the property owners and their assigns. In tidal waters surrounding Sweet Hall Marsh, commercial and recreational harvest of fish and crabs is allowed if in accordance with applicable state laws and regulations.

9.3 OPPORTUNITIES TO INCREASE PUBLIC ACCESS & VISITOR EXPERIENCE

9.3.1 York River Water & 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 VDWR is the lead state agency responsible for administration of the Virginia Birding and Wildlife Trail and more information is available at the following website: <https://dwr.virginia.gov/vbwt/>. Sweet Hall Marsh and YRSP are visitation sites on the Mattaponi, 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. VDCR and the Mattaponi and Pamunkey River Association (MPRA; <http://www.mpra.org>) are the primary entities responsible for administration of the Mattaponi, Pamunkey and York Rivers section of the Captain John Smith Chesapeake National Historic trail; website link: <https://www.nps.gov/cajo/index.htm>.

9.3.2 Machicomoco State Park

CBNERR-VA staff have been engaged with VDCR staff as the transfer of the Catlett "uplands" (Timberneck Farm) went from private to state ownership, and ultimately became Machicomoco State Park. As part of this transition, Reserve staff played a significant role in the permitting and design process of the Park's hand carry kayak and canoe launch. CBNERR-VA took the initiative to collect on-site data and develop a response paper that identified and addressed environmental and safety concerns. VDCR was receptive to CBNERR-VA input and incorporated design changes and time of year use restrictions. The floating dock and integrated kayak launch was constructed and completed in December 2020. Funds for the project were provided by Dominion Energy as part of a mitigation conservation fund for the James River power cable crossing.

9.3.3 Middle Peninsula Public Access Authority

Created by the Virginia General Assembly in 2002, the Middle Peninsula Chesapeake Bay Public Access Authority (MPPAA) recognizes that shorelines are high priority natural areas and that it is critical to set

aside access sites for all types of recreational activities important to the local economy and to the citizens of the Commonwealth of Virginia. Administered by Middle Peninsula Planning District Commission (MPPDC), members of the MPPAA include the counties of Essex, Gloucester, King & Queen, King William, Mathews and Middlesex, and the towns of Tappahannock, Urbanna, and West Point. The MPPAA has a public water access and recreational land online reservation system for reserving hunting tracts, nature trails, public shoreline fishing, waterfowl hunting, crabbing, boat slips, and many other public outdoor recreational opportunities on the Middle Peninsula; visit <https://vacoastalwilds.com/> for additional information. The MPPAA continues to identify land, either owned by the Commonwealth or private holdings, that can be secured for use by the general public to increase public access opportunities. CBNERR-VA will support the MPPDC in advancing the MPPAA as opportunities present themselves with the York River and small coastal basin geographic region.

9.3.4 Other Public Support Opportunities

Additional opportunities to increase public access and enhance the visitor use experience would align with CBNERR-VA's goal to "Enhance individual and community connections to estuaries and coastal watersheds through visitation and experiential education" (see section 3.4). Achieving this goal may manifest in the following ways, though is not strictly limited to them: (1) facilitate managed public access opportunities and enhance experiences through facilities, and information; (2) incorporate and demonstrate best practices in design, construction and renovation of facilities and amenities with emphasis on natural and nature-based (NNB) solutions and environmental sustainability; and (3) support community science and stewardship opportunities, along with other volunteer efforts, that contribute to reserve goals, programs and outreach.



CHAPTER 10 - LAND ACQUISITION

10.1 INTRODUCTION

Central to the mission of CBNERR-VA is the management and preservation of a network of reserves that represent the diversity of coastal ecosystems found within the YRE and its principal tidal tributaries. Societal benefits derived from protection of coastal lands and resources are well recognized, specific to the Reserve, these include maintaining the integrity of its natural resources and habitats, protecting water quality, and the opportunity to expand the depth and reach of its research and monitoring, education and training, and community outreach. Impacts associated with changes in climate, increased population growth and associated habitat fragmentation, and selected human activities continue to pose threats to Reserve components and nearby lands, habitats and species of concern. Details with respect to environmental conditions, natural and cultural resources, and priority management issues specific to each of the four Reserve components are provided in Section 2.5. The coastal environments that make up the Reserve are owned and managed by a combination of partners, including CBNERR-VA, state partners (e.g., Virginia Department of Conservation and Recreation [VDCR]) and private landowners (Tacoma Hunting & Fishing Club; see Sections 2.5 and 4.1 for additional details and Appendices for MOU's). To adequately protect and conserve the larger landscape ecosystem that impacts existing core Reserve components and to more fully represent the diversity of coastal ecosystems found within the YRE and its watershed, further land acquisition and conservation efforts over the span of this management plan is warranted. This plan provides a general discussion of land acquisition and or enhanced protection accomplishments during implementation of the previous management plan, project evaluation and ranking criteria, current plan priorities for acquisition and or enhanced protection, applicable approaches to land protections and potential funding and partner resources.

10.2 FEDERAL BOUNDARY & LAND ACQUISITION PLAN GUIDELINES

10.2.1 Authority & Purpose

Federal guidelines are provided by 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 ensure 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).

10.2.2 Core & Buffer Area Designation

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 are able to meet reserve research, monitoring, educational and stewardship needs. 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 habitats and 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 trails, 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).

10.3 PREVIOUSLY PROTECTED PRIORITY LAND & WATER RESOURCES

Lands and waters being targeted for protection and conservation by CBNERR-VA and its partners include coastal habitats and areas within the York River watershed (encompassing the Mattaponi and Pamunkey Rivers and YRE) and Mobjack Bay system that have significant ecological, conservation, recreation, historical, aesthetic, and cultural values. While all values are considered, emphasis has historically focused on ecological, conservation and recreation values as being the most important consideration when selecting specific targeted areas for acquisition within the Reserve. In addition to identified values, threats from natural and anthropogenic stressors are also considered when identifying and prioritizing areas for acquisition. Over the time interval covered by the Reserve's previous management plan (Reay et al. 2008), numerous noteworthy land and water resources were acquired and protected enhancing CBNERR-VA and its partners' ability to preserve and protect natural resources and serve community needs; selected efforts are highlighted below.

- *Catlett Islands*. NOAA Acquisition and Development Award NA09NOS4200109 was used to purchase multiple tracts (total area: ± 184 ha, 455 ac) of property on the Catlett Islands component of CBNERR-VA. These tracts comprise the core region of the Catlett Islands Reserve component and have long been identified as a high priority land acquisition property (Erdle and Heffernan 2005b). Purchased tracts include those labeled as Timberneck LLC. 64, 89, 90 and 91 and include properties from the water edged shoreline to the Reserve core boundary in the landward portions (see Figure 10.1). The tracts consist primarily of maritime upland forest and tidal meso/polyhaline marshes that are remarkably free of threats posed by exotic plant species. Fee simple ownership allowed for strengthened long-term protection,

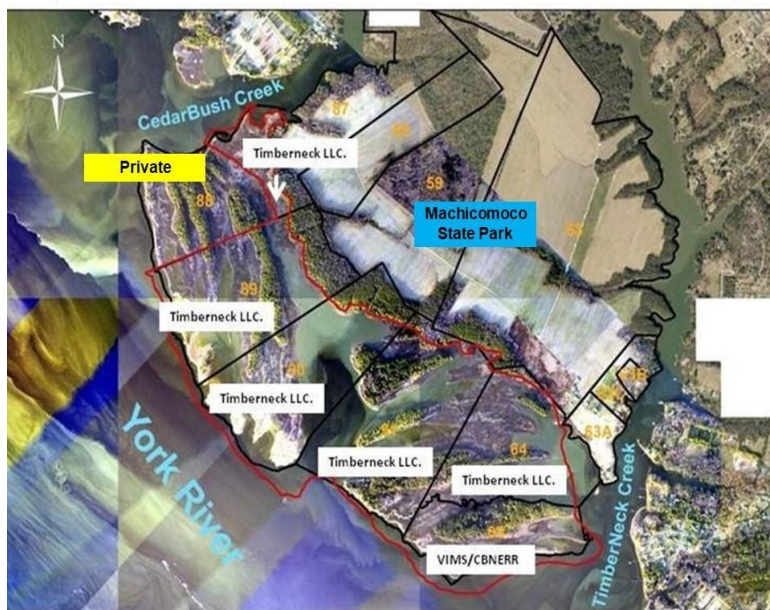


Figure 10.1. Aerial image of Catlett Islands Reserve component delineating core area, the single privately-owned tract, and the upland Machicomoco State Park (formerly Timberneck Farm). Image credit: S. Lerberg.

operation and management of the reserve component; the property was deeded to VIMS/W&M in May 2012.

- *Stieffen Tract*. Given its natural resources, large tract size (163 ha; 402 ac), location immediately adjacent to YRSP and high threat for land use conversion from forested to residential development, the Reserve in partnership with VDCR and the Trust for Public Lands (TPL) have long identified this tract as a high priority land acquisition property (Myers et al. 2008a). The tract 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. Purchased by TPL in 2018, and deeded to VDCR in 2019, CBNERR-VA and VDCR will continue communications as to possible core/buffer designation of the Stieffen tract to the Taskinas Creek component of the Reserve.

- *Timberneck Farm*. Occupying 261 ha (644 ac) of uplands adjacent to the Catlett Islands reserve component, Timberneck Farm was acquired by the Conservation Fund in 2017 in cooperation with VDCR and Dominion Energy, using funds from the Surry-Skiffes Creek-Wheaton Transmission Line Mitigation Fund. (see Figure 10.1). The property serves as the site of Machicomoco State Park, which hosts an interpretive center, campground, and small vessel launches. The interpretive plan will consider the breadth of the land's Algonquian cultural, agricultural and ecological legacy. The property was deeded to VDCR on October 20th, 2020. CBNERR-VA/VIMS have entered into an MOU to engage in cooperative management of the Catlett Islands and the Machicomoco State Park (see Appendix D). CBNERR-VA and VDCR will continue communications as to possible core/buffer designation of the Timberneck Farm to the Catlett Islands component of the Reserve.

10.4 PRIORITY ACQUISITION AREAS

10.4.1 Project Evaluation Criteria

Conservation land protection measures and acquisition are identified through a planned selection that places emphasis on the following lands attributes:

- Maintains or enhances Reserve representation of lower Chesapeake Bay and tidal tributary ecosystems with emphasis placed on climate change stressed systems and migration corridors;
- Borders current Reserve boundaries or boundaries of adjacent key conservation partner holdings;
- Unfragmented high ecological valued lands that contribute/sustain watershed environmental quality and habitat for species of concern;
- Enhances opportunities for Reserve and partner research, education and training, habitat management, and managed public access;
- Ease of establishing state control and inclusion into the Reserve boundary;
- Free of known or suspected environmental hazardous substances; and
- Owned by a willing seller and amenable to various funding sources and land conservation options.

10.4.2 Acquisition Strategies

CBNERR-VA and state partners use multiple methods or mechanisms to establish long-term management over conservation oriented lands. Some of the more conventional acquisition mechanisms available to the Reserve include the following:

- *Fee Simple Acquisition*. Results in absolute title to land and all rights associated with a property. Unless explicitly expressed in the deed, the property is generally free of any conditions, limitations, restrictions, or other claims against the title. A fee simple title has a virtually indefinite duration. In all

but extraordinary circumstances, the purchase price will not exceed Fair Market Value as determined by an appraisal and current market conditions. Depending on funding sources, reimbursement may be required if the said property is sold or transferred from Reserve use.

- *Conservation Easement*. Represents a legal agreement between a landowner and a land trust or government agency that permanently or for a specified time limits uses of the land in order to protect its conservation values. It allows landowners to continue to own and use their land, and they can also sell it or pass it on to heirs. Examples of acquired easement rights include riparian, subsurface mineral, agricultural, residential development, viewshed, and groundwater. Easement values are based on Fair Market Value as determined by an appraisal and current market conditions.
- *Donation*. Signifies an outright donation of land to a trust or federal, state, or local governments that may provide the donor with a charitable income tax deduction and a reduction in the value of one's taxable estate.

10.4.3 Conservation Partners & Funding Sources

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, fundraising 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 CBNERR-VA include but are not limited to those presented in Table 10.1.

Funding sources for coastal lands acquisition and conservation easements are varied as are individual program requirements. Summaries of key funding opportunities and programs are provided below.

- *NERRS Procurement, Acquisition, and Construction Fund*. Through Section 315 of the CZMA, Reserve procurement, acquisition, and construction (PAC) funds are available for projects identified in approved reserve management plans. The fund is competitive and requires a 1:1 federal/non-federal match.
- *U.S.F&WS North American Wetland Conservation Act (NAWCA) Program*. The North American Wetland Conservation Act (NAWCA) Program provides conservation funds for wetland acquisition, long-term protection and restoration. State and local governments, and non-profit organizations are eligible to receive funds. A 1:1 federal/ non-federal match is required.
- *NOAA's CZMP 306A Program*. Administered through an approved state CZMP, Section 306A funds are available for fee-simple acquisition, conservation easements, low cost construction and engineering designs, and educational and interpretative needs. A 1:1 federal/ non-federal match is required.

10.4.4 Priority Acquisition Targets

Based on selected criteria, CBNERR-VA has identified a number of project areas, summaries of priority projects are provided below.

- *Complete Fee Simple Ownership of the Catlett Islands*. The Reserve has an interest to continue towards fee-simple ownership of the final, privately held tract within the north-west region of Catlett Islands (see Figure 10.1). This tract is currently not incorporated into the Reserve's core boundary and does not have a conservation easement. Fee-simple ownership would 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 tract consists 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 acquisition of this tract is consistent with the Land Acquisition Inventory Plan of the NERRS, the Reserve's previous management plan (Reay et al. 2008), and Natural Resource Management Plan for Catlett Islands (Erdle and Heffernan 2005b).

Table 10.1. Listing of current and potential land protection and acquisition partners and selected federal government funding programs.

Partner Category	Land Protection & Acquisition Partners
Academic Institutes	VIMS; W&M
Federal Government	NOAA: NERRS 315 acquisition funds; CZMP 306 funds USF&WS: Cooperative Endangered Species Conservation Fund; Coastal Program; North American Wetlands Conservation Act; National Coastal Wetlands Conservation Grant Program USDA: Wetlands Reserve Program; Farmland Protection Program; Forestry Legacy USEPA: Clean Water State Revolving Fund; 319 Nonpoint Source Funds USDOT: Transportation Efficiency Act for the 21st Century National Fish & Wildlife Federation: Challenge Grants
Commonwealth of Virginia	Department of Forestry Department of Wildlife Resources Department of Conservation & Recreation Marine Resources Commission Department of Environmental Quality: Virginia Land Conservation Fund
Other Government Entities	Local Entities: Middle Peninsula Public Access Authority Counties: Gloucester, James City, York, Mathews, and King William
Nongovernmental Organizations	Local: Middle Peninsula Land Trust Regional: Virginia Outdoor Foundation National: Trust for Public Lands; The Conservation Fund; Ducks Unlimited; Izaak Walton League; The Audubon Society; Natural Heritage Institute; and Land Trust Alliance.
Reserve Property Owners & Corporate Organizations	Local: Tacoma Hunting & Fishing Club National: John Hancock Insurance Company

- *Protection of Taskinas Creek Upper Creek Watershed.* By nature of their critical habitat value and importance to water quality, acquisition and/or enhanced protection of headwater portions of Taskinas Creek's watershed is of interest to CBNERR-VA and VDCR (see Figure 10.2). Vegetative communities within these headwater sub-watersheds include mixed and hardwood forests, seepage swamps and limited emergent tidal wetlands. Tracts sharing a border with YRSP vary in acreage, typically ranging from 20-50 acres, and ownership. Additional land conservation, via fee simple acquisition and open space easements/management agreements, within this region is consistent with the Land Acquisition

Inventory Plan of the NERRS, the Reserve's previous management plan (Reay et al. 2008) and Natural Resource Management Plan for Taskinas Creek (Meyers et al. 2008a).

- *Protection of Sweet Hall Marsh Landscape.*

To adequately protect and conserve the larger landscape ecosystem of Sweet Hall Marsh, additional adjacent lands may require further conservation and/or open space easements. Habitat fragmentation will increasingly threaten nearby lands and to mitigate some of these impacts, CBNERR-VA may consider pursuit of conservation and open-space easements and management agreements on key tracts near the Reserve. Areas designated as high priority are those undeveloped marsh/upland/agricultural tracts located adjacent to Sweet Hall Marsh. Adding these lands to the Reserve, or protecting them through conservation easements or formal management agreements, would complement the current site with additional or like habitat for mobile species and wetland habitat transgression in light of elevated relative SLR rates. Additional land conservation, via fee-simple acquisition and open space easements/management agreements within this region is consistent with the Land Acquisition Inventory Plan of the NERRS, the Reserve's previous management plan (Reay et al. 2008) and the Natural Resource Management Plan for Sweet Hall Marsh (Meyers et al. 2008b).

- *Upriver Tidal Freshwater Reserve 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. As a result of periodic drought conditions and longer-term issues associated with climate change and relative SLR, vegetation community changes driven by salt intrusion (Perry and Hershner 1999) and inability to maintain marsh surface elevation have been documented. In order to provide representative habitats of the YRE, CBNERR-

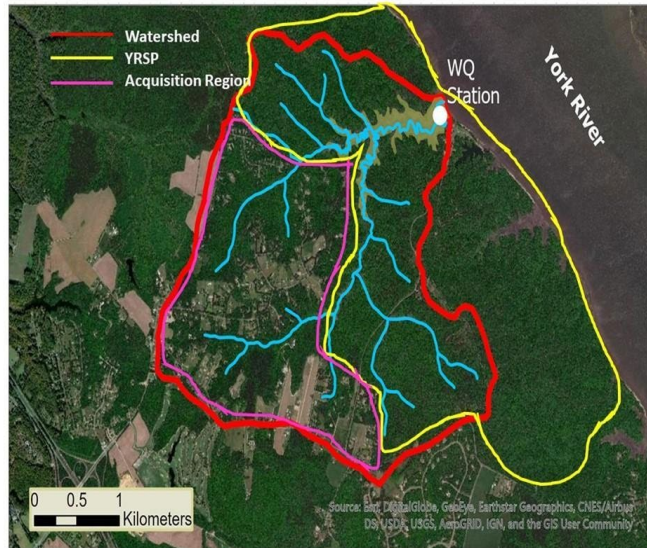


Figure 10.2. Aerial image of Taskinas Creek Reserve component delineating YRSP and upper watershed acquisition focus area. Image credit: D. Parrish.

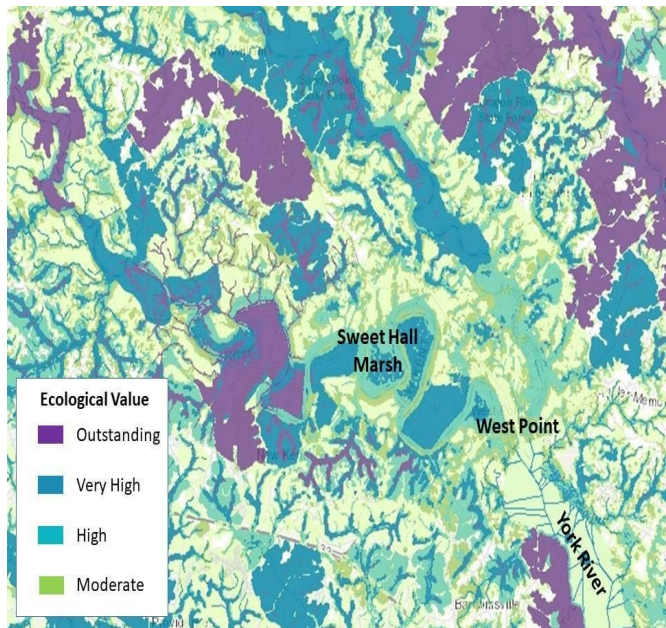


Figure 10.3. Ecological value map of the upper York River system, including the Mattaponi and Pamunkey Rivers. Map source: VCZMP Coastal Geospatial and Educational Mapping System (GEMS).

