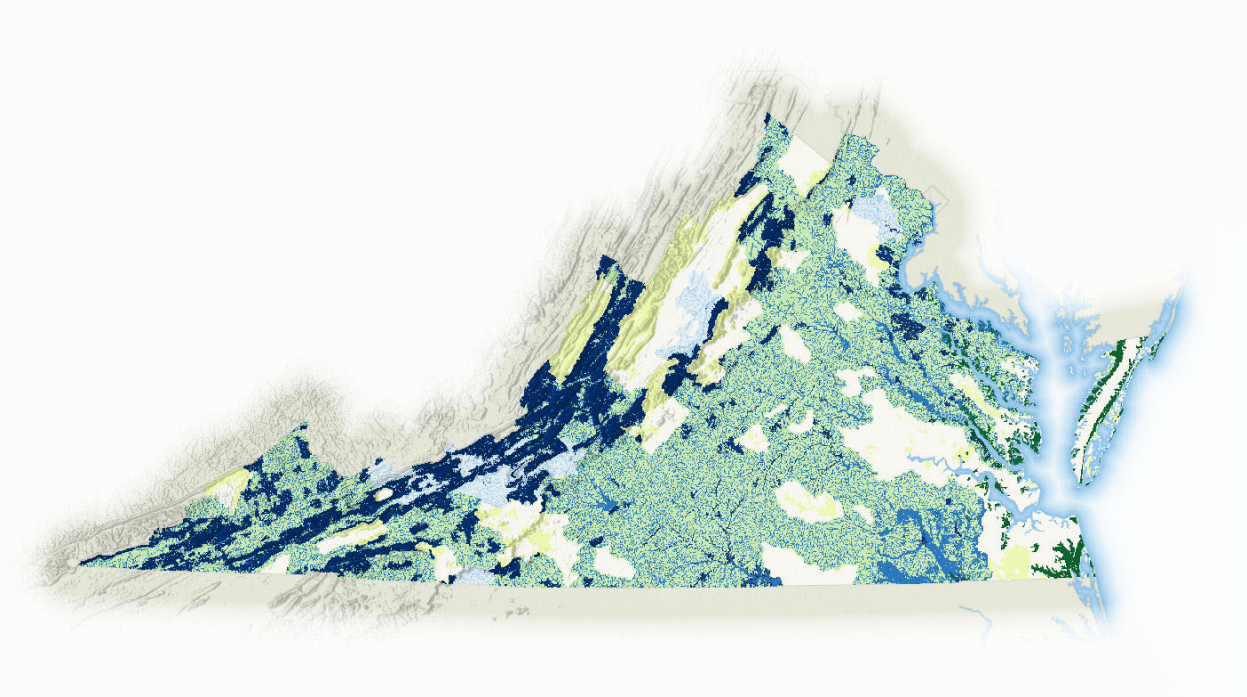
THE NATURE CONSERVANCY'S WATERSHED APPROACH TO COMPENSATION PLANNING

FOR THE VIRGINIA AQUATIC RESOURCES TRUST FUND



The Nature Conservancy

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Table of Contents

EXECUTIVE SUMMARY

The Virginia Aquatic Resources Trust Fund (VARTF) is an in-lieu fee (ILF) compensatory mitigation program that operates state-wide in Virginia with a strong history of success. The VARTF program is administered in partnership by The Nature Conservancy (TNC), the Norfolk District United States Army Corps of Engineers (Corps) and the Virginia Department of Environmental Quality (DEQ). VARTF provides a third-party mitigation option for permit applicants to address compensatory mitigation requirements associated with the Clean Water Act Section 404 and 401 and Virginia Water Protection permits issued by the Corps and DEQ, respectively. Through a variety of compensatory mitigation activities, VARTF restores, creates, enhances and preserves wetlands, streams and associated upland resources throughout Virginia. VARTF is recognized as a national model of in-lieu fee mitigation programs, and continually exceeds no net loss standards and other regulatory requirements for mitigating impacts to wetlands and streams. By utilizing TNC's science and conservation planning, VARTF protects and restores high-quality, resilient aquatic and terrestrial habitats that support rare species, sensitive communities, and ecological integrity.

As required by federal rule, VARTF must have a Program Instrument, approved by the local Corps district, that includes a Compensation Planning Framework (CPF). The CPF is used to describe and identify where an ILF will locate and pursue future mitigation projects. VARTF's first CPF was developed in 2009 and was incorporated into the program's 2011 Instrument and subsequent 2019 Program Instrument revisions. This document will replace the 2009 version. This CPF reflects how VARTF intends to incorporate advances in science, new spatial prioritization data, refinements to TNC's conservation approach, and the operational history of VARTF into its efforts to select and evaluate future compensatory mitigation sites.