VA has vested interest in the inclusion of a “true” tidal freshwater ecosystem within its multi-component reserve system. Initial planning will focus on high-outstanding ecological valued wetlands within the upper tidal Pamunkey or Mattaponi Rivers (see Figure 10.3) that currently have a number of conserved marsh ecosystems.



CHAPTER 11 - FACILITIES, INFRASTRUCTURE & EQUIPMENT

11.1 INTRODUCTION

CBNERR-VA is responsible for providing facilities, supporting infrastructure and equipment necessary to adequately support and enable a broad range of programs and activities required to accomplish its mission. While the Reserve principally operates from the VIMS main campus in Gloucester Point, the geographic distribution of its components requires various levels of supporting infrastructure and equipment at the individual Reserve components. The Facilities, Infrastructure and Equipment Plan includes a summary of guiding principles, existing assets, identified needs, and an inventory and replacement plan for selected equipment (e.g., vehicles, vessels and SWMP related equipment) to be applied over the plan implementation period.

11.1.1 Goals & Guiding Principles

The Reserve's overarching goal as related to facilities, infrastructure and equipment, is to provide a physical work environment and access to resources required of a distinguished center engaged in place-based estuarine and coastal research and monitoring, education, and resource management and conservation. Achieving this goal requires basic administrative responsibilities by CBNERR-VA and to some extent, VIMS (see Section 4.3).

Acknowledging that facilities, supporting infrastructure and condition of equipment serve as a physical expression of reserve values and priorities, construction, maintenance and purchase associated activities will be guided, not only by W&M, State and Federal rules and regulations, but by basic principles that protect the environment and exhibit responsible use of taxpayers' dollars. To the greatest extent possible, CBNERR-VA will be guided by the following principles:

- Facilities will be designed, sited and constructed to support multiple Reserve goals;
- Facilities design will be compatible, as possible, with the character of the local community and surrounding structures;
- Incorporate infrastructure and ground design elements that promote good environmental stewardship, with a specific focus on serving as a demonstration for residential land uses;
- Facilities planning will strive for energy, water and operational 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;
- Native plant species will be utilized in landscape and new plantings;
- Field infrastructure will be designed to minimize environmental impact in sensitive habitats and constructed of recycled materials when possible; and
- Equipment will be maintained at a high level to assure maximum life expectancy.

11.2 EXISTING FACILITIES

11.2.1 Buildings & Related Infrastructure

• *VIMS Main Campus.* The VIMS main campus is located in Gloucester Point, Virginia, at the mouth of the York River, a major tributary and passageway to Chesapeake Bay and the Atlantic Ocean. VIMS lies approximately 21 km (13 mi) southeast of the W&M campus in Williamsburg. In addition to the 17 ha (42-ac) main campus in Gloucester Point, VIMS has two satellite campuses. The Eastern Shore Laboratory (ESL), in the seaside village of Wachapreague, serves as a field station for research, teaching, and advisory activities, with easy access to the barrier islands, salt marshes, and lagoons of Virginia's Atlantic shore. The Kauffman Aquaculture Center, on the Rappahannock River, provides state-of-the-art quarantine facilities for work with non-native shellfish.



Figure 11.1. Aerial image of the VIMS Gloucester Point campus highlighting selected Reserve and supporting Institute facilities. Image source: VIMS.

As one of the largest marine-science centers in the US, VIMS maintains a comprehensive suite of research laboratories, teaching classrooms and faculty/staff offices (see Figure 11.1 for aerial view of Gloucester Point campus). As a federal-state partner and research center of VIMS, CBNERR-VA has full access to the Institute's facilities and associated resources. Primary Institute facilities support administration, core science disciplines, a graduate education program, advisory services, and various Institute support and research centers. Watermen's Hall houses the administrative units of the Institute, the Hargis Library (> 500 periodical subscriptions, 50,000 bound volumes and electronic access to literature worldwide), McHugh Auditorium (254-person capacity), numerous traditional and computerized classrooms (capacity: 10-84 persons) and a Visitors Center. Principal research facilities include Chesapeake Bay Hall (Primary departments/centers: Physical and Aquatic Health Sciences; area: 5,950 m² or 64,000 ft²), Andrews Hall (Biological and Physical Sciences; area: 6,600 m² or 71,000 ft²), Nunnally Hall (Fisheries Science; area: 1,579 m² or 17,000 ft²), Davis Hall (Center for Coastal resource Management; Marine Advisory Program, Virginia Sea Grant, CRM, MAP, VSG, ITNS and News & Media Services; 2,972 m² or 32,000 ft²), the Seawater Research Lab (includes VIMS Analytical Service Laboratory; area: 4,000 m² or 43,000 ft²) and the Aquaculture Genetics and Breeding Technology Center (area: 3,994 m² or 43,000 ft²). The Abrahamson House provides overnight accommodations for visiting scientists and guests (capacity: 7 individuals; 4 total rooms with 1st floor having single ADA accessible room).

VIMS Field Operations provides a broad range of skilled, technical services to the scientific community in addition to maintaining and operating the Institute's vessels fleet. The technicians, machinists, welders, fabricators, and mechanics on the staff can design, fabricate, and repair complex electronic and mechanical instruments and tools. They can also assist in designing field programs, operating vessels,

and conducting field work, either locally or away. The Institute's research fleet comprises more than 30 trailerable boats and several larger vessels manned with dedicated crews. Larger vessels include the R/V Tidewater (13 m or 43 ft), the R/V Bay Eagle (20 m or 65 ft) and the R/V Virginia (28 m or 93 ft). Small vessel operators must be state employees and hold appropriate VIMS certification and USCG captain licenses if required. The Field Support Center (area: 929 m² or 10,000 ft²) provides space for a broad range of technical services and vessel maintenance. Additionally, VIMS supports a research diving facility and is an organizational member of the American Academy of Underwater Sciences.

- *Chesapeake Bay National Estuarine Research Reserve in Virginia - Gloucester Point.* Reserve headquarters and principal research and education support facilities are located on the VIMS Gloucester Point campus (see Figure 11.2). Facilities and grounds include design elements to help facilitate and strengthen the Reserve's commitment to energy and resource conservation and comply with the ADA requirements. Primary facilities include an administrative office facility (Wilson House), the Catlett-Burruss Research and Education Laboratory, two modular facilities and various support storage units.

Wilson House serves as the Reserve's Headquarters providing office (capacity: 16 persons; area: 204 m² or 2200 ft²), and conference room (capacity: 12 persons; area: 41 m² or 440 ft²) space. The Catlett-Burruss Research and Education Laboratory, a 510 m² (5,480 ft²) facility is located immediately adjacent to Reserve headquarters, and serves as the Reserve's primary laboratory facility. The Laboratory contains five labs including the SWMP Calibration Lab, the CBNERR-VA Water Quality Analytical Lab, two research labs, the Environmental Education Lab (capacity: 32 persons; area: 103 m² or 1,105 ft²) and two storage bays (area: 33 m² or 360 ft²). The modular facility contains office (capacity: 6 persons; area: 145 m² or 1,571 ft²). Two garages provide an additional 89 m² (965 ft²) of space to support field operations. Upkeep of Gloucester Point facilities and grounds is provided by VIMS.



Figure 11.2. Aerial view of CBNERR-VA facilities and infrastructure at VIMS Gloucester Point campus highlighting design elements promoting good environmental stewardship, with a specific focus on residential options. Image source: VIMS.

11.2.2 Field Based Infrastructure

- *Goodwin Islands.* No facilities are available on Goodwin Islands and the Islands are water only accessible. The closest public trailerable vessel launch ramps are located at Gloucester Point and Back Creek Park (3000 Goodwin Neck Road, Yorktown VA; see Figure 9.1). Field based research and monitoring infrastructure include a continuous water quality station, SET-MHs, monitoring wells, along with a minimalist boardwalk along a reference wetland transect.

- *Catlett Islands.* No facilities are available on Catlett Islands proper but the adjacent Machicomoco State Park offers a number of supporting facilities including a interpretive center, restrooms, floating

launches and a trailerable vessel launch ramp; details as to Machicomoco State Park facilities and supporting infrastructure are highlighted in Section 9.2. Access to Catlett Islands is primarily via water through hand-carried vessel launch in Poplar Creek and trailerable vessel launch ramps in Cedarbush Creek and at Gloucester Point (see Figure 9.1). Upland access points are limited through the park trail and road network. Field based research and monitoring infrastructure include a high resolution tide gauge.

- *Taskinas Creek*. The Taskinas Creek component is embedded within the boundaries of YRSP, owned and operated by VDCR. Facilities supporting Reserve activities at YRSP include a visitor center, restrooms, a floating hand carried vessel launch in Taskinas Creek, and a trailerable vessel launch ramp in Croaker, just

upstream from the creek's mouth (see Figure 9.1). Field based research and monitoring infrastructure include continuous water quality and meteorological stations, a floating platform that allows for direct land access retrieval and deployment of water quality sondes and ISCO samplers (see Figure 11.3 for project location), in addition to minimalist boardwalks along selected wetland transects.

- *Sweet Hall Marsh*. Owned and maintained by Tacoma Hunt Club, facilities available to Reserve staff at Sweet Hall Marsh include a small boat shed with adjoining boat launch and pier used as a platform for water quality monitoring. Unpaved road access requires a security gate passcode and permission from the landowners and CBNERR-VA. The closest public trailerable vessel launch ramps are located at Lester Manor (Pamunkey River) and West Point, VA (Mattaponi River) (see Figure 9.1). Field based research and monitoring infrastructure include continuous water quality and meteorological stations, in addition to minimalist boardwalks along selected wetland transects.

11.2.3 Exhibits

- *VIMS's Visitors' Center*. Located in Watermen's Hall, VIMS's Visitors' Center features aquaria, multimedia displays, and life-sized models to help visitors better understand and appreciate the marine ecosystems of Chesapeake Bay. Displays also show how VIMS research, education and advisory service activities help sustain and enhance estuarine and coastal resources for current and future generations, both in Virginia and around the world.

- *YRSP Visitors' Center*. The current park visitors' center displays focus on the history, use and preservation of the YRE and its marshes, as well as wildlife found in the river and the park. CBNERR-VA staff provide periodic additions to the visitor center such as display screens and digital slideshows to enhance visitor engagement.



Figure 11.3. Aerial view of current and proposed YRSP facilities at the Taskinas Creek reserve component. Image source: goggle earth.

11.3 PROJECTED NEEDS & IMPROVEMENTS

CBNERR-VA has identified a number of facility improvements and new construction that would serve to maintain or enhance Reserve operations over the next five years. Proposed projects are not presented in a prioritized fashion and the Reserve will respond to funding opportunities as they become available.

11.3.1 Buildings & Related Infrastructure

- *CBNERR-VA Headquarters Shoreline Protection.* The current bulkhead structure protecting Reserve headquarters at Gloucester Point has passed its life expectancy and is failing at several locations. In keeping with the VIMS Campus Development Plan, a breakwater system, with extensive beach nourishment and wetland vegetation planting, is proposed for this site as well as for the immediate properties (see Figure 11.3). Given that this site is used extensively by the Reserve’s Education Program, the design will contain elements, such as an enhanced interpretative area and education pavilion, to support programmatic offerings. Cost estimates will be determined following plan development.



Figure 11.4. Aerial view of CBNERR-VA Headquarters highlighting location of failing shoreline protection infrastructure. Image sources: VIMS and W. Reay.

- *CBNERR-VA Supplemental Laboratory and Field Support Facility.* While a well-established reserve, CBNERR-VA Headquarters and laboratory facilities are aged, and represent disjointed and substandard office and laboratory space. As example, the CBNERR-VA modular research lab, purchased in 1995 with a 10-year life expectancy, is located across campus and slated for removal when construction begins on the new VIMS Fisheries Building. Additionally, lab and field associated staff offices are located in an aged modular unit adjacent to the Catlett-Burruss Research and Education Laboratory. VIMS has expressed interest in replacing that facility with a lab/office facility to better meet the needs of the Reserve and Institute. Cost estimates will be determined following plan development.

- *CBNERR-VA Dormitory.* CBNERR-VA currently lacks capacity to provide visiting scientists, educators and partners with dormitory rooms. This constraint impacts all Reserve programmatic sectors and limits participation in a number of well recognized programs and efforts such multi-reserve studies, multi-day education and training opportunities, summer intern and fellowship programs, and volunteer programs such as AmeriCorps. A limited room dormitory, with full bathrooms, and washer/dryer capacity would be fully utilized. Cost estimates will be determined following plan development.

11.3.2 Exhibits & Interpretative Trails

- *Taskinas Creek Education and Interpretive Exhibit Enhancements.* Enhanced interpretive exhibits at the YRSP Visitors Center are needed to showcase Reserve science and improve aquarium support to showcase live specimens and habitats of the YRE and watershed. Exhibits will utilize advanced current technology to support a dynamic and interpretative messaging to foster environmental stewardship and

enhance the Reserve and park experience for all visitors. Exhibits will be linked to the Taskinas Creek marsh boardwalk and interpretative trail as well as other physical and biological real-time observing platforms within the YRE. Projected costs: \$250,000.

- *Taskinas Creek Marsh Boardwalk and Interpretive Trail.* There is currently no access to Taskinas Creek wetlands or integrated interpretative trail to highlight NERRS SWMP or sentinel site initiative. A trail and boardwalk system adjacent to the YRSP Visitors' Center will allow up-close access to the marsh and SWMP infrastructure where teaching stations will highlight challenges of Reserve habitats along with ongoing research and monitoring efforts and findings (see Figure 11.4 for proposed project location). Boardwalk and trail teaching stations will be integrated into interpretive exhibits within the YRSP Visitors' Center. Projected cost: \$150,000.

- *Catlett Islands Marsh and Forest Hummock Boardwalk and Interpretive Trail.* There is currently no public access to the marsh or forest hummocks of the Catlett Islands, located at Machicomoco State Park. A trail and boardwalk system through these ecosystems would allow opportunities for interpretation, including educational programming and informational signage related to the ongoing research and monitoring efforts of CBNERR-VA in this Reserve component. Boardwalk and trail, including signage, could also be integrated into the Machicomoco's Interpretive Center. Continued discussions between CBNERR-VA staff and State Park staff are needed to design and construct this interpretive project.

11.4 VEHICLES, VESSELS & EQUIPMENT

CBNERR-VA supports field operations associated with national/regional environmental monitoring programs as well as multi-investigator scientific studies. Field operations support includes a broad range of skilled staff along with the capability to operate and maintain vessels, vehicles and technical equipment. The current Reserve's vessel, vehicle and selected NERRS SWMP equipment inventory are provided in Tables 11.1 – 11.3, respectively. Additionally, estimated replacement dates based on industry and staff experience criteria are provided. Guidelines for vehicle and vessel replacement are 150,000 mi for vehicles, 25 years for vessel hulls, and 10 years for outboard motors and trailers; canoes and associated trailers have an extended life expectancy. Replacement time intervals assume adherence to maintenance schedules, including hardware and software/firmware upgrades, over equipment life-span. Note: life expectancies for SWMP equipment is specific to computer and communication hardware (5-6 years); specific water quality and meteorological sensors are calibrated routinely and replaced on an as needed basis.



Figure 11.5. Fixed wing eBee Plus drone used in marsh vegetation surveys. Image credit: A. Demeo.

11.4.1 Vehicles

Table 11.1. Current CBNERR-VA vehicle inventory including vehicle, description and estimated replacement date. Notes: SB: short bed, LB: long-bed, EC: extended cab; CC: crew cab, 4x4: four-wheel drive, TP: tow package

ID	Description	Replacement Year
T-55	2002, GMC 1500 Series, 4x4, EC, cap, TP	2025
T-64	2005, Chevy 2500 Series, 4x4, LB, CC, TP	2024
T-65	2005, Chevy 2500 Series, 4x4, SB, CC, cap, TP	2022
T-86	2011, Ford Escape, 4x4	2025

11.4.2 Vessels

Table 11.2. Current CBNERR-VA trailerable vessel inventory including vessel ID, description and estimated replacement date. All vessels carry a research vessel (R/V) designation and therefore have restrictive passenger requirements. Notes: SC: sport cabin, CC: center console, RHIB: rigid-hulled inflatable boat, SA: single axle, DA: dual axle.

Name	Description	Replacement Year
R/V Skimmer	Hull: 2003 C-Hawk, 22 ft, SC Motor: 2020 Yamaha 150 hp Trailer: 2011, Load Rite, DA	Hull: 2028 Motor: 2030 Trailer: 2031
R/V Bittern	Hull: 2007 Maritime Skiff, 20 ft, CC Motor: 2007 Yamaha 115 hp Trailer: 2016, Load Rite, SA	Hull: 2032 Motor: 2022 Trailer: 2026
RV/RHIB	Hull: 2010 Zodiac Hurricane, 22 ft, RHIB, CC Motor: 2019 twin Yamaha 70 hp Trailer: 2020, Load Rite, DA	Hull: 2030 Motor: 2029 Trailer: 2030
Canoes	Hull: 2002 Old Town, 17 ft Number: 8 Trailer: 2002, MO Trailer Corp., SA	Hull: 2032 Trailer: 2027

11.4.3 SWMP Related Equipment

Table 11.3. Current CBNERR-VA primary SWMP station supporting equipment including description and estimated replacement date. Note: each primary water quality station includes two (2) data sondes so as to allow for continuous measurement and backup as needed.

Station/Equipment	Equipment Description	Replacement Year
Water Quality		
Goodwin Islands	Year(s): 2016 (2); Make/Model(s): YSI, EXO2	2022
Clay Bank	Year(s): 2017 (2); Make/Model(s): YSI, EXO2	2022
Taskinas Creek	Year(s): 2016 & 2018; Make/Model(s): YSI, EXO2	2022 & 2023
Sweet Hall Marsh	Year(s): 2017 (2); Make/Model(s): YSI, EXO 2	2022
Weather		
Taskinas Creek	Year: 2001; Model: UTM 10	2022
Other Equipment		
Automated Sampler	Year: 2010; Make/Model: ISCO/6712	2022
Spectrometer	Year: 2006; Make/Model: Shimadzu, UV-2450	2022
Fluorometer	Year: 2016; Make/Model: Turner Designs, Trilogy	2024

11.4.4 Survey & Water Level Related Equipment

Table 11.4. Current CBNERR-VA primary geospatial, supporting reconnaissance equipment and tide gauges including description and estimated replacement date. SH, TC, CI denotes Sweet Hall Marsh, Taskinas Creek and Catlett Islands, respectively.

Description	Life Expectancy (years)	Replacement Year
Trimble R8 GNSS (RTK) System		
2008 Base station	10	2028
2011 Rover	10	2028
2009, DNA03 Digital level w/ Invar Rods	10	2024
2018, Trimble Leica Sprinter Level with staffs	10	2028
2016, Tribble Geo7x dual freq. w/ Flightware Technology	10	2026
2018, ebee Plus AUS fixed wing drone	10	2028
2019, DJI Mavic Quadcopter Drone	5	2024
Multiple years, Tide gauge H360 & H3611 sensors	8	SH: 2022, TC: 2025, CI: 2025



REFERENCES

- Barbier, E.B., S.D. Hacker, C. Kennedy, E.W. Koch, A.C. Stier, and B.R. Silliman. 2011. The value of estuarine and coastal ecosystem services. *Ecological Monographs*. 81(2): 169-193. <https://doi.org/10.1890/10-1510.1>
- Beven, J., and H. Cobb. 2004. Tropical cyclone report: Hurricane Isabel, 6-19 September, 2003. https://www.nhc.noaa.gov/data/tcr/AL132003_Isabel.pdf. (Accessed 10/5/21).
- Blanton, D., C. Downing, and D. Linebaugh. 1993. A cultural resource inventory and preservation plan for the Timberneck Farm Property and Catlett Islands, Gloucester County, Virginia. William & Mary Center for Archaeological Research, William & Mary. 54 pp. plus appendices.
- Brown, J., and S. Erdle. 2009. Amphibians, reptiles, birds and mammals of the York River. *Journal of Coastal Research*. SI 57: 111-117. <https://doi.org/10.2112/1551-5036-57.sp1.111>
- Carey, J. 2021. The complex case of Chesapeake Bay restoration. *Proceedings of the National Academy of Sciences*. 118(25): e2108734118. <https://doi.org/10.1073/pnas.2108734118>
- CBNERR-VA. 2009. A site profile of the Chesapeake Bay National Estuarine Research Reserve in Virginia. K. Moore and W. Reay (editors). CBNERR-VA, Virginia Institute of Marine Science. <http://dx.doi.org/doi:10.21220/m2-qqcc-3469>
- Center for Conservation Biology (CCB). 2021. CCB Mapping Portal. <https://ccbbirds.org/maps/#eagles>. (Accessed 11/24/21).
- Chesapeake Bay Program Office Data Center updated 7/21/2020; data downloaded 10/7/2021.
- Chesapeake Executive Council. 1988. Comprehensive research plan for the Chesapeake Bay Program, Agreement Commitment Report. <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=2000VUAT.PDF>
- Chesapeake Executive Council. 2014. Chesapeake Bay Watershed Agreement. Chesapeake Bay Program. https://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf
- Chesapeake Bay Program (CBP), 2020. Chesapeake Progress. Data accessed July 28 2020. <https://www.chesapeakeprogress.com>
- Colgan, C.S. 2009. The value of estuary regions in the U.S. economy. In: L.H. Pendleton (editor), *The Economic and Market Value of Coasts and Estuaries: What's at Stake? Restore America's Estuaries*. p. 37-64. https://estuaries.org/wp-content/uploads/2020/02/The-Economic-and-Market-Value-of-Coasts-and-Estuaries-What's-at-Stake_2008.pdf

- Commonwealth of Virginia (CVA). 2019. Commonwealth of Virginia Chesapeake Bay TMDL phase III watershed implementation plan. 223 pp.
<https://www.deq.virginia.gov/home/showpublisheddocument/4481/637469262077670000>
- Commonwealth of Virginia (CVA). 2021. Virginia Coastal Resilience Master Plan. 266 pp.
<https://www.dcr.virginia.gov/crmp/document/VirginiaCoastalResilienceMasterPlan-Print.pdf>.
- Dahl, T.E., and S.M. Stedman. 2013. Status and trends of wetlands in the coastal watersheds of the Conterminous United States 2004 to 2009. U.S. Department of the Interior, Fish and Wildlife Service and National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 46p.
<https://www.fws.gov/wetlands/documents/Status-and-Trends-of-Wetlands-In-the-Coastal-Watersheds-of-the-Conterminous-US-2004-to-2009.pdf>. (Accessed 10/5/21).
- Ding, H. and A.J. Elmore. 2015. Spatio-temporal patterns in water surface temperature from Landsat time series data in the Chesapeake Bay, USA. *Remote Sensing Environment*. 168, 335–348.
<https://doi.org/10.1016/j.rse.2015.07.009>, 2015.
- Eggleston, J. and J. Pope. 2013. Land subsidence and relative sea-level rise in the southern Chesapeake Bay region. *US Geological Survey Circular 1392*. 30p. doi.org/10.3133/cir1392.
- Egloff, K.T., M.E.N. Hodges, J.F. Custer, K.R. Doms, and L.D. McFaden. 1988. Archaeological investigations at Croaker Landing 44JC70 and 44JC71. Commonwealth of Virginia Division of Historic Landmarks. 88 pp. https://www.dhr.virginia.gov/pdf_files/Archeo_Reports/JC-206_AE_Investigations_Croaker_Landing_44JC70_44JC71_1988_VDHR_report.pdf
- Egloff, K., and D. Woodward. 2006. *First People: The Early Indians of Virginia*, 2nd Ed. University of Virginia Press, 112 pp. <http://www.worldcat.org/isbn/0813925487>
- Erdle, S. 2015. Coastal Training Program Strategic Plan: 2015-2019. CBNERR-VA, Virginia Institute of Marine Science, William & Mary. 24 pp.
- Erdle, S., and K. Heffernan. 2005a. Management plan for Goodwin Islands: Chesapeake Bay National Estuarine Research Reserve – Virginia. Natural Heritage Technical Report 05-03, Virginia Department of Conservation and Recreation. 45 pp. plus appendices.
https://www.vims.edu/cbnerr/docs/stewardship_docs/gi_plan_combo08-2005.pdf
- Erdle, S., and K. Heffernan. 2005b. Management Plan for Catlett Islands: Chesapeake Bay National Estuarine Research Reserve – Virginia. Natural Heritage Technical Report 05-04, Virginia Department of Conservation and Recreation. 45 pp. plus appendices.
https://www.vims.edu/cbnerr/docs/stewardship_docs/ci_Plan_combo_0805.pdf
- Erickson, M. 2013. A lost Spanish mission on the York River. Daily Press.
<https://www.dailypress.com/history/dp-nws-spanish-mission-on-the-york-20130508-story.html>.
- Ezer, T., L.P. Atkinson, W.B. Corlett and J.L. Blanco. 2013. Gulf Stream’s induced sea level rise and vulnerability along the U.S. mid-Atlantic coast. *Journal of Geophysical Research*, Vol. 118: 685-697.
doi.org/10.1002/jgrc.20091

- Fleming, G.P., P.P. Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. The natural communities of Virginia: Classification of ecological community groups. First 39 Management Plan for Taskinas Creek Reserve - 2008 Approximation. Natural Heritage Technical Report 01-01, Virginia Department of Conservation and Recreation. 76 pp.
- Friedrichs, C.T. 2009. York River physical oceanography and sediment transport. *Journal of Coastal Research*. SI 57: 17-22. <https://doi.org/10.2112/1551-5036-57.sp1.17>
- Gillett, D., and L. Schaffner. 2009. Benthos of the York River. *Journal of Coastal Research*. SI 57: 80-98. <https://doi.org/10.2112/1551-5036-57.sp1.80>
- Glick, P., B.A. Stein, and N.A. Edelson, editors. 2011. *Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment*. National Wildlife Federation. 168 pp. <http://www.worldcat.org/isbn/061540233X>
- Hewitt, H., J. Ellis, and M. Fabrizio. 2009. Fisheries of the York River system. *Journal of Coastal Research*. SI 57: 99-110. <https://doi.org/10.2112/1551-5036-57.sp1.99>
- Hilton, T.W., R.G. Najjar, L. Zhong and M. Li. 2008. Is there a signal of sea level rise in Chesapeake Bay salinity? *Journal of Geophysical Research*, 113, C09002, doi: 10.1029/2007JC004247.
- Hobbs, C.H. 2009. York River Geology. *Journal of Coastal Research*. SI 57: 10-16. <https://doi.org/10.2112/1551-5036-57.sp1.10>
- IPCC. 2013. Annex 1: Atlas of Global and Regional Climate Projections, edited by: van Oldenborgh, G. J., Collins, M., Arblaster, J., Christensen, J. H., Marotzke, J., Power, S. B., Rummukainen, M., and Zhou, T., in: *Climate Change 2013: The Physical Science Basis. Contributions of the Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by: Stocker, T. F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V., and Midgley, P. M., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- IPCC. 2021. Summary for Policymakers. In: *Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Pean, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B. R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekci, R. Yu, and B. Zhou (eds.). Cambridge University Press. In Press. http://ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf.
- Irby, I. D., Friedrichs, M. A. M., Da, F., and Hinson, K. E. 2018. The competing impacts of climate change and nutrient reductions on dissolved oxygen in Chesapeake Bay, *Biogeosciences*, 15, 2649–2668, <https://doi.org/10.5194/bg-15-2649-2018>.
- Johnson, K. 2014. *Climate change vulnerability assessment for natural resources management: Toolbox of methods with case studies*. Version 2.0. U.S. Fish and Wildlife Service. 92 pp. http://climate.calcommons.org/sites/default/files/Johnson%20KA%202013%20Guide%20to%20Vulnerability%20Assessment%20Methods_Version%202.0.pdf

- Journal of Coastal Research (JCR). 2009. The Chesapeake Bay NERRS in Virginia: A Profile of the York River Ecosystem. K. Moore and W. Reay (editors). Journal of Coastal Research. Special Issue 57. 125 pp. <https://meridian.allenpress.com/jcr/issue/number/10057>
- Kane, A., T.C. Burkett, S. Kloper, and J. Sewall. 2013. Virginia's Climate Modeling and Species Vulnerability Assessment: How Climate Data Can Inform Management and Conservation. National Wildlife Federation. <https://www.nwf.org/~/media/PDFs/Global-Warming/Climate-Smart-Conservation/Virginias%20Climate%20Vulnerability%20AssessmentFinal.pdf>
- Kennish, M.J. 2002. Environmental threats and environmental future of estuaries. Environmental Conservation. 29(1): 78-107. <https://doi.org/10.1017/S0376892902000061>
- Lee, S. B., M. Li, and F. Zhang. 2017. Impact of sea level rise on tidal range in Chesapeake and Delaware Bays, J. Geophysical Research Oceans 122: 3917–3938, doi:10.1002/2016JC012597.
- Lerberg, S. 2018. Chesapeake Bay National Estuarine Research Reserve in Virginia Sentinel Site Plan. CBNERR-VA, Virginia Institute of Marine Science. 28pp. + appendices. <https://www.vims.edu/cbnerr/resources/cbnerr-va-sentinel-site-plan-for-website.pdf>
- Lin, J., and A. Kuo. 2001. Secondary turbidity maximum in a partially mixed microtidal estuary. Estuaries. 24: 707-720. <https://doi.org/10.2307/1352879>
- Madsen, T., and N. Wilcox. 2012. When it rains, it pours: global warming and the increase in extreme precipitation from 1948-2011. Environment America Research & Policy Center. 32 pp. plus appendices. <https://environmentamerica.org/sites/environment/files/reports/When%20It%20Rains%2C%20It%20Pours%20vUS.pdf>
- Marshall, H. 2009. Phytoplankton of the York River. Journal of Coastal Research. SI 57: 59-65. <https://doi.org/10.2112/1551-5036-57.sp1.59>
- Mattaponi Indian Reservation. Official Site of the Mattaponi Indian Reservation. <https://www.mattaponination.com>. (Accessed 8/16/20).
- McDonald, J.T., and L.A. Dominguez. 2010. Professional preparation for science teachers in environmental education. In: A.M. Bodzin and B.S. Klein (editors), The Inclusion of Environmental Education in Science Teacher Education. p. 17-30. https://doi.org/10.1007/978-90-481-9222-9_2
- McLeod, G., T. Allen, E. Steinhilber, S. Hutt, M. Solano, and K. Burdick. 2020. Future sea level and recurrent flooding risk for coastal Virginia. Commonwealth Center for Recurrent Flooding Resiliency. 27 pp. plus appendices. <https://www.floodingresiliency.org/wp-content/uploads/2020/03/Future-Sea-Level-and-Recurrent-Flooding-Risk-for-Coastal-Virginia-Final-Version.pdf>
- Meier, M.F. and J.M. Wahr. 2002. Sea level is rising: Do we know why? Proceedings of the National Academy of Sciences USA. 99(10): 6524-6526. doi: 10.1073/pnas.112214499.
- Moore, K.R. 2009. NERRS SWMP BioMonitoring Protocol: Long-term monitoring of estuarine submersed and emergent vegetation communities. NERRS Technical Report. 36 pp.

https://coast.noaa.gov/data/docs/nerrs/Research_TechSeries_TechReportSWMPBio-MonitoringProtocol.pdf

Moore, K.R. 2009. Submerged aquatic vegetation of the York River. *Journal of Coastal Research*. SI 57: 50-58. <https://doi.org/10.2112/1551-5036-57.sp1.50>

Morris J., P. Sundareshwar, C. Nietch, B. Kjerfve, and D. Cahoon. 2002. Responses of coastal wetlands to rising sea level. *Ecology*. 83: 2869-2877. [https://doi.org/10.1890/0012-9658\(2002\)083\[2869:ROCWTR\]2.0.CO;2](https://doi.org/10.1890/0012-9658(2002)083[2869:ROCWTR]2.0.CO;2)

Myers, R., K. Heffernan, P. Coulling, A. Belden, and A. Chazal. 2008a. Management Plan for Taskinas Creek Chesapeake Bay National Estuarine Research Reserve. Natural Heritage Technical Report 07-10, Virginia Department of Conservation and Recreation. 43 pp. plus appendices. https://www.vims.edu/cbnerr/docs/stewardship_docs/tc_plan3_08.pdf

Myers, R.K., K.E. Heffernan, P.P. Coulling, N. Van Alstine, A.C. Chazal, and S.Y. Erdle. 2008b. Management Plan for Sweet Hall Marsh Chesapeake Bay National Estuarine Research Reserve. Natural Heritage Technical Report 07-09, Virginia Department of Conservation and Recreation. 48 pp. plus appendices. https://www.vims.edu/cbnerr/docs/stewardship_docs/sh_plan_3-08.pdf

Najjar, R.G., C.R. Pyke, M. Adams, D. Breitbart, C. Hershner, M. Kemp, R. Howarth, M. Mulholland, D. Secor, K. Sellner, D. Wardrop, and R. Wood. 2010. Potential climate-change impacts on the Chesapeake Bay. *Estuarine Coastal and Shelf Science*. 86: 1-20. <https://doi.org/10.1016/j.ecss.2009.09.026>

National Park Service (NPS). 2020. Werowocomoco. Captain John Smith National Historic Trail. National Park Service. <https://www.nps.gov/cajo/planyourvisit/werowocomoco.htm>. (Accessed 8/16/20).

Nichols, M.M., S.C. Kim, and C.M. Brouwer. 1991. Sediment characterization of the Chesapeake Bay and its tributaries, Virginian Province. *Virginia Institute of Marine Science*. 88 pp. <https://doi.org/10.21220/V5BQ60>

NOAA Climate. 2021. Climate Change: Atmospheric Carbon Dioxide. Updated October 7, 2021. <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>. (accessed 12/6/2021).

NOAA Global Monitoring Laboratory (GML). 2021. Carbon cycle greenhouse gases. <https://www.gml.noaa.gov/ccgg/trends/>. (accessed 11/23/21).

NOAA/NCEI. 2021. U.S. Billion-Dollar Weather and Climate Disasters. National Centers for Environmental Information. National Oceanic and Atmospheric Administration. <https://www.ncdc.noaa.gov/billions/>. (Accessed 10/5/21).

NOAA/NERRS. 2002. National Estuarine Research Reserve System Restoration Science Strategy: A Framework. Estuarine Reserves Division. NOAA. 33 pp.

NOAA/NERRS. 2011. National Estuarine Research Reserve System System-wide Monitoring Program Plan. NOAA. 60 pp. https://coast.noaa.gov/data/docs/nerrs/Research_2011SWMPPlan.pdf

- NOAA/NERRS. 2012. National Estuarine Research Reserve System Sentinel Sites Program Guidance for Climate Change Impacts. NOAA. 23pp.
https://www.vims.edu/cbnerr/resources/noaa_nerrs_sentinelsites_guidancedoc_2012.pdf
- NOAA/NERRS. 2015. Standard Operating Procedures Mapping Land Use and Habitat Change in the National Estuarine Research Reserve System. NOAA. 27 pp. plus appendices.
https://coast.noaa.gov/data/docs/nerrs/Standard_Operating_Procedures_Mapping_Land_Use_and_Habitat_Change_in_the_NERRS.pdf
- NOAA/NERRS. 2016. Coastal Habitat Response to Changing Water Levels. NERR Sentinel Site Application Module 1. NOAA. 12 pp.
https://coast.noaa.gov/data/docs/nerrs/Research_SentinelSitesGuidanceDoc.pdf.
- NOAA/NERRS. 2017. The National Estuarine Research Reserve System Strategic Plan 2017-2022. NOAA. 9 pp. <https://coast.noaa.gov/data/docs/nerrs/StrategicPlan.pdf>
- NOAA/NERRS. 2020. Vegetation Monitoring Standard Operating Protocol, v1.1. National Estuarine Research Reserve System (NERRS) Biomonitoring Workgroup. NOAA. 41 pp.
https://www.vims.edu/cbnerr/resources/noaa_nerrs_vegetation-monitoring-sop-v1.1_2020.pdf
- NOAA/OCM. 2013. Reserve System Management Plan Guidelines and Resources. NOAA. 103 pp.
<https://coast.noaa.gov/data/docs/nerrs/reserves-management-plan-guidelines.pdf>
- NOAA/OCM. 2020. Coastal Training Program Performance Monitoring Manual. 56 pp.
- NOAA RESTORE Science Program. 2015. NOAA RESTORE Act Science Program Science Plan. Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program. 54 pp. plus appendices. https://cdn.coastalscience.noaa.gov/restore/Science_plan.pdf
- NOAA Tides and Currents. 2021 The State of High Tide Flooding and Annual Outlook.
https://tidesandcurrents.noaa.gov/HighTideFlooding_AnnualOutlook.html. (Accessed 10/5/21).
- Orth, R.J., D.J. Wilcox, J.R. Whiting, E.R. Smith, and A.K. Kenne. 2019. 2019 Distribution of submerged aquatic vegetation in Chesapeake Bay and coastal bays. Virginia Institute of Marine Science.
<https://www.vims.edu/research/units/programs/sav/reports/2019/index.php>
- Pamunkey Indian Reservation. 2020. The Pamunkey Indian Tribe Official Tribal Website.
<http://pamunkey.org/>. (Accessed 8/16/20).
- Perry, J.E., and R.B. Atkinson. 2009. York River tidal wetlands. Journal of Coastal Research. SI 57: 40-49.
<https://doi.org/10.2112/1551-5036-57.sp1.40>
- Perry, J.E., and C.H Hershner. 1999. Temporal changes in the vegetation pattern in a tidal freshwater marsh. Wetlands. 19(1): 90-99. <https://doi.org/10.1007/BF03161737>

- Plunket, J., Stanzel, K., Weber, R., and S. Lerberg. 2015. Climate Change Vulnerability Assessment Tool for Coastal Habitats: Guidance Documentation. https://ccvatch.files.wordpress.com/2018/04/ccvatch_guidance05-15.pdf
- Preston, B. L. 2004. Observed winter warming of the Chesapeake Bay estuary (1949–2002): Implications for ecosystem management, *Environmental Assessment*, 34: 125–139, <https://doi.org/10.1007/s00267-004-0159-x>.
- Pringle, W. J., J. Wang, K.J. Roberts and V.R. Kotamarthi. 2021. Projected changes to cool-season storm tides in the 21st century along the northeastern United States coast. *Earth's Future*, 9, e2020EF001940. <https://doi.org/10.1029/2020EF001940>
- Raposa, K., S. Lerberg, C. Cornu, J. Fear, N. Garfield, C. Peter, R. Weber, G. Moore, D. Burdick, and M. Dionne. 2018. Evaluating tidal wetland restoration performance using National Estuarine Research Reserve System reference sites and the Restoration Performance Index (RPI). *Estuaries and Coasts*. 41: 36-51. <http://doi.org/10.1007/s12237-017-0220-7>
- Raposa, K., K. Wasson, E. Smith, J. Crooks, P. Delgado, S. Fernald, M. Ferner, A. Helms, L. Hice, J. Mora, B. Puckett, D. Sanger, S. Shull, L. Spurrier, R. Stevens, and S. Lerberg. 2016. Assessing tidal marsh resilience to sea-level rise at broad geographic scales with multi-metric indices. *Biological Conservation*. 204B: 263-275. <https://doi.org/10.1016/j.biocon.2016.10.015>
- Reay, W., S. Erdle, S. McGuire, S. Lerberg, K. Moore, and C. Riley. 2008. Chesapeake Bay National Estuarine Research Reserve in Virginia Management Plan: 2008-2012. CBNERR-VA, Virginia Institute of Marine Science. 131 pp. + appendices. <https://doi.org/10.21220/V5W730>
- Reay, W. 2009. Water quality within the York River estuary. *Journal of Coastal Research*. SI 57: 23-39. <https://doi.org/10.2112/1551-5036-57.sp1.23>
- Reay, W., and K. Moore. 2005. Impacts of tropical cyclone Isabel on shallow water quality of the York River estuary. In: Sellner, K. (editor), *Hurricane Isabel in Perspective*. Chesapeake Research Consortium, CRC Publication 05-160. p. 135-144. <https://scholarworks.wm.edu/vimsbooks/6>
- Reay, W., and K. Moore. 2009. Introduction to the Chesapeake Bay National Estuarine Research Reserve in Virginia. *Journal of Coastal Research*. SI 57: 1-9. <https://doi.org/10.2112/1551-5036-57.sp1.1>
- Rice, K.C. and J.D. Jastram. 2015. Rising air and stream-water temperatures in Chesapeake Bay region, USA. *Climatic Change* 128:127–138 DOI 10.1007/s10584-014-1295-9.
- Rice, K.C., M.R., Bennett, and J. Shen. 2011. Simulated changes in salinity in the York and Chickahominy Rivers from projected sea-level rise in Chesapeake Bay. U.S. Geological Survey Open-File Report 2011–1191. 23 p. plus appendices. <https://doi.org/10.3133/ofr20111191>
- Shen, J., and L. Haas. 2004. Calculating age and residence time in the tidal York River using three-dimensional model experiments. *Estuarine, Coastal and Shelf Science*, 61, 449-461. <https://doi.org/10.1016/j.ecss.2004.06.010>
- Shields, E.C., K.A. Moore, and D.B. Parrish. 2018. Adaptations by *Zostera marina* dominated seagrass