The updated CPF utilizes a tiered approach that relies upon TNC's science and GIS-based analysis of priority lands and waters as well as the Commonwealth of Virginia's priorities for land protection. This incorporates both TNC and partner focal areas for conservation and restoration. The intention of the CPF is to develop and produce asset maps of conservation targets which will be used to inform and guide where VARTF pursues project development. This approach relies on a GIS tool to create 1) maps to visualize targets at statewide and basin-level scales and 2) an evaluation framework for individual compensatory mitigation sites. VARTF has named this GIS tool the Mitigation Priority Area Conservation Tool, or M-PACT. The Tier 1 Priority Areas include lands and waters identified by TNC as Resilient and Connected Systems, which are areas that are expected to support biodiversity and maintain function in response to climate change, and those landscape priorities that focus conservation efforts on critical habitats in Virginia. Tier 2 Priority Areas reflect aquatic conservation and restoration initiatives of partner organizations identified through the Commonwealth's ConserveVirginia online tool, and also include already-protected lands.

As this Compensation Planning Framework incorporates the most relevant and available science for conserving resilient lands and waters as well as the collaborative conservation priorities of statewide partners, it can serve as a model for other states and ILF programs across the country. With the expectations to utilize the most up-to-date and relevant data, this framework can also serve as a watershed approach to be used by all mitigation providers in Virginia, to collectively advance the protection and restoration of the highest environmental targets within the state.

PART ONE: COMPENSATION PLANNING FRAMEWORK DEVELOPMENT AND METHODOLOGY

I. Background and Introduction

The Nature Conservancy (TNC) is a global conservation organization with offices in all 50 U.S. states and over 70 countries. As the world's largest conservation non-profit, TNC's mission is to conserve the lands and waters on which all life depends. In 1995, to address a growing need to provide high quality compensatory mitigation for impacts to streams and wetlands in Virginia, the Virginia Chapter of TNC established the Virginia Aquatic Resources Trust Fund (VARTF). VARTF is an in-lieu fee (ILF) compensatory mitigation program that operates state-wide with a strong history of success. Utilizing TNC's science and conservation planning, VARTF protects and restores high-quality, aquatic and terrestrial habitats that support rare species, sensitive communities, and ecological integrity. By consolidating the mitigation requirements of multiple impacts, TNC is able to use VARTF to implement large-scale restoration, enhancement and protection projects that deliver watershed-scale conservation outcomes. Since its inception in 1951, the TNC mission has evolved to address ever more complex environmental challenges, including climate change and increasing demands for food, water, energy and infrastructure. Conservation of resilient lands and waters remains a global priority of TNC, and the VARTF program directly supports the ambitious goals established within the organization's North American Region to conserve a resilient and connected network of lands and waters.

Background and Success of VARTF

The VARTF program is administered in partnership by TNC, the Norfolk District United States Army Corps of Engineers (Corps) and the Virginia Department of Environmental Quality (DEQ). VARTF provides a third-party mitigation option for permit applicants to address compensatory mitigation requirements associated with Clean Water Act Section 404 and 401 and Virginia Water Protection permits issued by the Corps and DEQ, respectively. VARTF is recognized as a national model of in-lieu fee mitigation programs, and continually exceeds no net loss standards and other regulatory requirements for mitigating impacts to wetlands and streams.

Over the past 25 years, VARTF has provided substantial benefits to the restoration and protection of Virginia's wetlands and streams. Through 2019, VARTF has been used to offset 337 acres of impacts to non-tidal and tidal wetlands and over 214,000 linear feet of streams. TNC has offset these impacts through more than 100 approved compensatory mitigation sites throughout Virginia, in some of the most ecologically important areas in the state. Over 20,000 acres have been protected, restored and preserved through these mitigation sites, including over 9,000 acres which have been added to public lands (through 20 mitigation sites) in Virginia.

Program-wide Accomplishments through 2019				
Resource Type	**Impacts**	**Restored**	**Preserved**	**Total Protected**
Wetlands (ac)	325	679	3997	4676
Tidal Wetland (ac)	12	72	315	387
Stream (l.f.)	214,974	93,718	660,280	753,998
Upland/Riparian Buffer (ac)	N/A	765	4,713	5,478
Additional Protected (ac)	N/A	N/A	10,013	10,018
Total (acres)	**337**	**1516**	**19,038**	**20,559**
Total (linear feet)	**214,974**	**93,718**	**660,280**	**753,998**

Program-wide, VARTF is providing offsets that exceed impacts. For non-tidal wetlands, the program has released 50% more credits over the required offsets. Once all current projects are completed, VARTF expects to have generated 2:1 leverage for non-tidal wetland impacts, with twice as much compensation provided than was required. Similarly, for tidal wetlands, VARTF has released three times the amount of credits required to meet the liability of the program. Once currently proposed tidal wetland projects are completed, VARTF will have generated eight times the

required compensation credits for the impacts using the program. Regarding streams, VARTF has currently completed, constructed, or released credits to offset 60% of the required liabilities with projects in development to generate nearly twice the amount of required stream compensation for the program.