- meadows in response to water quality and climate forcing. *Diversity* 10(4): 125.
<https://doi.org/10.3390/d10040125>
- Shields, E.C., D.B. Parrish, and K.A. Moore. 2019. Short-term temperature stress results in seagrass community shift in a temperate estuary. *Estuaries and Coasts* 42:755-764.
<https://doi.org/10.1007/s12237-019-00517-1>
- Sisson, G., J. Shen, S. Kim, J. Boon, and A. Kuo. 1997. VIMS three dimensional hydrodynamic eutrophication model (HEM-3D): Application of the hydrodynamic model to the York River system. SRAMSOE Report 341, Virginia Institute of Marine Science. 64 pp. plus appendices.
<https://doi.org/10.21220/V5ZB3N>
- Stein, B., L. Kruner, and J. Adams. 2000. *Precious Heritage: The status of biodiversity in the United States*. Oxford University Press, Oxford, New York. 399 pp.
<http://www.worldcat.org/isbn/0195125193>
- Steinberg, K., and R. Condon. 2009. Zooplankton of the York River. *Journal of Coastal Research*. SI 57: 66-79. <https://doi.org/10.2112/1551-5036-57.sp1.66>
- Sturm, S., and B. Neilson. 1977. Water quality in the York River. SRAMSOE Report 130, Virginia Institute of Marine Science. 27 pp. plus appendices. <https://doi.org/10.21220/V5F73Z>
- Swanton, J.R. 1946. *The Indians of the Southeastern United States, Volume 2*. Smithsonian Institution. 943 pp. <http://www.worldcat.org/isbn/0403000505>
- Sweet, W. V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler and C. Zervas, C. 2017. Global and regional sea level rise scenarios for the United States, NOAA Technical Report NOS CO-OPS 083.
- Upper Mattaponi Indian Tribe. 2021. The Upper Mattaponi Indian Tribe. <https://umitribe.org/> (Accessed 8/16/20).
- U.S. Army Corps of Engineers (USACE) 2019. Chesapeake Bay Comprehensive Water Resources and Restoration Plan. USACE. 26 pp. plus appendices. <https://www.nab.usace.army.mil/Missions/Civil-Works/chesapeake-bay-comprehensive-plan/>
- U.S. Census Bureau, 2010 and 2019 American Community Survey 5-Year Estimates, <https://data.census.gov/>.
- U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. Soil survey of King William County, Virginia. 327 pp.
- U.S. Department of Agriculture, Soil Conservation Service. 1980. Soil survey of Gloucester County Virginia. 88 pp.
- U.S. Department of Agriculture, Soil Conservation Service. 1985. Soil survey of James and York Counties and the City of Williamsburg Virginia. 137 pp.

- U.S. Environmental Protection Agency (USEPA). 2020. Chesapeake Bay Submerged Aquatic Vegetation Water Quality and Habitat-Based Requirements and Restoration Targets: A Second Technical Synthesis. Chesapeake Bay Program. USEPA. 55 pp.
https://www.chesapeakebay.net/documents/Submerged_Aquatic_Vegetation_Water_Quality_and_Habitat-Based_Requirements_and_Restoration_Targets_2000.pdf
- U.S. Environmental Protection Agency (USEPA). 2021. York Tributary Summary: A summary of trends in tidal water quality and associated factors 1985-2018. Integrated Trends Analysis Team, Chesapeake Bay Program. USEPA. 45 pp. <https://cast.chesapeakebay.net/Home/TMDLTracking>
- United States Geological Survey. 2020. Chesapeake Bay nontidal network mapper.
<https://va.water.usgs.gov/storymap/NTN>. Accessed 8/13/2020.
- University of Maryland Center for Environmental Science (UMCES). 2020. Chesapeake Bay and watershed report card: 2019. Integration and Application Network, UMCES. 6 pp.
<https://ecoreportcard.org/site/assets/files/2452/2020-chesapeake-bay-watershed-report-card.pdf>
- University of Maryland Center for Environmental Science (UMCES). 2021. Chesapeake Bay and watershed report card: 2020. Integration and Application Network, UMCES. 4 pp.
<https://ecoreportcard.org/site/assets/files/2452/2020-chesapeake-bay-watershed-report-card.pdf>
- University of Virginia. 2019. Weldon Cooper Center for Public Service, Demographics Research Group. 2019. Virginia Population Projections. <https://demographics.coopercenter.org/virginia-population-projections>
- Virginia Council of Indians (VCI). 2008. Virginia Council on Indians. A Guide to Writing about Virginia Indians and Virginia Indian History.
http://vagovernmentmatters.org/archive/files/writersguide_0e4a25bc6c.pdf
- Virginia Department of Conservation and Recreation (VDCR). 2000a. Natural Area Preserve Management Guidelines. Virginia Department of Conservation and Recreation. 11 pp.
- Virginia Department of Conservation and Recreation (VDCR). 2000b. York River State Park Resource Management Plan. Virginia Department of Conservation and Recreation.
- Virginia Department of Historic Resources (VDHR). 2020. First People: The Early Indians of Virginia. Virginia Department of Historic Resources. <https://www.dhr.virginia.gov/first-people-the-early-indians-of-virginia>. (Accessed 8/16/20).
- Virginia Indian Archive (VIA). 2020. Encounter: The Mattaponi River.
<http://www.virginiaindianarchive.org/items/show/123>. (Accessed 8/16/20).
- VIMS. 2015. VIMS Strategic Plan 2015-2020. Virginia Institute of Marine Science. 8 pp.
https://www.vims.edu/about/leadership_admin/dean/strategic_plan_2015/index.php
- VIMS. 2019. Threats to Chesapeake Bay. Office of Research and Advisory Services, Virginia Institute of Marine Science. 6 pp. https://www.vims.edu/about/leadership_admin/ras/documents/threats-to-chesapeake-bay-10-2019.pdf

Virginia Secretary of the Commonwealth (VSC). 2020. Virginia Indians.

<https://www.commonwealth.virginia.gov/virginia-indians/>. (Accessed 8/16/20).

White House Executive Order 13508. 2009. Chesapeake Bay Protection and Restoration. Federal

Register: 74(93): 8 pp. <https://www.govinfo.gov/content/pkg/FR-2009-05-15/pdf/E9-11547.pdf>

World Resources Institute (WRI). 2020. New data shows millions of people, trillions of property at risk from flooding - but infrastructure investments now can significantly lower flood risk.

<https://www.wri.org/news/release-new-data-shows-millions-people-trillions-property-risk-flooding-infrastructure> (Accessed 10/5/21).

Young, B., E. Byers, K. Gravuer, K. Hall, G. Hammerson, and A. Redder. 2011. Guidelines for using the NatureServe climate change vulnerability index Release 2.1. NatureServe.

https://www.natureserve.org/sites/default/files/guidelines_natureserveclimatechangevulnerabilityindex_r2.1_apr2011.pdf



APPENDICES

- Appendix A. MOU between NOAA and VIMS for the management of CBNERR-VA.
- Appendix B. Federal consistency determination.
- Appendix C. National Environmental Policy Act (NEPA) determination.
- Appendix D. MOU between VDCR and VIMS for management of the Catlett Islands component of CBNERR-VA and Machicomoco State Park.
- Appendix E. MOU between VDCR and VIMS for management of the Taskinas Creek component of CBNERR-VA and York River State Park.
- Appendix F. MOU between the Tacoma Hunting and Fishing Club and VIMS for management of the
- Appendix G. Coastal Training Program topic area crosswalk
- Appendix H. Federal and State laws applicable to natural resource management and protection.
- Appendix I. Reserve natural area management guidelines.
- Appendix J. Public comments received during Federal Register public comment period.

Appendix A. MOU between NOAA and VIMS for the management of CBNERR-VA.

**Memorandum of Understanding
Between the
National Oceanic and Atmospheric Administration
and the
Virginia Institute of Marine Science
detailing the State-Federal roles in the management of the
Chesapeake Bay National Estuarine Research Reserve in Virginia.**

I. PARTIES AND PURPOSE

This Memorandum of Understanding (MOU or agreement) establishes the framework for the cooperative management of Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR-VA) in the Commonwealth of Virginia, between the National Oceanic and Atmospheric Administration (NOAA), Office for Coastal Management and the Virginia Institute of Marine Science, The College of William & Mary (VIMS/W&M). This agreement supersedes the previous agreement between NOAA and VIMS/W&M regarding CBNERR-VA made on February 6, 1991.

II. AUTHORITY

The authority for this agreement is the Coastal Zone Management Act of 1972, as amended (CZMA, 16 U.S.C. §§ 1451-65), and its implementing regulations at 15 C.F.R. Parts 921, 923.

III. BACKGROUND

A. The Commonwealth of Virginia has determined the waters and related coastal habitats of Goodwin Islands, Catlett Islands, Taskinas Creek and Sweet Hall Marsh provide unique opportunities for the study of natural and human processes to contribute to the science of estuarine ecosystem processes, enhance environmental education opportunities and public understanding of estuarine areas, and provide a stable environment for research through the long-term protection of reserve resources.

B. The Commonwealth of Virginia has determined that the resources of the CBNERR-VA and the values they represent to the citizens of Virginia and the United States will benefit from the management of these resources as part of the National Estuarine Research Reserve (NERR) System.

C. VIMS/W&M, as the agency designated by the Governor of Virginia, is responsible for maintaining, operating and managing the CBNERR-VA in accordance with Section 315 of the CZMA, 16 U.S.C. § 1461, and acknowledges the value of state-federal cooperation for the long-term management and protection of the CBNERR-VA in a manner consistent with the purpose of its designation.

D. NOAA finds that the Commonwealth of Virginia satisfied the legal and procedural requirements for designation and, pursuant to its authority under Section 315 of the CZMA, 16 U.S.C. § 1461, and in accordance with implementing regulations at 15 C.F.R. Part 921, designated the CBNERR-VA.

E. The CBNERR-VA management plan approved by NOAA describes the goals, objectives, strategies/actions, administrative structure, and institutional arrangements for the CBNERR-VA, including this agreement and others. In consideration of the mutual agreements herein, NOAA and VIMS/W&M agree to the roles indicated in Section IV of this agreement.

IV. STATE-FEDERAL ROLES IN RESERVE MANAGEMENT

A. VIMS/W&M Role in CBNERR-VA Management

The VIMS/W&M shall:

1. be responsible for compliance with all federal laws and regulations, and ensure that the CBNERR-VA management plan is consistent with the provisions of the CZMA and implementing regulations;
2. ensure protection of the natural and cultural resources of the CBNERR-VA, and ensure enforcement of the provisions of state law and regulations aimed at protecting the CBNERR-VA;
3. ensure adequate, long-term protection and management of lands and waters included within the Goodwin Islands, Catlett Islands, Taskinas Creek and Sweet Hall Marsh boundaries;
4. cooperate with NOAA to apply for and manage funds to support the CBNERR-VA in accordance with federal and state laws, the CBNERR-VA management plan, annual funding guidance from NOAA, and any other NOAA directives pertaining to CBNERR-VA operations, research and monitoring, education and stewardship, and, as necessary, land acquisition and CBNERR-VA facility construction;
5. conduct and coordinate research and monitoring programs that encourage scientists from a variety of institutions to work together to understand the ecology of the CBNERR-VA ecosystem to improve coastal management;
6. conduct and maintain programs that disseminate research results via materials, activities, workshops, and conferences to resource users, state and local agencies, school systems, the general public, and other interested parties;
7. provide staff and endeavor to secure state funding for the manager, education coordinator, and research coordinator;
8. secure facilities and equipment required to implement the provisions within the CBNERR-VA management plan;
9. ensure adequate support for facilities operation and maintenance;
10. maintain effective liaison with local, regional, state, and federal policy makers, regulators, and the general public;
11. serve as principal contact for issues involving proposed boundary changes and/or amendments to the CBNERR-VA management plan; and
12. cooperate with NOAA regarding review of performance pursuant to Sections 312 and 315 of the CZMA, 16 U.S.C. §§ 1458 and 1461, 15 C.F.R. § 921.40, and ongoing management plan approvals.

B. Federal Role in CBNERR-VA Management

NOAA's Office for Coastal Management shall:

1. administer the provisions of the Sections 312 and 315 of the CZMA, 16 U.S.C. § 1458 and 16 U.S.C. § 1461, respectively, to ensure that the CBNERR-VA operates in accordance with goals of the NERR System and the CBNERR-VA management plan;
2. review and process applications for financial assistance from the VIMS/W&M, consistent with 15 C.F.R. Part 921, for management and operation of the CBNERR-VA, and, as appropriate, land acquisition and facility construction;
3. advise VIMS/W&M of existing and emerging national and regional issues that have bearing on the CBNERR-VA and NERR System;
4. maintain an information exchange network among reserves, including available research and monitoring data and educational materials developed within the NERR System; and
5. to the extent possible, facilitate the allocation of NOAA resources and capabilities in support of CBNERR-VA goals and programs.

C. General Provisions

1. Nothing in this agreement shall obligate either party in the expenditure of funds, or for future payments of money. Each party bears its own costs to implement this agreement. NOAA may provide Federal funding in accordance with the CZMA and any requirements of the U.S. Department of Commerce through financial assistance awards that are separate from this agreement.
2. A free exchange of research and assessment data between the parties is encouraged and is necessary to ensure success of cooperative studies.

D. Other Provisions

1. Nothing in this agreement diminishes the independent authority or coordination responsibility of either party in administering its respective statutory obligations. Nothing in this agreement is intended to conflict with current written directives or policies of either party. If the terms of this agreement are inconsistent with existing written directives or policies of either party entering this agreement, then those portions of this agreement that are determined to be inconsistent with such written directives or policies shall be invalid; but the remaining terms not affected by the inconsistency shall remain in full force and effect. In the event of the discovery of such inconsistency, and at the first opportunity for revision of this agreement, the parties shall seek to amend or terminate this agreement in accordance with the provisions of section VI of this agreement.
2. Any disagreement on the interpretation of a provision, amendment, or other matter related to this agreement shall be resolved informally at the lowest operating level of each party's respective organization. If such disagreement cannot be resolved, then the area(s) of disagreement shall be stated in writing and presented to the other party for further consideration. If agreement is not reached within thirty (30) days of

presentation, then the parties shall forward the written presentation of the disagreement to their respective higher official for appropriate resolution.

V. PROGRAM EVALUATION

In accordance with sections 312 and 315 of the CZMA, 16 U.S.C. §§ 1458 and 1461, and 15 C.F.R. § 921.40, NOAA's Office for Coastal Management will schedule periodic evaluations of VIMS/W&M performance in meeting the terms of this agreement and the CBNERR-VA management plan. Where findings of deficiency occur, NOAA may initiate action in accordance with the interim sanctions or withdrawal of designation procedures established by the CZMA and applicable regulations at 15 C.F.R. Part 921, Subpart E.

VI. EFFECTIVE DATE, REVIEW, AMENDMENT, AND TERMINATION

- A. This agreement is effective on the date of the last signature on this agreement and shall be in effect until terminated by either party.
- B. This agreement will be reviewed periodically by both parties and may only be amended by the mutual written consent of both parties.
- C. This agreement may be terminated by mutual consent of both parties or by unilateral termination by either party. Termination of this agreement may provide grounds for NOAA (at its discretion) to withdraw designation of the CBNERR-VA from the NERR System, pursuant to applicable provisions of the CZMA and its implementing regulations as described under 15 C.F.R. Parts 921 (Subpart E) and 923 (Subpart L). Section 315 of the CZMA, 16 U.S.C. § 1461, provides that NOAA may withdraw designation of a NERR if: (1) NOAA finds that any of the criteria for establishing the reserve no longer exist; or (2) a substantial portion of the research conducted within the reserve fails to meet NERR System guidelines. In making any decision to withdraw designation, NOAA will take into consideration factors set forth in 15 C.F.R. § 921.40.
- D. If any clause, sentence, or other portion of this agreement shall become illegal, null, or void for any reason, the remaining portions of this MOU shall remain in full force and effect.
- E. No waiver of right by either party of any provision of this agreement shall be binding unless expressly confirmed in writing by the party giving the waiver.

IN WITNESS THEREOF, the parties have caused this agreement to be executed.

PAYNE.JEFFREY
 Y.LYNN.13658
 33881

Digitally signed by
 PAYNE.JEFFREY.LYNN.13
 65833881
 Date: 2021.11.30
 10:47:34 -05'00'

Jeffrey L. Payne, Ph.D.
 Director
 Office for Coastal Management
 National Ocean Service
 National Oceanic and Atmospheric Administration
 U.S. Department of Commerce

Derek Aday, Ph.D.
 Dean & Director
 Virginia Institute of Marine Science
 College of William & Mary

Date:

Date: 12-3-2021

Appendix B. Federal consistency determination.



Commonwealth of Virginia

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Andrew R. Wheeler
Secretary of Natural and Historic Resources

Michael S. Rolband, PE, PWD, PWS Emeritus
Director
(804) 698-4000

February 15, 2022

Ms. Tricia Hooper
NOAA Office of Coastal Management
Sent via email: tricia.hooper@noaa.gov

RE: Federal Consistency Negative Determination: Revisions to the Chesapeake Bay-Virginia National Estuarine Research Reserve 2022-2026 Management Plan (DEQ 22-005F)

Dear Ms. Hooper:

The Commonwealth of Virginia has completed its review of the negative determination submitted for the above-referenced project. The Department of Environmental Quality (DEQ) is responsible for coordinating Virginia's review of federal consistency documents submitted under the Coastal Zone Management Act and responding to appropriate officials on behalf of the Commonwealth. This letter is in response to your submission dated and received December 23, 2021 and additional information received via email on January 14, 2022.

PROJECT DESCRIPTION

The National Oceanic and Atmospheric Administration (NOAA) submitted a negative determination for a proposed revision of the management plan for the Chesapeake Bay Virginia National Estuarine Research Reserve. Plan revisions are required at least every five years. This revised plan is intended to replace the plan approved in 2008. The draft revised management plan outlines the reserve's: strategic goals and objectives; administrative structure; programs for conducting research and monitoring, education, and training; resource protection, restoration, and manipulation plans; public access and visitor use plans; consideration for future land acquisition; and facility development to support reserve operations. NOAA states that the approval of the revised plan would have no coastal effects as there are no substantive changes between the actions and priorities included in this plan and the previous management plan.

FEDERAL CONSISTENCY UNDER THE COASTAL ZONE MANAGEMENT ACT

DEQ 22-005F
Chesapeake Bay-Virginia National Estuarine Research Reserve 2022
Negative Determination

Pursuant to the Coastal Zone Management Act of 1972, as amended, federal activities located inside or outside of Virginia's designated coastal management area that can have reasonably foreseeable effects on coastal resources or coastal uses must, to the maximum extent practicable, be implemented in a manner consistent with the Virginia Coastal Zone Management (CZM) Program. The Virginia CZM Program consists of a network of programs administered by several agencies. The DEQ coordinates the review of federal consistency documents with agencies administering the enforceable and advisory policies of the Virginia CZM Program.

FEDERAL CONSISTENCY CONCURRENCE

Based on DEQ's review of the submission, it appears that the proposal is consistent with the CZM Program since the activities as described are not anticipated to have effects on the enforceable policies of the CZM Program.

According to the negative determination, the proposed action would have no coastal effects. DEQ concurs that the proposal is consistent with the Virginia CZM Program provided NOAA obtains any applicable permits and approvals if necessary. However, other state approvals which may apply to this project are not included in this consistency concurrence.

If you have questions, please do not hesitate to call me at (804) 659-1915 or Julia Wellman at (804) 774-8237.

Sincerely,



Bettina Rayfield, Manager
Environmental Impact Review and Long Range
Priorities Program

Appendix C. National Environmental Policy Act (NEPA) determination.



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office for Coastal Management
Silver Spring Metro Center, Building 4
1305 East-West Highway
Silver Spring, Maryland 20910

MEMORANDUM FOR: The Record

FROM: Patmarie S. Nedelka *Patmarie S. Nedelka*
NEPA & Environmental Compliance Coordinator

SUBJECT: Categorical Exclusion (CE) for the approval of the revised Chesapeake Bay-Virginia NERR Management Plan

DATE: July 29, 2022

The National Oceanic and Atmospheric Administration's (NOAA) Policy and Procedures for Compliance with the National Environmental Policy Act and Related Authorities (NOAA Administrative Order 216-6A and Companion Manual for NAO 216-6A) establishes NOAA's policy and procedures for compliance with the National Environmental Policy Act, the CEQ regulations, Executive Order (EO) 12114 (Environmental Effects Abroad of Major Federal Actions), EO 11988 and 13690 (Floodplain Management), and EO 11990 (Protection of Wetlands). It was used by NOAA to examine for the approval of the revised Chesapeake Bay-Virginia NERR Management Plan for its potential to impact the quality of the human environment as discussed below.

Program Background:

The National Estuarine Research Reserve System (NERRS or Reserve System) is a network of 30 areas representing different biogeographic regions and estuarine types within the United States that are protected for long-term research, monitoring, education, and coastal stewardship. Established by the Coastal Zone Management Act of 1972, as amended, the Reserve System is a partnership program between NOAA and the coastal states.

As part of this partnership, federal regulations require reserves to have a NOAA-approved management plan that is revised every five years (15 C.F.R. Part 921.33(c)). NERRS management plans serve as the foundation and guide for reserve activities; collectively they describe the capacities of the Reserve System. These documents can be used as source documents for other internal and external partner programs such as the National Estuary Program and the Coastal Zone Management Program, as well as national efforts such as the National Climate Assessment. NOAA works collaboratively with each reserve to support the development and approval of its management plan, and to ensure compliance with federal regulations and alignment with national priorities and programs.

Per federal regulations, 15 C.F.R. Part 921.13, management plans must describe the reserve's most pressing coastal management issue. The NERRS program is administered at the federal level by the Ecosystems Program, Stewardship Division within NOAA's Office for Coastal Management (OCM). The Ecosystems Program is responsible for administering the NERRS program through financial assistance, technical services and information, and participation in priority national, regional, state, and local forums.

Description of the Action(s):

NOAA is proposing to approve the Chesapeake Bay-Virginia NERR revised management plan for the period 2022-2026 (attached). The Reserve was designated in February 1991 and this plan is the fourth edition of the Reserve’s management plan. It supports the strategic goals of NOAA and the Virginia Institute of Marine Science (VIMS). The strategic plan included in this document, which addresses these priorities, was developed through collaborative engagement with partners, including professional colleagues and public and private stakeholders. The strategic plan responds to needs through the integrated activities of the Research, Stewardship, Education, and Coastal Training programs. The purpose of this plan is to provide a framework for program undertakings over the next five years, and to guide Reserve staff and stakeholders in management decisions.

This plan is intended to guide efforts and investments in a collaborative manner that addresses place-based needs while providing regional impact. Functional areas include:

- Enhancing and inspiring stewardship, protection, and management of estuaries, their watersheds and cultural connections through place-based approaches;
- Generation, application and transfer of scientific knowledge with respect to estuarine and coastal watershed resources to increase understanding, appreciation and betterment of coastal communities; and
- Advancement of environmental literacy and appreciation, allowing for better resource stewardship and science-based decisions that positively affect estuaries, their watersheds and communities.

Underlying these functional areas are CBNERR-VA’s core values and orienting principles, represented by its five Pillars of Operation:

1. Integration Across Programs (Administration, Research, Education, Training, and Stewardship)
2. Responsible Conduct of Research;
3. Advisory Service and Technical Assistance;
4. Communications;
5. Diversity, Equity, Inclusion, and Justice

These Pillars of Operation are the bedrock of the Reserve’s program development and the lens through which the Reserve approaches its roadmap toward vision achievement.

By actively using this Management Plan to guide Reserve programs, CBNERR-VA strives to fulfill its mission to exhibit leadership in coastal zone management through relevant estuarine and coastal watershed science and education programs that promote natural resource stewardship and science-based solutions to complex socio-ecological challenges.

CE category number, title, and CE text that applies to the proposed action(s):

The proposed action is in compliance with NERRS program regulations whereby all Reserves must update their management plans. The reserve’s revised management plan will be used to guide the future of the reserve and lacks the specificity necessary to conduct a thorough NEPA. The management plan will be used by NOAA as part of the financial assistance award process; however, all funded activities will be subjected to a thorough NEPA review and all necessary environmental compliance will be completed prior to the state’s expenditure of federal funds.

The Chesapeake Bay-Virginia NERR revised management plan does not include a boundary expansion, nor does it add or significantly change allowable uses, uses requiring a permit, or propose new restrictions on existing uses. The approval of the management plan is not part of a larger action; it can therefore be reviewed independently. Approval of the reserve's revised management plan falls within the categorical exclusion A5 - Updates to existing National Estuarine Research Reserve (NERR) management plans, provided that the update does not change NERR boundaries or add or significantly change allowable uses, uses requiring a permit, or restrictions on uses.

Effects of the Action(s):

OCM has considered the administrative approval of the Chesapeake Bay-Virginia NERR management plan in the context of the extraordinary circumstances listed in the NOAA Companion Manual for NAO 216-6A. No extraordinary circumstances are present, as summarized below (and in attachment).

- Requirements are in place to ensure no adverse effects on human health or safety, and to ensure no effects from hazardous or toxic substances
- The area does not contain unique environmental characteristics
- There are no effects to protected species or historic resources
- There are no effects to minority communities
- No introduction, growth or expansion of invasive species is anticipated
- All federal and state laws will be complied with, and all effects are known
- The requested services are not unique or uncertain and there is no potential for cumulative impacts.

The legal notice of availability for the 30-day public comment period was published in the Federal Register on March 1, 2022 (87 FR 11418). One comment was received and documented in the management plan's Appendix J and addressed throughout the management plan as appropriate.

The administrative action of approving a management plan will have no effect on the human environment; any specific activities that may be funded in the future by NOAA will undergo a thorough NEPA analysis and all environmental compliance requirements will be completed prior to the expenditure of federal funds. There is no change to the Reserve's boundary nor does the plan add or significantly change allowable uses, uses requiring a permit, or restrictions on uses. Any future proposed land acquisitions or changes to allowable uses will be subject to NEPA and environmental review, as appropriate.

Environmental Compliance Needs:

The federal consistency provision of the CZMA requires that any federal action occurring in or outside of a state's coastal zone, which has a reasonably foreseeable effect on land uses, water uses, or natural resources of the coastal zone, must be consistent with enforceable policies contained in the state's Federally-approved coastal management program. NOAA submitted the consistency determination, as required by 15 C.F.R. Part 930, Subpart C, and in compliance with the state's review procedures. On February 15, 2022, The Commonwealth of Virginia completed its review of the proposed action, and concurred with NOAA's federal consistency negative determination that the proposed action would have no coastal effect and is consistent with the Virginia CZM Program and is included as Appendix B.

The administrative action of approving the Reserve's revised management plan will have no effect on listed species or essential fish habitat and has no potential to cause effect to any historic resources. No other compliance requirements are triggered by the action of approving the management plan revision. NOAA will conduct thorough environmental analysis and complete all environmental compliance requirements prior to the expenditure of subsequent federal funding requests that implement the plan.

Categorical Exclusion Determination:

Based upon the above analysis, NOAA has determined that the action proposed falls within A5 - *Updates to existing National Estuarine Research Reserve (NERR) management plans, provided that the update does not change NERR boundaries or add or significantly change allowable uses, uses requiring a permit, or restrictions on uses* - a category of actions that does not individually or cumulatively have a significant effect on the quality of the human environment; is not connected to a larger action (40 CFR 1508.25(a)); and does not involve extraordinary circumstances precluding use of the CE. As such, NOAA has determined that the approval of the reserve's management plan is categorically excluded from further NEPA review.

Attachments:

Chesapeake Bay Virginia NERR Revised Management Plan
Extraordinary Circumstances Evaluation Document

**MANAGEMENT PLAN UPDATE FOR THE
CHESAPEAKE BAY VIRGINIA NATIONAL ESTUARINE RESEARCH RESERVE**

**Environmental Compliance and NEPA Extraordinary Circumstances Evaluation
Document for Non-Grant Actions**

1. Clean Water Act (CWA, Section 404) and Rivers and Harbors Act of 1899 (RHA, Sections 9 and 10 and regulations at 33 CFR Parts 322 and 323)

- This action will include the placement/removal of structures, work involving dredging, disposal of dredged or fill material or pollutants into waters of the United States, filling, excavation, or any or modification of a navigable waterways of the United States. *Yes, permit* **X No**

EXPLAIN: Routine administrative action.

2. Coastal Zone Management Act (CZMA, Section 307 and regulations at 15 CFR 930)

- For federal assistance to a State or local government: **X n/a** *Yes, consistency certification* *No*
Indicate if this action is listed by the State as subject to federal consistency review.
- For other actions: Indicate if this action (inside or outside a state’s coastal zone) will have reasonable foreseeable effects (direct, indirect, or cumulative) on coastal uses or resources. *Yes, consistency determination* **X No**
- If no: This action is listed by the State as subject to federal consistency review. *n/a* **X Yes, negative determination** *No*

EXPLAIN: Routine administrative action – Concurrence received on negative determination

3. Endangered Species Act (ESA, Sections 7 and 10)

- This action will target ESA-listed (or -proposed) species. *Yes, permit* **X No**
 - This action will be in an area where ESA-listed (or -proposed) species or critical habitat (CH) may occur. *Yes, effects determination* **X No**
- Effects determination:** *NMFS* *USFWS*
- No effects*
 - May affect but not likely to adversely affect (NLAA), informal consultation*
 - May affect and likely to adversely affect (LAA), formal consultation*

EXPLAIN: Routine administrative action.

4. Magnuson-Stevens Fishery Conservation and Management Act (MSA, Section 305(b))

- This action will be in an area designated as essential fish habitat (EFH). *Yes* **X No**
- This action (within or outside of EFH) may adversely affect (reduce the quality and/or quantity of) EFH. *Yes* **X No**

- Effects determination: *No adverse effects*
 May adversely affect EFH, consultation

EXPLAIN: Routine administrative action.

5. Marine Mammal Protection Act (MMPA, Sections 101(a)(5)(A-D) and 104)

- This action will result in direct “take” of marine mammals. *Yes, permit* **X No**
- This action will be in an area where marine mammals occur. *Yes* **X No**
- This action will result in incidental (unintentional but not unexpected) “take” of marine mammals. *Yes, authorization* **X No**

EXPLAIN: Routine administrative action.

6. Migratory Bird Treaty Act (MBTA) and Bald Eagle Protection Act

- This action will be in an area where migratory birds occur. *Yes* **X No**
- This action will be in an area where bald or golden eagles occur. *Yes* **X No**
- This action will involve any of the following: take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or, barter any bald or golden eagle or migratory bird, alive or dead, or any part nest, or eggs of such a bird. *Yes, permit* **X No**

EXPLAIN: Routine administrative action.

7. National Historic Preservation Act (NHPA, Section 106 and regulations at 36 CFR 800.16 and 800.3(a))

- This action is an undertaking with the potential to cause effects on historic properties listed on or eligible for listing in the National Register of Historic Places (NHRP), even assuming historic properties are present. *Yes, consultation with:* **X No**
 SHPO *THPO*
 - This action will be in or near an area that has a federally-listed historic property or a State cultural resource/historic property. *Yes* **X No**
- Effects determination: *No historic properties affected*
 No adverse effects
 Adverse effect

EXPLAIN: Routine administrative action.

8. National Marine Sanctuaries Act (NMSA, Section 304(d)), Antiquities Act, and Other Federal Protected Area Laws

- This action is likely to destroy, cause the loss of, or injure a sanctuary resource. *Yes, consultation* **X No**
- This action will be in or near a National Marine Sanctuary. *Yes* **X No**
- If yes: The activities within the Sanctuary are prohibited. **X n/a** *Yes, permit* *No*
- This action will be in or near other federal protected areas (e.g., National Park, National Monument, Wildlife Refuge). *Yes* **X No**

EXPLAIN: Routine administrative action.

9. EO 11988 - Floodplain Management; 13690 - Federal Flood Risk Management Standard; and 11990 - Protection of Wetlands

- This action will be in or affecting floodplains and wetlands that involve acquiring, managing, and disposing of federal lands and facilities; providing federally undertaken, financed or assisted construction and improvements; and conducting federal activities and programs affecting land use such as water and related land use resource planning, regulating, and licensing activities. Yes **X No**

EXPLAIN: Routine administrative action.

10. EO 13175 - Consultation and Coordination with Indian Tribal Governments

- There are tribal communities in the action area. Yes **X No**
- This action will have tribal implications. Yes, *consultation* **X No**

EXPLAIN: Routine administrative action.

11. Other Resources

- Sensitive resources (e.g., submerged vegetation, beaches and dunes, coral reefs or associated water bodies [e.g. embayment areas]) are present in the action area. Yes **X No**
- This action will degrade or disturb coral reefs. Yes **X No**
- This action will degrade or disturb previously undisturbed areas. Yes **X No**
- This action will result in air emissions (temporary or permanent, air quality changes). Yes **X No**
- This action will generate (short- or long-term) noise impacts. Yes **X No**

EXPLAIN: Routine administrative action.

12. Other Federal, State and Local Laws and EOs

- There are other Federal, State and Local Laws and EOs requirements for this action. Yes **X No**

EXPLAIN: Routine administrative action.

13. NEPA Extraordinary Circumstances

- a. This action will have adverse effects on human health or safety that are not negligible or discountable. Yes **X No**

EXPLAIN: Routine administrative action.

- b. This action will have adverse effects on an area with unique environmental characteristics (e.g., wetlands, floodplains, national marine sanctuaries, marine national monuments) that are not negligible or discountable. Yes **X No**

COMMENTS: Discussed on questions 8, 9, 11 and 12.

- c. This action will have adverse effects on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA that are not negligible or discountable. Yes **X No**

COMMENTS: Discussed on questions 3, 4, 5, 6, and 8.

- d. This action will have the potential to generate, use, store, transport, or dispose of hazardous or toxic substances, in a manner that may have a significant effect on the environment. Yes **X No**

EXPLAIN: Routine administrative action.

- e. This action will have adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the NHPA of 1966, National Historic Landmarks designated by the Secretary of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes. Yes **X No**

COMMENTS: Discussed on questions 7, 8 and 12.

- f. This action will have a disproportionately high and adverse effect on the health or the environment of minority or low-income communities, compared to the impacts on other communities (EO 12898). Yes **X No**

EXPLAIN: Routine administrative action.

- g. This action will contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of the species. Yes **X No**

EXPLAIN: Routine administrative action.

- h. This action will potentially violate any Federal, State, or local law or requirements imposed for protection of the environment. Yes **X No**

EXPLAIN: Routine administrative action.

- i. This action will have highly controversial environmental effects. Yes **X No**

EXPLAIN: Routine administrative action.

- j. This action will have the potential to establish a precedent for future action or an action that represents a decision in principle about future actions with potentially significant environmental effects. Yes **X No**

EXPLAIN: Routine administrative action.

- k. This action will have uncertain, unique, or unknown environmental effects. Yes **X No**

EXPLAIN: Routine administrative action.

- l. This action will have the potential for significant cumulative impacts when Yes **X No**

the proposed action is combined with other past, present and reasonably foreseeable future actions, even though the impacts of the proposed action may not be "significant" (as defined by 40 CFR 1508.27) by themselves.

EXPLAIN: Routine administrative action.

Appendix D. MOU between VDCR and VIMS for management of the Catlett Islands component of CBNERR-VA and Machicomoco State Park.

MEMORANDUM OF UNDERSTANDING

This MEMORANDUM OF UNDERSTANDING (“MOU”) is made and entered into this 18th day of October, 2019, by and between the **COMMONWEALTH OF VIRGINIA, DEPARTMENT OF CONSERVATION AND RECREATION**, an agency of the Commonwealth of Virginia, of 600 East Main St., 24th Floor, Richmond, Virginia 23219 (“DCR”) and the **VIRGINIA INSTITUTE OF MARINE SCIENCE/CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE**, with its principal place of business located at P.O. Box 1346, Rt. 1208 Greate Road, Gloucester Point, Virginia 23062.

WITNESSETH:

WHEREAS, DCR and VIMS/CBNERR agree to cooperate on the construction of a hand carry boat launch across VIMS/CBNERR property at the site of Poplar Creek for the future Machicomoco State Park. DCR and VIMS/CBNERR further agree to cooperate with the management of the Catlett Island component of the CBNERR and the future Machicomoco State Park.

WHEREAS, DCR and VIMS/CBNERR will work together to develop appropriate warning notification signage to alert recreational boaters to restricted access onto the Catlett Islands, adjoining intertidal habitats, and near any sensitive scientific equipment not located on the islands or adjoining intertidal habitats.

WHEREAS, DCR and VIMS/CBNERR agree that no additional structures (except the hand carry boat launch) will be constructed in Poplar Creek without prior written approval from both parties.

NOW, THEREFORE, in consideration of the foregoing recitals, the reciprocal duties and obligations set forth herein below and other goods and valuable consideration, the receipt and sufficiency of which is acknowledged, the parties agree as follows:


Management and Operational Services:

- VIMS/CBNERR will monitor resource conditions within the Catlett Island Reserve to ensure that resource degradation does not occur as a result of excessive visitor use. Appropriate measures will be taken to restore any damages. DCR will work with VIMS/CBNERR to mitigate any resource degradation issues if they should occur.
- DCR will assume all responsibilities for public access infrastructure replacement and maintenance to the Poplar Creek hand carry launch within the VIMS/CBNERR Catlett Island Research Reserve.
- DCR will work in cooperation with VIMS/CBNERR to develop interpretive and educational programming to inform the public about the coastal and historic resources of the region.

IN WITNESS HEREOF, the parties have caused this Agreement to be executed as of the date first set forth hereinabove.

VIMS/CBNERR

VIRGINIA INSTITUTE OF MARINE
SCIENCE/CHESAPEAKE BAY NATIONAL
ESTUARINE RESEARCH RESERVE

By: 
John T. Wells, Dean and Director
Virginia Institute of Marine Science

DCR

COMMONWEALTH OF VIRGINIA,
DEPARTMENT OF CONSERVATION AND
RECREATION

By: 
Clyde E. Cristman, Director
Virginia Department of Conservation and
Recreation

**Appendix E. MOU between VDCR and VIMS for management of the Taskinas Creek component of
CBNERR-VA and York River State Park.**

**Memorandum of Understanding
between the
Department of Conservation and Recreation
and the
Virginia Institute of Marine Science
detailing management roles of the
Taskinas Creek Component
of the
Chesapeake Bay National Estuarine Research Reserve in Virginia**

I. PARTIES AND PURPOSE

This Memorandum of Understanding (MOU or agreement) establishes the framework for the cooperative management of the Taskinas Creek component of the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERR-VA) in the Commonwealth of Virginia, between the Department of Conservation and Recreation (VDCR) and the Virginia Institute of Marine Science (VIMS). The CBNERR-VA program is administered by VIMS as a research center and responsible for the day-to-day operations of the CBNERR-VA. This agreement supersedes the previous agreement between VDCR and VIMS made on August 19, 2008.

II. BACKGROUND

WHEREAS, the Commonwealth of Virginia has determined the waters and related coastal habitats of Goodwin Islands, Catlett Islands, Taskinas Creek and Sweet Hall Marsh provide unique opportunities for the study of natural and human processes to contribute to the science of estuarine ecosystem processes, enhance environmental education opportunities and public understanding of estuarine areas, and provide a stable environment for research through the long-term protection of reserve resources; and

WHEREAS, the Commonwealth of Virginia has determined that the designation of Taskinas Creek, as a component of the CBNERR-VA under the National Estuarine Research Reserve (NERR) system as provided for the Coastal Zone Management Act of 1972, as amended, would provide for beneficial long-term research and public education to improve coastal management capabilities of the Commonwealth and the United States; and

WHEREAS, the VDCR owns and manages the property known as Taskinas Creek within the boundaries of York River State Park (YRSP), is willing to make a long-term commitment to the CBNERR-VA by making a substantial portion of the Taskinas Creek watershed within YRSP, along with adjacent state waters, designated as a Taskinas Creek Research Reserve (TCRR) for the purposes and in the manner set forth below and in VDCR's Resource Management Plan for YRSP and the CBNERR-VA's Management Plan; and

WHEREAS, the VDCR and VIMS recognize that the designation of TCRR within YRSP is an acknowledgement that the area is a natural field laboratory to be used, in consonance with current uses, to study and gather data on natural and human processes occurring within the watershed of this York River tributary to the lower Chesapeake Bay, and further to provide a basis for increased public awareness and understanding of the complex nature of estuarine systems, their values and benefits to man and nature, and the problems that confront them, all

of which are reflective of the goals of the CBNERR-VA which are preservation, research and education; and

WHEREAS, the establishment of the TCRR will augment the present management, educational, and research functions of the VDCR within YRSP, but shall not be used as a substitute for the present management, education, or research functions of VDCR; and

NOW, THEREFORE, for and in consideration of mutual covenants herein contained, it is agreed by and between the parties the following:

ARTICLE I. Research Reserve Boundary

The TCRR will include land owned by the VDCR within YRSP, as delineated in the CBNERR-VA Management Plan (see Appendix A of this agreement).

ARTICLE II. Ownership and Management of Taskinas Creek Area

The real and personal property within the boundaries of the TCRR shall continue to be owned and managed by the VDCR except as specifically provided below or by a separate MOU developed for a specific facility or other infrastructure. The use of the YRSP property within the boundaries of the TCRR shall be in accordance with the purpose for which it was established.

The TCRR will be cooperatively managed and operated by the VDCR and VIMS in accordance with YRSP's Master Plan and the CBNERR-VA Management Plan and any developed natural resource management plans having relevance for YRSP and TCRR.

The parties agree to coordinate fully their programs and activities conducted in the TCRR. Disputes concerning such activities and programs shall be resolved at the appropriate level of management.

ARTICLE III. Uses of the Taskinas Creek Research Reserve

That portion of the YRSP designated as the TCRR will be used primarily for ecological research and public education. Natural resource management activities carried out in the TCRR under the YRSP Resource Management Plan will be compatible with the site's designation as an open/sensitive undeveloped zone. Manipulative research and management within the TCRR will be permitted only with the concurrence of the parties to this agreement on a case-by-case basis.

Research will be directed towards but not limited to: (1) a better understanding of the ecological relationships within the estuarine environment; (2) baseline ecological measurements; (3) monitoring significant changes in the estuarine environment; and (4) assessment and prediction of the effects of man's activities on the estuarine environment.

Educational programs will be designed to increase public knowledge and awareness of estuarine systems and their uses to man, and may serve as a model for similar programs elsewhere in the Bay area and in other estuarine systems.

Designation of the TCRR will not restrict passive recreational activities within the core area nor fishing and water-oriented recreational and other wildlife-oriented activities which have been traditionally conducted in YRSP, nor to contravene the manner in which these activities are regulated by appropriate law. The designation of the TCRR is in no way meant to obstruct the achievement of the goals and objectives of the VDCR as they pertain to the YRSP. Resource conditions within the TCRR Reserve will be monitored to ensure that resource degradation does

not occur as a result of excessive visitor use. Appropriate measures will be taken to minimize any damages observed as a result of monitoring.

YRSP and CBNERR-VA shall work out arrangements for the use of existing nature trails and facilities for TCRR oriented programs. VDCR and CBNERR-VA will jointly plan and pursue, if necessary, the creation of any new trails, boardwalks, exhibits, docks, parking areas, facilities, equipment, etc., that enhance the management, research and education goals of YRSP and the TCRR. It is understood that these additional facilities will be developed to protect the environment in the area by locating administrative facilities and public access in appropriate sites. Either CBNERR-VA or VDCR financial assistance award monies may be used for these purposes.

Ownership of scientific and education instruments and equipment purchased by VIMS and located at YRSP will remain with VIMS. Siting and placement of such equipment will be jointly agreed upon by CBNERR-VA and YRSP.

Personnel engaged in TCRR sponsored research, stewardship and education projects will be afforded access to YRSP on the same basis with regard to the payment of parking and other fees as personnel engaged in YRSP or VDCR sponsored activities. Such individuals will be identified by presentation of an approved CBNERR-VA permit or by a permit issued by VDCR.

ARTICLE IV. Administration of the Taskinas Creek Research Reserve

The VDCR will have primary management responsibilities for day to day administration, operations, and maintenance of the TCRR in cooperation and consultation with CBNERR-VA. Other cooperative projects between the VDCR and VIMS and other academic institutions or other organizations which are designed specifically to address TCRR goals of education, research and preservation shall also require cooperation and consultation.

VDCR and the VIMS further agree to cooperate on the following TCRR management functions:

- a. VDCR and CBNERR-VA will conduct meetings as needed or requested, to review previous activities, identify upcoming research, education, resource protection, and restoration needs, and other areas of interest for YRSP and will help seek funding to fulfill these identified needs;
- b. VDCR will enforce YRSP rules and regulations and CBNERR-VA management policies within the TCRR and will notify the CBNERR-VA on non-compliance of personnel engaged in CBNERR-VA sponsored/permitted activities so as to rectify any issues;
- c. VDCR and CBNERR-VA will monitor the impact of visitor use and reserve activities and take steps to mitigate impacts;
- d. VDCR and the CBNERR-VA will review proposed research, education and resource protection/restoration projects to be conducted in the TCRR. Initial review will be based on the VDCR Research and Collection Permit and CBNERR-VA Research Permit applications. Following the review process, VDCR and CBNERR-VA will issue permits and track approved research, education and resource protection/restoration projects as required;
- e. Acceptance of a VDCR and TCRR project permit requires responsible parties to submit final project reports to VDCR and CBNERR-VA. Upon receipt, VDCR and CBNERR-VA will discuss findings as related to the management of YRSP and the TCRR. Final reports

and/or associated information products will be archived by VDCR and/or CBNERR-VA;
and;

- f. VDCR and CBNERR-VA will be involved in the review and update of YRSP's Master Plan, CBNERR-VA's Management Plan, and any developed natural resource management plans having relevance for YRSP and TCRR.

ARTICLE V. Advisory Service and Research Reserve Management Plans

Both VDCR and CBNERR-VA/VIMS personnel will be appointed to service committees that oversee activities and address strategic planning initiatives that may impact the TCRR.

This MOU between VDCR and VIMS will be updated based on mutually determined needs. It is encouraged that review and updates of this agreement occur when VDCR's YRSP Master Plan and CBNERR-VA's Management Plan are updated and be incorporated into such plans.

ARTICLE VI. Termination of the MOU

This MOU shall be in effect until superseded.

If VIMS ceases to operate the TCRR as a designated NERR, or NERR designation is withdrawn or otherwise terminated, this MOU and the VIMS' interest shall be terminated and the VDCR shall again have the full and exclusive control of the property.

For purposes of the Article, the parties agree that a decision to terminate this Agreement shall be made jointly by the parties, with two years advance notice given.

IN WITNESS WHEREOF, the parties hereto have caused this MOU to be executed on this date 22 December, 2021.

Joyce van der Laan Smith
Witness

Judy L. ROSENZ
Witness

Thomas L. Smith, DCR Deputy for
Clyde Cristman, Director
Department of Conservation and Recreation

Derek Aday
Derek Aday, Dean and Director
Virginia Institute of Marine Science
William & Mary

Appendix F. MOU between the Tacoma Hunting and Fishing Club and VIMS for management of the Sweet Hall Marsh component of CBNERR-VA.

Management Agreement

**Sweet Hall Marsh National Estuarine Research Reserve
in Virginia**

THIS MANAGEMENT AGREEMENT, made this 1st day of May, 2008 by and between Tacoma Hunting and Fishing Club, hereinafter called the Grantor, and The College of William and Mary in Virginia, hereinafter called the Grantee. This Management Agreement supercedes the original Management Agreement for the Sweet Hall Marsh component of the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA) dated September 24, 1990.

WITNESSETH

WHEREAS, the Grantor is owner in fee simple of certain real property (hereinafter described and referred to as "Sweet Hall Marsh"), situated in the County of King William, Commonwealth of Virginia, being more particularly delineated as "freshwater tidal wetlands extending from mean low tide on the Pamunkey River to the wetland/upland border landward of the Pamunkey River" as shown in Exhibit A, attached hereto and incorporated by reference herein; and

WHEREAS, Sweet Hall Marsh has substantial wetland resources and significant natural, ecological, research, educational, and aesthetic values, which this management agreement will help to preserve, maintain, and protect water quality and important aquatic resources and habitats of the Pamunkey River; and

WHEREAS, this Management Agreement is being made with the intention and understanding of both the Grantor and Grantee that the subject property will remain designated as a component of the CBNERRVA; and

WHEREAS, the Grantor desires and intends that the natural, ecological, research, educational, and aesthetic values of Sweet Hall Marsh shall be preserved and maintained by restricting and limiting the use of the land and contiguous water areas of the property, on the terms and conditions and for the purpose hereinafter set forth, and the Grantee is willing to accept responsibility for managing the property for the purpose of conducting basic scientific and applied research and providing timely and accurate information to the Grantor and the citizens of the Commonwealth regarding the quality and conservation of the resources, both living and non-living, of Sweet Hall Marsh, on the terms and conditions and for the purposed hereinafter set forth; and

NOW THEREFORE, as an absolute gift of no monetary consideration (\$0.00) but in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, the Grantor hereby conveys to the Grantee, its successors, and assigns for a period of five (5) years a Management Agreement for the purpose of research, observation, and education and to the extent hereinafter set forth with respect to Sweet Hall Marsh.

To achieve these objectives, the following conditions and restrictions are set forth:

ARTICLE I. GENERAL PURPOSE AND DURATION

1. General Purpose – The purpose of this Management Agreement is to preserve and protect the environment of Sweet Hall Marsh and to maintain its natural and cultural values and its dominant scenic, rural, woodland, and wetland character so that the property remains suitable for long-term research on natural and human processes occurring within the Pamunkey River Tributary of the Chesapeake Bay.

2. Duration – This Management Agreement shall be valid for a 5 year period, and the terms, conditions, restrictions and purposes imposed with this Management Agreement shall not only be binding on the Grantor but also the Grantor’s agents, personal representatives, heirs, assigns and all other successors to the Grantor’s interests for the duration of the Management Agreement, subject to the agreed upon termination provisions. This Management Agreement may be renegotiated at the end of the 5 year period at the discretion of both parties.

ARTICLE II. MANAGEMENT OBJECTIVES

3. Management Plan Preparation and Implementation – There shall be an updated Management Plan prepared to provide the framework to direct and track progress of the CBNERRVA. In addition to the CBNERRVA Management Plan, there shall be a Natural Resource Management Plan developed specifically for Sweet Hall Marsh to guide the management process that balances the research and education mission of the Grantee with the objectives of the Grantor while adequately protecting natural resources.

Both the CBNERRVA Management Plan and the Sweet Hall Marsh Natural Resources Management Plan shall be prepared by the Virginia Institute of Marine Science (VIMS), in consultation with other resource management agencies of the Commonwealth, and shall be submitted to the Grantor for their review and approval. The Grantor and Grantee shall meet at least annually, and more frequently at the request of the either party, to review the Management Plans and research, education and stewardship results and, where appropriate, to develop more specific recommendations for carrying out certain aspects of the Plans. The CBNERRVA Management Plan and Sweet Hall Marsh Natural Resources Management Plan shall be updated at least every five years.

4. On-Site Management. VIMS is the agency designated by the Grantee and the Governor of the Commonwealth of Virginia to manage the CBNERRVA. In this capacity, VIMS shall serve as on-site manager for research on Sweet Hall Marsh and shall be responsible for seeing that research, education and stewardship activities conducted on the property is conducted in a manner consistent with the goals of the CBNERRVA, the objectives of the CBNERRVA Management Plan and Sweet Hall Marsh Natural Resources Management Plan, and the wishes of the Grantor and Grantee.

The on-site manager will be the Grantee's primary representative for the purpose of monitoring uses of the property for consistency with this Management Agreement.

5. Natural Area Preservation – Sweet Hall Marsh shall be maintained as open space, wildlife and waterfowl habitat, and a natural field laboratory for research and education, consistent with the resource protection policies of the Grantor. Any industrial commercial activities shall be prohibited on Sweet Hall Marsh. The protection and conservation of the marsh and bottomlands subject to this Management Agreement is consistent with the goals and policies of the CBNERRVA.

6. Research, Education and Stewardship – Sweet Hall Marsh shall be used for research, education and stewardship activities associated with the CBNERRVA. Research and education uses of Sweet Hall Marsh shall be in accordance with the principles, objectives, and performance standards set forth in the CBNERRVA Management Plan developed by VIMS and approved by the Grantor and Grantee, it being understood that the proposed research, education and stewardship activities will not involve large groups of people or continuous or frequent visits to the site by other than the few regularly designated personnel of VIMS. The CBNERRVA will provide review and approval of proposals for research, education and stewardship activities at Sweet Hall Marsh. Proposals and activities shall be approved by the Grantor and Grantee. Such approval shall not be unreasonably withheld.

7. Information Exchange – Research, education and stewardship activities conducted at Sweet Hall Marsh shall be used to enhance awareness, understanding, and wise use of estuarine environments. VIMS shall provide the Grantor and Grantee with an annual report on research, education and stewardship activities conducted at Sweet Hall Marsh and shall disseminate timely and accurate information to the Governor, General Assembly, State and local agencies, industry, and the citizens of the Commonwealth regarding the living and non-living resources of Sweet Hall Marsh and their relationship to the Chesapeake Bay system and the coastal waters of the Commonwealth of Virginia.

ARTICLE III: CONTROLLED ACTIVITIES

8. Wetland and Forest Maintenance – Wetlands shall be protected and maintained in accordance with the CBNERRVA Management Plan, Sweet Hall Marsh Natural Resources Management Plan and the Wetlands Guidelines developed pursuant to Chapter 2.1 of Title 62.1 of the Code of Virginia. Forest management activities shall be conducted in accordance with Best Management Practices promulgated by the Commonwealth of Virginia, Division of Forestry and recommended by the U.S. Department of Agriculture, Forest Service and Soil Conservation Service. There shall be no other destruction or alteration of wetlands on Sweet Hall Marsh, except as needed to eradicate noxious plant species, enhance native wetland communities, and as approved by the Grantor and Grantee. Management activities shall not materially impair the scenic quality of Sweet Hall Marsh.

9. Waterfowl and Wildlife Maintenance. Waterfowl and wildlife maintenance activities shall be conducted in accordance with the CBNERRVA Management Plan. In general, such activities shall be limited to maintenance of existing habitat and minor improvements, where necessary (such as tree thinning to improve understory vegetation, opening of small areas to provide a great diversity of habitats, raising and releasing of geese and ducks), and as approved by the Grantor and Grantee. Any waterfowl and wildlife management activities shall be carried out under the guidance of the Commonwealth of Virginia, Department of Game and Inland Fisheries and the U.S. Department of the Interior, Fish and Wildlife Service. Any plant and insect management activities that may affect species of plants or insects protected under the Virginia Endangered Plant and Insect Species Act shall be carried out under the guidance of the Virginia Department of Agriculture and Consumer Service.

10. Hunting and Fishing – The Grantor may pursue such hunting and fishing activities as it may elect as long as such activities are in compliance with applicable state or federal law.

11. Water Quality – There shall be no human activities on or uses of Sweet Hall Marsh that are detrimental or adverse to the maintenance and conservation of surface and subsurface water quality. There shall be no manipulation or alteration of natural water courses, shorelines, marshes or other water bodies, nor shall there be activities conducted on or around Sweet Hall Marsh or the Pamunkey River that could alter natural water level flow, salinity, or turbidity of Sweet Hall Marsh or the Pamunkey River, or both.

12. Structures, Roads, Trails and Plantings – There shall be no restrictions on the Grantor’s right to construct hunting blinds, nesting boxes or other structures, and plantings throughout the marsh. All Roads and significant trails will be restricted to the buffer region of Sweet Hall Marsh. All structures, roads, trails and plantings should be constructed in a manner to minimize damage to the natural resources of Sweet Hall Marsh. Structures constructed and utilized by the Grantee must be for research, education, stewardship and naturalistic purposes and approved by the Grantor. Similarly, the Grantor must approve removal of existing research, education, stewardship and naturalistic structures.

13. Signs and Billboards – Display of billboards, signs, or other advertisements is not permitted on or over Sweet Hall Marsh except to state the name and/or address of the owner, to provide notice of the designation as a component of CBNERRVA, to post the property as a No Wake Zone, and/or to post the property against the trespass.

14. Subdivision – Sweet Hall Marsh shall not be partitioned or subdivided during the life of this management agreement.

15. Excavation, Dredging, and Mining – Excavation, dredging, mining and removal of loam, gravel, soil, rock, sand, coal, petroleum, and other materials or alteration of the topography of the land is prohibited on the Sweet Hall Marsh except as

related to the collection of geological data. Such activities shall be planned for in the CBNERRVA Management Plan and approved by the Grantor and Grantee.

16. Industrial and Commercial Activities – No industrial or commercial activities shall be conducted at Sweet Hall Marsh

17. Trash, Rubbish, and Waste – Neither the Grantor or the Grantee shall authorize dumping of soil, trash, ashes, garbage, waste, or offensive materials on Sweet Hall Marsh or filling in of any wetland, pond, or waterway and such dumping shall be absolutely prohibited. Neither the Grantor or the Grantee shall not be responsible for unauthorized dumping.

18. Off Road Vehicles – Neither the Grantor or the Grantee shall authorize operation of motor vehicles, trail bikes or all-terrain vehicles within the core area of Sweet Hall Marsh (see Exhibit A for delineation of core and buffer regions).

ARTICLE IV. ENFORCEMENT AND REMEDIES

19. Injunctive Relief and Restoration – Upon any breach of the terms of this management agreement by the Grantor, its successors and assigns or the Grantee, its successors and assigns, the breaching party may be subject to suit to (1) enjoin any breach or enforce any covenant by temporary restraining order, preliminary and/or permanent injunction; (2) require that the property be restored promptly to the condition required by the management agreement; or (3) seek any other remedy available, in law or equity, to assure compliance with the terms of this management agreement.

20. Perpetual Right of Enforcement – Failure on the part of the Grantee to enforce any covenant or provision hereof shall not discharge or invalidate such covenant, or any other covenant, condition, or provision of a subsequent breach or default.

ARTICLE V. GRANTOR'S RIGHTS

21. Grantor's Rights – The Grantor expressly reserves to itself, its personal representatives, heirs, successors and assigns the right to:

- a) Continue the naturalistic uses of Sweet Hall Marsh under the terms and conditions set forth herein;
- b) Continue to hunt, fish, or trap on Sweet Hall Marsh and raise and release ducks and geese subject to applicable laws;
- c) Improve, repair, restore, alter, remove, remodel, or replace permitted structures and planting; and
- d) Continue the use of Sweet Hall Marsh for all purposes consistent with this Management Agreement.

ARTICLE VI. RIGHT OF GRANTEE

22. Rights of Grantee – To accomplish the purpose of this Management Agreement the following rights are conveyed to the Grantee by the Management Agreement:

- a) To preserve and protect the conservation values of the Sweet Hall Marsh.
- b) To enter upon the Sweet Hall Marsh at reasonable times in order to conduct approved research, education and stewardship activities and to monitor Grantor's compliance with and otherwise enforce the terms of this Management Agreement' provided that such entry shall be upon prior reasonable notice to Grantor, such entry shall be by water, and shall not unreasonably interfere with Grantor's use and quite enjoyment of the Sweet Hall Marsh; and further provided that any such entry during a period commencing two weeks prior to the migratory waterfowl seasons in the Commonwealth of Virginia shall be made only with prior notice to and consent fro the Grantor, which consent may be withheld in the grantor's sole discretion.
- c) To give permission to appropriate persons to conduct research, education and stewardship activities approved for the Sweet Hall Marsh component of CBNERRVA, provided that permittees carry and display an official permit issued by the Grantee and approved by the Grantor.
- d) To prevent any activities or use of the Sweet Hall Marsh that is inconsistent with the purposes of this Management Agreement and to require the restoration of such areas or features or the Sweet Hall Marsh that may be damaged by any inconsistent activity or use.

ARTICLE VII. GRANTOR'S AND GRANTEE'S LIABILITY

23. Upkeep by Grantor – The Grantor, its successors, and assigns further agrees that it shall be responsible for upkeep of Sweet Hall Marsh and shall hold the Grantee, its successors and assigns harmless from charges or liens arising out of upkeep or taxes.

24. Taxes – The Grantor agrees to pay any and all real property taxes and assessments levied by competent authority on the property.

25. Grantor's Liability – The Grantor, its successors, and assigns shall not be held responsible for injury to persons or damages to property arising out of any research or educational activity being conducted on Sweet Hall Marsh pursuant to the CBNERRVA Management Plan and this management agreement except those arising out of the negligence of the Grantor, its successors, and assigns. All persons participating in research, education or stewardship activities at Sweet Hall Marsh must sign a liability

release form indemnifying and holding harmless the Grantor, its officers, directors, agents, and guests, from any and all liability, claims, or expenses for injury, death, or damages to self or property, including without limitation attorney's fees, resulting from or arising out of or in anyway relating to the activities of the Grantee, any of its representatives, agents or guests, or resulting from, or occurring in the course of transit to or from Sweet Hall Marsh. A copy of the release form appears as Exhibit B.

The Grantee has inspected Sweet Hall Marsh and accepts its condition "as is". Any existing conditions or future conditions relating to permitted uses of Sweet Hall Marsh by the Grantor, including without limitation any hunting and fishing activities, shall not constitute conditions giving rise to a claim of negligence on the part of the Grantor or to any potential liability for damage to property or injury to person. The Grantor's liability for all other activities on Sweet Hall Marsh shall remain in effect.

26. Grantors' Liability – The Commonwealth of Virginia and all its agencies and institutions are covered by a self-insurance program as authorized by Section 2.1-526.8 of the Code of Virginia which is based upon a comprehensive general liability manuscript policy form as shown in Exhibit C. All persons who are not employees of the Commonwealth must receive approval from the Grantor and furnish evidence of liability coverage in the amount of \$100,000/\$300,000/\$100,000 before participating in research, education and stewardship activities at Sweet Hall Marsh. All persons, whether employees of the Commonwealth or not, shall sign a liability release form reference in paragraph 25 and appearing in Exhibit B.

ARTICLE VIII. PUBLIC ACCESS

27. Public Access – The granting of this Management Agreement does not grant to the public any right to enter the property. The Grantor reserves the right to place a gate or chain with a lock across any and all roads leading into Sweet Hall Marsh. If a lock is employed, a key will be made available to the Grantee to use for authorized purposes by authorized personnel only in accordance with the Management Plan and the terms of this agreement. The Grantee's right of entry permits use of the Grantor's pier for water quality sampling and other activities approved by the Grantor, but does not include access to the interior of buildings or structures. All other protection against trespass by the public shall remain in effect.

ARTICLE IX. MISCELLANEOUS

28. Transfer and Reversion – The Grantor agrees to send in writing to the Grantee the names and addresses of any party to who Sweet Hall Marsh is to be transferred at the time said transfer is executed. The Grantee agrees to hold this Management Agreement exclusively for conservation purposes, and that it will not transfer the management agreement in exchange for money, other property, or services. This provision shall not preclude the Grantee from using the monetary value of any donations or gifts from the Grantor as match for money, other property, or services that will contribute to fulfilling the objectives of the management Plan or the terms of this agreement.

The Grantee may assign its rights under this Management Agreement to VIMS in such manner as to achieve the purposes and conditions herein. If any such assignee shall cease to exist or abandon this Management Agreement or the rights and duties of enforcement herein set force, or if proceedings are instituted for condemnation of this Management Agreement, the Management Agreement and rights of enforcement shall revert to the Grantee. If the Grantee shall be dissolved and if the terms of the dissolution fail to provide a successor, then the court shall appoint an appropriate successor as Grantee.

29. Termination – In the event that circumstances arise that cause Sweet Hall Marsh to be withdrawn from the CBNERRVA, cause the CBNERRVA to cease to exist, or cause the Grantee to not have sufficient funds to conduct activities under the CBNERRVA, this management agreement shall be terminated by the Grantee by providing 90 days written notice to the Grantor. If either party breaches the terms and conditions of this management agreement, the other party may terminate this management agreement with 90 days written notice.

30. Notification – The Grantor agrees to notify the Grantee, in writing, before exercising any reserved right the exercise of which may have an adverse impact on the conservation interests associated with Sweet Hall Marsh. Any notices by the Grantor to the Grantee pursuant to any provision hereof shall be sent by registered or certified mail, return receipt requested, addressed to Coleman Wortham, III, Davenport & Company, LLC, 901 East Cary Street, Richmond, Virginia 23219, with copies to F. Scott Reed, Dominion Environmental Services, 5000 Dominion Blvd., Glen Allen, VA 23060 and Philip W. Reed, Virginia Outdoor Foundation, James Monroe Building, 101 N. 14th St., 17th Floor, Richmond, VA 23219.

IN WITNESS WHEREOF, the Grantor and Grantee have hereunto set their hands and seals the day and year above written.

Grantor:

Tacoma Hunting + Fishing (SEAL)

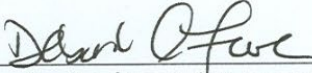
by Colman Wortham, III (SEAL)
President

ACCEPTED BY
AS GRANTEE

John S. Wells 11/1/07 (SEAL)

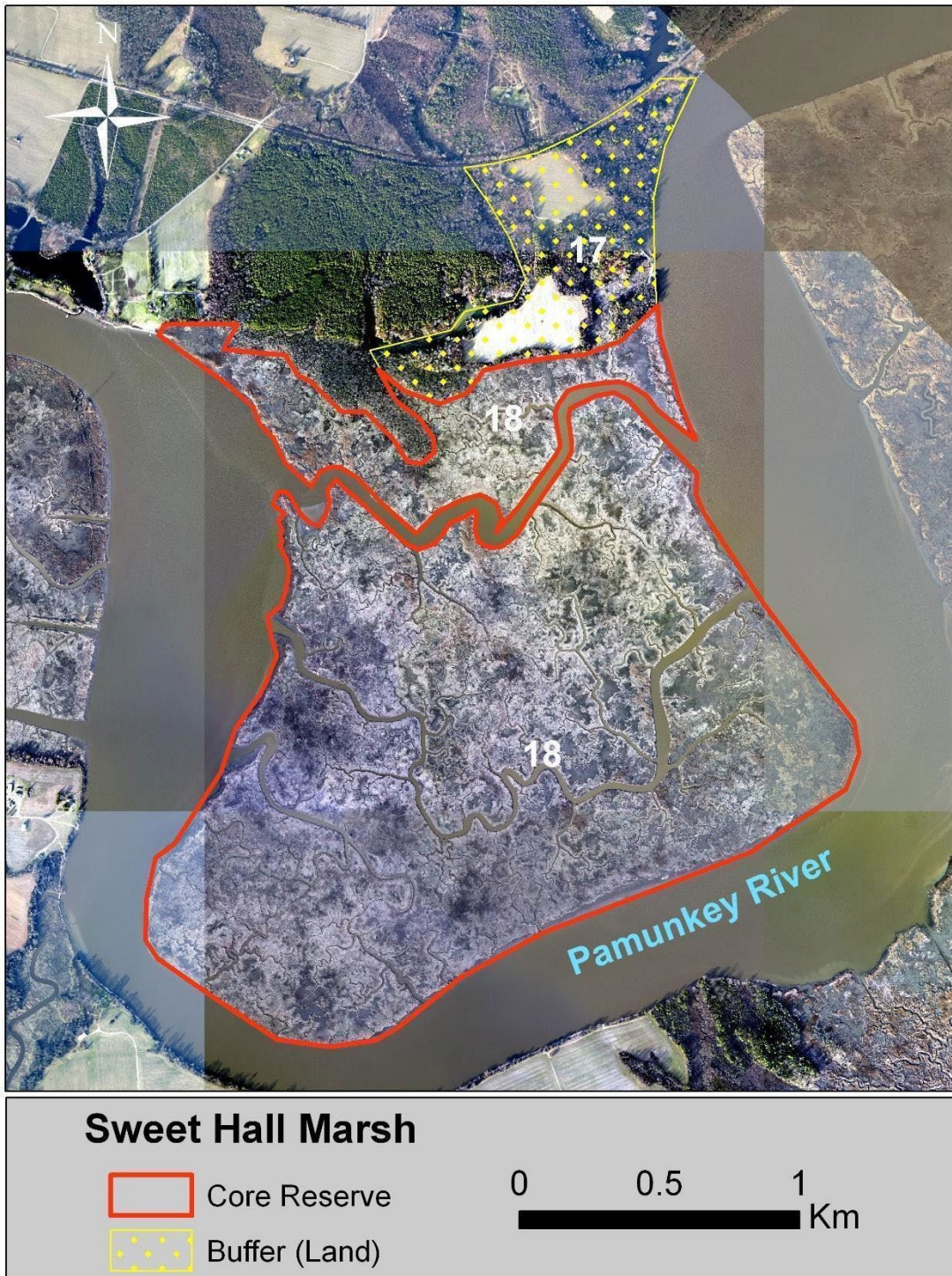
_____ (SEAL)

APPROVED AS TO FORM:



Senior Assistant Attorney General for the
Attorney General of Virginia

Exhibit A. Map of property highlighting boundary of agreement.





Office of Sponsored Programs

CERTIFICATE OF LIABILITY COVERAGE

Administered by
Commonwealth of Virginia
Department of the Treasury
Division of Risk Management
PO Box 1879
Richmond, VA 23218-1879

ISSUED TO: Tacoma Hunting and Fishing Club
and all interested parties

AUTHORITY: § 2.2-1837, Code of Virginia and the Commonwealth of Virginia Risk Management Plan

COVERAGE PERIOD: Continuous, effective November 1, 2021

PURPOSE: Verification of liability coverage for activities of the **Virginia Institute of Marine Science**, its employees, and authorized agents as it relates to all business of the Institute.

COVERAGE: Tort Liability, including Medical Malpractice and Automobile Liability

LIMITS: \$100,000 for tort claims against the Commonwealth; \$2,000,000 for tort claims against persons; and up to \$2,000,000 for medical malpractice claims against health care providers (as set forth in §8.01-581.1 *et seq.*, Code of Virginia)

This document is for information only. It does not alter any provisions of the Code of Virginia or the Commonwealth of Virginia Risk Management Plan.

VERIFIED BY:


Signature


Signature

Name: Connie Motley
Title: Director of Sponsored Programs
Date: 11/04/2021

Name: Carol K. Tomlinson
Title: VIMS Risk Manager
Date: 11/04/2021

1375 Greate Road, Gloucester Point, Virginia 23062-2026
(804) 684-7029 FAX (804) 684-7614

Exhibit C. Certificate of Insurance.



Virginia Institute of Marine Science
School of Marine Science

CERTIFICATE OF COVERAGE

ISSUED TO: **Tacoma Hunting and Fishing Club**

INSURER: COMMONWEALTH OF VIRGINIA

AUTHORIZATION: Risk Management Plan and the Code of Virginia, §2.2-1837 and §2.2-1840

COVERAGE PERIOD: Period of contract

PURPOSE: Verification of insurance coverage for activities of its employees and authorized agents.

COVERAGES: Tort Liability, including Medical Malpractice and Automobile. This covers liability and physical damage for use of rental/leased vehicles used on official business.

LIMITS: \$2,000,000 - Tort claims against persons \$100,000 - Tort claims against the Commonwealth \$1,650,000 - Medical Incident per occurrence - Effective 7/1/02 \$1,600,000 - Medical Incident per occurrence - Effective 7/1/01 ACV - Non owned (hired, rented/leased) vehicles

ADMINISTRATOR: Division of Risk Management
P.O. Box 1879 Richmond, VA 23218-1879

This is for information only. It does not alter any provisions of the Risk Management Plan nor the Code of Virginia.

VERIFIED BY:

State Official's Name: Jane A. Lopez
Title: Director, Sponsored Programs

Date: 8/16/07

Appendix G. Coastal Training Program topic crosswalk.

Note (i) and italics indicate potential programming in exploration at time of publication.

Priority Issue	Topics	Professional Development and Knowledge Exchange: Thematic Trainings, Workshops and Summits	Initiatives	Grants	Conferences	Workgroups	Target Audiences and Partners
		Capacity Building	Community Engagement			Technical Assistance	
		Capacity Building	Capacity Building			Community Engagement	
Climate Change and Coastal Resilience	<ul style="list-style-type: none"> •Managed Retreat communications •community engagement •decision-making •Agricultural challenges 	<ul style="list-style-type: none"> •SET 101 •Equitable Negotiation for Strategic Relocation •Restoration Workshop •VA Master Plan: (i) •Resilience Project Implementation •Community Engagement •Financing •BRIC/DCR CFPF (i) 	<ul style="list-style-type: none"> •Managed Retreat Summit (i) •MidA: Peer-to-Peer Dialogues and Diaries (i) •Community-based environmental monitoring (i) 	<ul style="list-style-type: none"> •Land Use Trade-Offs – Coastal Farming Challenges •CZM: Restoration •SE RISA •NSF CoPe 2019 (i) •NOAA Adsci 2020 (i) •NSF CoPe more CFC (i) 	<ul style="list-style-type: none"> •SFAA •At What Point Managed Retreat Workshop 	<ul style="list-style-type: none"> •YRSCBR (NHRSC) •HR Climate Resilience •Wetlands Watch Adaptive Land Management and Community Engagement •Coastal Policy Team •17 Rooms •Climigration Network Communications Workgroup 	<p>Target Audiences:</p> <ul style="list-style-type: none"> •Federal, state, tribal, regional, local agency staff and elected officials •Non-profits •Business enterprises and organizations •Civic, user and interest groups <p>Partners:</p> <ul style="list-style-type: none"> •VCPC •IEN •GMU •MidA CTPs •CZMP •NOAA CBO •Climigration Ntwk
Water Quality and Watershed Management	<ul style="list-style-type: none"> •Applied (CBNERR-VA) science/research •HABs •Agricultural intersection (esp. as related to SLR - draining and sediments, e.g.) (i) 	<ul style="list-style-type: none"> •Digital Tools •HABs (DOH x comms x sci) (i) 	<ul style="list-style-type: none"> •YRSCBR: Strategic Plan and Cornerstones •Symposium (also in Comms/Mgmt) •MidA 5 senses •Chesapeake Monitoring Coop: <ul style="list-style-type: none"> •Tribal initiative (i) •Qualitative input/TEK (i) •Future of WQ monitoring summit (i) •Tri-water river partnership/summit (i) 	<ul style="list-style-type: none"> •DEQ: YRSCBR •NERR/NFWF: State of the York (also in Comms/Mgmt) 	<ul style="list-style-type: none"> •VA WQMC Conference 	<ul style="list-style-type: none"> •YRSCBR •Ed and Outreach •Science •Business •NHR •Virginia WMC •HR WQ Technical Committee •SAV NERRS 	<p>Target Audiences:</p> <ul style="list-style-type: none"> •Federal, state, tribal, regional, local agency staff and elected officials •Non-profits •Academics •Business enterprises and organizations •Civic, user and interest groups <p>Partners:</p> <ul style="list-style-type: none"> •Roundtable members •GreenFin •VIMS •DEQ •NOAA CBO
Coastal Community Development and Land Use Planning	<ul style="list-style-type: none"> •Ecosystem Services •Responsible Recreation •Triple Bottom Lines •Resilient Development 	<ul style="list-style-type: none"> •Framework for Ecosystem Services •Wetland Delineation •Perennial Stream Determination •Planning Effective Projects (also in Comms/Mgmt) •Social Science Basics (also in Comms/Mgmt) •CBLP in Spanish (i) •Ecosystem Valuation (i) •What is social vulnerability – how measure, what mean for SLR (i) (also in CC&CR) •Floodplain property best practices (for buyers and sellers) (i) (also in CC&CR) 	<ul style="list-style-type: none"> •Ecosystem Valuation think/link tank (i) 	<ul style="list-style-type: none"> •NOAA: Ecosystem Benefits 	<ul style="list-style-type: none"> •Social Coast •Balancing Nature and Commerce 	<ul style="list-style-type: none"> •MPPDC •HRPDC, and workgroups 	<p>Target Audiences:</p> <ul style="list-style-type: none"> •Federal, state, tribal, regional, local agency staff and elected officials •Non-profits •Academics •Contractors and consultants •Civic, user and interest groups <p>Partners:</p> <ul style="list-style-type: none"> •MPPDC •HRPDC •GWRC •PlanRVA •Del Convriss-Fowler •CCRM •DCR SWCD; LWCF

		•Conflict mgmt (also in comms and mgmt)					
Communications and Management	<ul style="list-style-type: none"> •Effective mgmt •Internal (CBNERR-VA) capacity •Effective science communications •Managed Retreat (comms) •Behavior Change •Conflict mgmt (also in comm dev and land use planning) (i) 	<ul style="list-style-type: none"> •Planning Effective Virtual Meetings •Dealing with Disruptive Behaviors •TCS: Virtual Engagement •Tribal Engagement 101 with localities (i) •Research Communications: (i) <ul style="list-style-type: none"> •Storycollider •Presentation and delivery •Grant writing and funding for tribes (i) •Conflict mgmt 	<ul style="list-style-type: none"> •YRSCBR: Strategic Plan, Cornerstones, roundups •Symposium (also in WQ) •CBNERR: <ul style="list-style-type: none"> •Comms plan •Brand refresh •BP/website/editorial calendar wkgrps •Show and share •Mindmelds •Staff meetings •CBNERR-VA video •Indigenous Peoples in NERRS mgmt. (Hollings) •Covid on the Coast •Office Hours (i) – for comms, engagement, grant support, editing (CPT focus) •Identifying spheres of influence for messaging (i) – share network with VA Master Plan 	•NERR/NFWF: State of the York (also in WQ)	•CHOW	<ul style="list-style-type: none"> •VIMS Outreach •NERRS and CTP DEIJ •CBP DEIJ •NERRS Strategic Planning •NERRS MAD 	<p>Target Audiences:</p> <ul style="list-style-type: none"> •Federal, state, tribal, regional, local agency staff and elected officials •Academics <p>Partners:</p> <ul style="list-style-type: none"> •IEN •Upper Mattaponi •GreenFin

Appendix H. Federal and State laws applicable to natural resource management and protection.

Legislation	Citation	Responsible Agency
Presidential Order on Introduction of Exotic Species	Executive Order #11987	Office of the President
U.S. Noxious Weed Law	7 USC 2802-2814	U.S. Department of Agriculture
U.S. Clean Water Act	33 USC 1344	U.S. Army Corps of Engineers, U.S. Environmental Protection Agency
U.S. Anadromous Fish Conservation	16 USC 757a-757g	National Marine Fisheries Service
U.S. Clean Air Act	42 USC 7401-7671q	U.S. Environmental Protection Agency
National Environmental Policy Act	42 USC 4321-4307d	All Federal agencies
Lacey Act (exotics)	18 USC 42	U.S. Department of Interior
U.S. Endangered Species Act	16 USC 1531-1544	U.S. Fish and Wildlife Service, National Marine Fisheries Service
U.S. Fish and Wildlife Coordination Act	16 USC 661-668s	Numerous
U.S. Migratory Bird Treaty Act	16 USC 701-712	U.S. Fish and Wildlife Service
U.S. Aquatic Nuisance Prevention and Control Act	16 USC 4701-4751	U.S. Fish and Wildlife Service, National Marine Fisheries Service
Virginia Commercial Fishing Law / Recreational Fishing Law	VA Code 28.2-100-1001	Virginia Marine Resources Commission
Virginia Wetlands Act	VA Code 28.2-1300-1320	Virginia Marine Resources Commission
Virginia Historic Resources Law	VA Code 10.1-2200-2216	Virginia Department of Historic Resources
Virginia Antiquities Act	VA Code 10.1-2300-2306	Virginia Department of Historic Resources
Virginia Endangered Species Act	VA Code 29.1-563-570	Virginia Department of Game and Inland Fisheries
Virginia Fish and Wildlife Law	VA Code 29.1-100 et seq.	Virginia Department of Game and Inland Fisheries
Virginia Endangered Plant and Insect Species Act	VA Code 3.1-1020-1030	Virginia Department of Agriculture and Consumer Services

Virginia Noxious Weed Law	VA Code 3.1-296.11-296.21	Virginia Department of Agriculture and Consumer Services
Virginia Chesapeake Bay Preservation Act	VA Code 10.1-2100-2115	Virginia Department of Conservation and Recreation
Virginia Water Quality Improvement Act of 1997	VA Code 10.1-2118-2128.B.	Virginia Department of Conservation and Recreation
Virginia Water Control Law	VA Code 62.1-44.2-44.34	Virginia Department of Environmental Quality
Virginia Ground Water Management Act	VA Code 62.1-44.84-44.104	Virginia Department of Environmental Quality
Virginia Environmental Quality Act	VA Code 10.1-1200-1221	Virginia Department of Environmental Quality
Virginia Waste Management Act	VA Code 10.1-1400-1457	Virginia Department of Environmental Quality
Virginia Open Space Land Act	VA Code 10.1-1700-1705	Virginia Outdoor Foundation
Virginia Erosion and Sediment Act	VA Code 10.1-560-571	Virginia Department of Conservation and Recreation
Virginia National Area Preserves Act	VA Code 10.1-202-217	Virginia Department of Conservation and Recreation
Virginia Conservation Easement Act	VA Code 10.1-1009-1016	Virginia Department of Conservation and Recreation

Appendix I. Reserve Natural Area Management Guidelines

These management 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 CBNERR-VA natural areas. The primary and overriding objective of natural areas stewardship is to provide for the continued presence of the diverse habitats and associated flora and fauna found within the boundaries of CBNERR-VA. Reserve natural area management guidelines were adapted from the natural area preserve management guidelines developed by the VDCR, Division of Natural Heritage (VDCR 2000a).

PUBLIC USE

Reserve natural areas are acquired and managed primarily to perpetuate the long-term quality, condition, and viability of natural resources contained or supported within their boundaries. Some Reserve natural areas can be managed to meet this objective while at the same time accommodating some level of public use. Compatible and appropriate types of uses for each Reserve natural area are identified through the management planning process. Visitor use is monitored and data is used for refining public use and visitor access objectives. Some Reserve natural areas contain extremely fragile habitats and species that are damaged by even low levels of visitation, whereas others are more resilient and may be capable of sustaining higher levels of public use. Some Reserve natural areas may be closed seasonally but open for visitor use at specific times of year. At others, visitation may be restricted to specific areas, such as along a designated trail or boardwalk.

Public use of Reserve natural areas can conflict with Memorandum of Understandings with private property owners and with the primary natural resource management and protection objectives mandated by NERRS designation. The term “public use” as used here includes such activities as hiking, camping, biking, fishing, hunting, swimming, and unpermitted research and education activities. It is a plain fact that human visitors often harm or threaten population viability of rare plants and animals, as well as their often-fragile habitats. The degree of damage depends on the frequency, intensity, and location of visitor activity. Some level of public use may be considered as appropriate if the characteristics of visitation and use are compatible with the resource protection priority and if such use does not threaten or degrade occurrences of natural resources. Additionally, with the scarcity of funds to support natural areas management, costs to monitor and manage public use cannot be excessive.

Guidelines relating to specific types of public uses in the context of Reserve natural areas management follow. These are organized into three use categories, based on their appropriateness under normal circumstances and management situations.

Category 1: Normally Appropriate Uses

- *Wildlife-watching, wildflower and native plant observation, photography.* These non-consumptive uses by the public are often compatible with natural areas management. At some sites, trails or observation platforms may be beneficial for managing impacts of large groups or increased numbers of visitors participating in these activities. Visitation may, in some cases, need to be limited to specific seasons. Such is the case with natural areas supporting populations of colonial nesting birds, so that nesting success is not decreased as a result of the presence of humans.
- *Hiking.* Trails and vestiges of old roads nearly always exist as a result of land use prior to the establishment of a Reserve natural area. Such trails may or may not be appropriate for public use by hikers, depending on factors such as proximity to occurrences of natural resources, active erosion, wetland crossings, and other terrain features. New trails, if they are to be constructed, should be carefully located and maintained. All proposals for new trails in a Reserve natural area, whether for recreation, research, or education, will be reviewed by CBNERR-VA and other land managing entities.

- *Research and Monitoring.* Proposals for research funding support on natural area reserves will be reviewed on an individual basis. Studies to be conducted within Reserve boundaries will require prior submission of a research permit application, review and approval by CBNERR-VA staff, and issuance of a written permit. Research methods will be used that minimize adverse effects on natural resources and physical features at the Reserve component. At project conclusion, researchers will be required to remove evidence of their work such as residue from destructive sampling techniques (clipped plots), temporary shelters for instrumentation, plastic flagging, and visual plot locators such as stakes, wire flags, or sampling station monuments. Researchers are also required to submit a final report of their findings.

- *Teaching and Interpretation.* The use of Reserve natural areas for educational programs is highly appropriate. Natural areas present an opportunity to observe many forms of life as well as the natural processes that maintain them. Reserve natural areas are also ideal locations for introducing students to the concept and value of biodiversity and for educating people of all ages of the need for broad and comprehensive approaches to natural resource management. As with other public uses of natural areas, teaching and interpretation activities must be managed to prevent adverse impacts on natural heritage resources. CBNERR-VA staff or appropriate persons should accompany all group field trips to Reserve natural areas.

Category 2: Conditionally Appropriate Uses

- *Fishing, picnicking, canoeing.* Whether or not these activities constitute appropriate public uses depends on (1) the site-specific characteristics of a particular natural area and (2) the observed consequences of such uses. For example, circumstances may allow low numbers of fishermen to use a beach that supports rare beach nesting birds and animals. In some natural areas, however, there is clear justification for prohibiting these uses because they are known or expected to cause negative impacts to rare and/or sensitive species. In all cases, where allowed, the effects of such uses will be monitored. If negative impacts to natural resources are observed, the causative public use(s) will be discontinued.

- *Swimming.* Swimming is not an authorized activity on Reserve natural areas, due primarily to the issue of public safety. With no lifeguards or patrols in place on public beaches or waterways, responsible landowning public agencies cannot officially sanction swimming. Rather, in nearly all cases, they must prohibit or actively discourage it. On privately-owned Reserve properties, decisions to allow swimming or to prohibit it are the responsibility of the landowner. In cases where beach uses such as sunbathing and beach-walking result in direct damage to fragile beach and dune habitats that support rare species, such impacts will be documented and the specific causative use(s) discontinued.

- *Hunting.* As with fishing, hunting is not necessarily incompatible with natural area management. Hunting may be both compatible and necessary for the purpose of controlling populations of animals that need to be limited. However, hunting is an activity that can and often does result in conflicts between user groups. For example, public use by wildlife watchers who visit a natural area to view migratory waterfowl is not compatible with concurrent waterfowl hunting. Likewise, use of a reserve by nature photographers or educators would not be a compatible use during periods when hunting activities were taking place. In most instances, hunting on Reserve natural areas will be limited temporally and conducted specifically to allow for traditional use within Reserve boundaries or to meet the management objective of controlling animal populations that, if left unchecked, present a threat to natural heritage resources on site. On privately-owned Reserve properties, decisions to allow hunting or to prohibit it are the responsibility of the landowner.

Category 3: Incompatible and Inappropriate Uses

- *Camping.* Camping activities inevitably result in repeated localized intensive use and long-term degraded site effects. Even low-intensity camping styles cause some adverse impacts. Therefore, with the exception of identified areas specifically designated for camping within the York River State Park, which contains the Taskinas Creek component of the Reserve, camping is considered incompatible with the objectives of the Reserve and is prohibited.
- *Bicycles.* Mountain biking has become a popular outdoor activity that exerts increasing pressure on sensitive natural areas and soils with a high erosion potential. Except for accessing established parking areas and public access points designed for automobiles, use of bicycles in Reserve natural areas is prohibited. Mountain bike trails are available within specific portions of York River State Park that do not encompass the Taskinas Creek component of the Reserve.
- *Horseback riding.* As with bicycles, frequent horseback riding within an area results in negative impacts to soils and vegetation. Additionally, the introduction of invasive weeds from both manure and hoof-borne vectors is a documented negative aspect of horseback riding in managed natural resource areas. Therefore, horseback riding in Reserve natural areas is prohibited. Horseback riding trails are available within specific portions of York River State Park that do not encompass the Taskinas Creek component of the Reserve.
- *Off-road vehicles.* Motorized all-terrain-vehicles including SUVs, “four-wheelers,” and dirt bikes are prohibited within Reserve natural areas. These uses degrade trails and cause severe erosion requiring expensive repairs. Noise pollution from vehicle engines reduces the quality of the outdoor experience for other authorized user groups and constitutes harassment to wildlife. The use of such motorized vehicles is perhaps the most incompatible of all public use categories in natural areas.
- *Unleashed pets.* Visitors are not prohibited from bringing pets with them when visiting Reserve natural areas. However, by regulation, pets must at all times remain under leash restraint while on CBNERR-VA and VDCR-owned lands. Free-roaming dogs pose a particular threat to natural heritage resources and to various species of wildlife. For these reasons, all dogs or other domestic animals accompanying visitors to Reserve natural areas must be kept on leash at all times.
- *Collection of plants, animals, minerals, or artifacts.* In order to protect occurrences of rare species, the collection and removal of plant material, animals, minerals (rocks), or artifacts is prohibited. For legitimate research and education purposes, collection of specimens may be approved by CBNERR-VA following submission and review of a Reserve research permit. In addition to the CBNERR-VA research permit, a VDCR/Natural Heritage permit is required for research and the collection of plants, animals, minerals and/or artifacts at the Taskinas Creek component of the Reserve whose boundaries are within York River State Park.

SITE OPERATIONS MANAGEMENT

Roads and Facilities

- *Roads.* Several areas of the Reserve have existing roads from previous land uses. Building new roads is nearly always inappropriate in Reserve natural areas and seldom is there sufficient justification to do so. Even roads outside of the Reserve, especially along boundaries, may adversely affect resources within the Reserve natural areas due to impacts such as introduction of invasive species, noise pollution, and alteration of local hydrology. Existing interior roads, skid trails, or historic traces will be mapped and described. Roads within natural areas of the Reserve may be considered for closure or obliteration if they have no specific utility or function.

- *Rights-of-way.* Utility corridors such as powerline rights-of-way can and do exist in natural areas. Siting of new corridors within Reserve boundaries is highly inappropriate and should be prevented by Reserve Deed of Dedication language. All non-CBNERR-VA entities (rights-of-way maintenance contractors, utilities, municipalities, etc.) should be informed of the sensitivity and importance of natural resources in the Reserve. Frequency and methods for rights-of-way maintenance will be used that have the fewest negative effects on natural resources. Such coordination will decrease adverse impacts to rare species and increase CBNERR-VA inclusion in planning for expansion or improvement to utility corridors near or within natural area preserves.
- *Access Points.* Public access facilities and points of entry to Reserve natural areas will be designed so as to meet the primary objective of protecting natural resources. Access designs will first and foremost function to restrict or direct visitor activity in ways that protect fragile habitats. Determining and mapping the location of sensitive areas within the preserve is essential so that threats can be abated and vulnerable resources protected.
- *Facilities and Infrastructure.* Guard rails, signs, fences, gates, trail steps, and other devices or measures may be installed as necessary for site security and visitor safety. Potentially dangerous conditions such as dead trees, branches, abandoned wells or pits, and similar hazards on trails or in authorized public use areas may be removed, cleared, filled in, or otherwise remedied. Evidence of past human use such as fences, fence rows, culverts, trash dumps, and abandoned vehicles or structures (having no historic or scientific value) may be removed from Reserve properties.

BIOLOGICAL RESOURCE MANAGEMENT

- *Restoration of Natural Hydrology.* Hydrologic conditions altered by human activities such as drainage or fill placement may be restored, as appropriate, to create soil moisture regimes necessary for the benefit and enhancement of natural community and rare species occurrences. Stewardship actions that affect hydrology will be conducted for the purpose of meeting Reserve habitat maintenance and restoration objectives. Specific actions will be described in Reserve Component Specific Management Plans and be in accordance with local, state, and federal laws and regulations.
- *Erosion Control and Conservation Plantings.* Control of erosion in Reserve natural areas of the reserve that result from human disturbance may be accomplished through conservation plantings or by other means in order to meet Reserve resource stewardship goals, to protect water quality, and to abate man-induced soil loss arising from previous land surface alterations. Species native to Virginia (and if possible, native to the specific region) will be used for conservation plantings to achieve soil stabilization. Erosion problems on adjacent or nearby lands that impinge on Reserve stewardship issues may be addressed in cooperation with CBNERR-VA and the landowner. Erosion mitigation plans will be developed as needed in cooperation with appropriate agencies, parties, and stakeholders.
- *Invasive Species Control.* Measures to control invasive plants and animals will be taken using accepted methods consistent with objectives stated in Reserve Component Specific Management Plans. The term “control of invasive species” may in some cases include the control of plant succession, even if targeted plants are native to Virginia. Actions recommended for the control of any plant or animal species, noxious or otherwise, will be described in Reserve Component Specific Management Plans.
- *Insect and Disease Control.* Insect or disease control programs will be undertaken only if the infestation or outbreak threatens adjacent natural areas, will drastically alter natural ecological

processes within the Reserve natural area or cause adverse economic impacts on adjacent property, or constitutes a public health emergency provided that such control programs are approved by CBNERR-VA and other managing entities or are provided for by law.

- *Pesticide Use.* The use of certain pesticides is one means by which Reserve stewards may accomplish specific management objectives. Reserve Component Specific Management Plans describe those situations under which pest management, such as invasive plant control programs, will be undertaken. Pesticide use in the context of natural area stewardship is mostly limited to herbicide applications for controlling invasions of exotic vegetation that threaten on-site occurrence of rare species or natural communities or weedy growth in public access facilities such as parking areas. Other use of pesticides should be made only with project review and approval by CBNERR-VA, other managing entities and appropriate property owners.
- *Forest Harvesting and Silviculture.* Objectives of Reserve management do not include production of a continuous supply of forest products or income streams. Many silvicultural practices such as chemical and/or mechanical site preparation, fertilization, drainage, and plantation establishment are, in most instances, not compatible with protection and stewardship goals on natural areas as they can conflict with the goal of maintaining and enhancing natural plant communities and rare species habitats. Nevertheless, actions such as cutting, deadening, or removing trees are not necessarily incompatible with natural areas management. Some silvicultural activities may be appropriate tools for Reserve natural area management, but only when the objective is improvement or creation of habitat conditions for a targeted natural community and/or species of concern.
- *Traditional Wildlife and Fisheries Management.* Reserve natural areas are not purchased or managed for the objective of providing fishing, hunting, or trapping opportunities for the general public. It is therefore inappropriate to take management actions on Reserves with the specific intent of improving consumptive recreation opportunities. However, certain types of hunting, fishing, or trapping activities may, at times, be considered compatible with Reserve stewardship goals. For example, hunting may occur on some Reserves natural areas under circumstances such as retained rights, conditions of transfer, traditional use, or to meet population reduction objectives. Hunting, fishing, and trapping activities for the purpose of protecting or enhancing specific natural resources will be described in Reserve Component Specific Management Plans.

ARCHEOLOGICAL & HISTORIC RESOURCES

Archeological and historic resources on Reserve natural areas will be protected. Inventories for archeological and historic resources will be conducted and recommendations for conservation will be included in Reserve Component Specific Management Plans. Resources may be considered for interpretive and/or research value as identified and prescribed in the Plan. The collection of artifacts will be discouraged and only permitted for justified research studies approved by CBNERR-VA, the Department of Historic Resources and the VDCR (Taskinas Creek component).

Eligible historic structures will be surveyed and nominated for placement on the Virginia Landmarks Register. Archeological research may vary, from recordation surveys where no collection or excavation is performed, to intensive excavations usually focused in a confined area. Consequently, compatibility of archaeological research and natural area preserve stewardship may vary and each proposed action should be assessed on an individual basis. Certain resources are protected by established statutes, regulations, and guidelines. Activities which would in some way affect significant historic resources may require review and/or permitting by the Department of Historic Resources.

MINERALS

Mineral exploration and extraction are incompatible and inappropriate uses on Reserve natural areas, and are prohibited in all cases. Soil disturbance, especially at the scale necessary to remove mineral resources, is clearly at odds to the purposes and objectives of Reserve natural area establishment and stewardship. Simply stated, dedicated Reserve natural areas will have no mineral exploration or exploitation. Collection of any surface mineral specimens for research or educational purposes requires the prior issuance of a research and collection permit by CBNERR-VA and the VDCR (Taskinas Creek component).

Appendix J. Public comments received during Federal Register public comment period.

Reserve Management Plan Public Comments

Development of the Chesapeake Bay-Virginia National Estuarine Research Reserve management plan occurred over six years and included direct input from all Reserve staff members, the Virginia Institute of Marine Science, as well as the National Oceanic and Atmospheric Administration's Office for Coastal Management and Chesapeake Bay Office. Input from land managing partners was obtained via revisions to existing Memoranda of Understanding. Additional input was obtained from diverse reserve stakeholders throughout the drafting process via regular interactions and communication with members of the York River and Small Coastal Basin Roundtable. This includes:

- Federal agencies (e.g., Environmental Protection Agency, United States Geological Survey)
- State government (e.g. Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation)
- Tribal government (e.g. Upper Mattaponi Tribe)
- Regional and local governments (e.g. regional planning district commission and soil and water conservation districts)
- Nonprofit organizations (e.g. Chesapeake Bay Foundation)
- Industry & civic groups (e.g., Lake Anna Civic Association)

NOAA's Office for Coastal Management reviews and approves the plan after ensuring sufficient opportunity for comment by the public, per 15 Code of Federal Regulations 921.33. NOAA published a notice announcing the availability of the draft plan for a 30-day public comment period in the Federal Register on March 1, 2022. The comment period ended on March 31, 2022.

After the required 30-day public comment period, only one public comment was received, a statement during interagency review that the United States Geological Survey (USGS) has no comment at this time. Thank you. Therefore, no substantive revisions to the document were necessary. Specific comments received on the plan are noted below in bold and are followed by a description of how the reserve addressed the comment.

Comment 1: The USGS has no comment at this time.

Reserve response: No response required.