VARTF has proposed and completed a wide variety of mitigation projects encompassing a range of activities including the following: wetland restoration (grading, ditch plugging or filling, drain tile removal, tree planting) wetland enhancement (hydrologic improvements, tree planting, invasive species control), wetland preservation (land acquisition and protection), stream restoration (dimension, pattern, and profile restoration, earthwork, structure installation, planting live stakes and riparian buffers, livestock exclusion), stream enhancement (earthwork, structure installation, planting, livestock exclusion, invasive species management), and stream preservation (land acquisition and protection). Detailed annual reports providing historic background and updates on all VARTF projects, the use of VARTF funds and status of program mitigation requirements and offsets can be obtained from the VARTF website at www.nature.org/vartf.

Overview of Compensation Planning Framework

In 2008, the Corps and the United States Environmental Protection Agency (EPA) jointly issued a regulation revising and clarifying requirements for compensatory mitigation. The regulation ("the federal mitigation rule") covers all forms of compensatory mitigation, including in-lieu fee programs such as VARTF. Each in-lieu fee program must have a Program Instrument, approved by the local Corps district, that must include a Compensation Planning Framework (CPF). The CPF is "used to select, secure, and implement aquatic resource restoration, establishment, enhancement, and/or preservation activities" (332.8(c)).[1]

All compensatory mitigation options (mitigation banks, ILFs and permittee-responsible mitigation) are required to select and implement mitigation projects based on a watershed approach. As defined by the federal mitigation rule, a watershed approach "means an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed. It involves consideration of watershed needs, and how locations and types of compensatory mitigation projects address those needs. A landscape perspective is used to identify the types and locations of compensatory mitigation projects that will benefit the watershed and offset permits. The watershed approach may involve consideration of landscape scale, historic and potential aquatic resource conditions, past and projected aquatic resource impacts in the watershed, and terrestrial connections between aquatic resources when determining compensatory mitigation requirements for DA [Department of the Army] permits" (332.2) [1]. The CPF requirement ensures ILF programs have sufficient knowledge and planning to locate and develop suitable compensation sites in the future, thus meeting the requirement to use a watershed approach. The structure and nature of ILF programs allows for the sale of credits (i.e. impacts to resources) prior to the identification and implementation of compensatory mitigation sites. VARTF employs a statewide approach to identifying conservation targets and resource priorities within each watershed and uses a prioritization strategy for identifying and evaluating potential compensation sites in priority areas.

Per the 2008 rule (332.8(c)) [1], the CPF must include the following ten elements and any other information deemed necessary for effective compensation planning by the district engineer. No additional information has been requested by the district engineer.

I. The geographic service area(s), including a watershed-based rationale for the delineation of each service area;
II. A description of the threats to aquatic resources in the service area(s), including how the in-lieu fee program will help offset impacts resulting from those threats;

[1] *Compensatory Mitigation for Losses of Aquatic Resources, Final Rule (33 CFR Parts 325 and 332)*

III. An analysis of historic aquatic resource loss in the service area(s);
IV. An analysis of current aquatic resource conditions in the service area(s), supported by an appropriate level of field documentation;
V. A statement of aquatic resource goals and objectives for each service area, including a description of the general amounts, types and locations of aquatic resources the program will seek to provide;
VI. A prioritization strategy for selecting and implementing compensatory mitigation activities;
VII. An explanation of how any preservation objectives identified in element V and addressed in the prioritization strategy in element VI satisfy the criteria for use of preservation in section 332.3(h);
VIII. A description of any public and private stakeholder involvement in plan development and implementation, including, where appropriate, coordination with federal, state, tribal and local aquatic resource management and regulatory authorities;
IX. A description of the long-term protection and management strategies for activities conducted by the in-lieu fee program sponsor;
X. A strategy for periodic evaluation and reporting on the progress of the program in achieving the goals and objectives in element V of this section, including a process for revising the planning framework as necessary.

VARTF's first CPF was developed in 2009 and was incorporated into the program's 2011 Instrument and subsequent 2019 Program Instrument revisions. This document will, once approved by DEQ and the Corps, replace the 2009 version. The document addresses the ten required elements of a CPF with the relevant element identified in footnotes. This updated and revised CPF reflects how VARTF intends to incorporate advances in science, new spatial prioritization data, refinements to TNC's conservation approach, and the operational history of VARTF into its efforts to select and evaluate future compensatory mitigation sites.

The updated CPF utilizes a tiered approach that relies upon TNC's science and GIS-based analysis of priority lands and waters as well as the Commonwealth of Virginia's priorities for land protection. The intention of the CPF is to develop and produce asset maps of conservation targets which will be used to inform and guide where VARTF pursues project development. This approach relies on a GIS tool to create 1) maps to visualize targets at statewide and basin-level scales and 2) an evaluation framework for individual compensatory mitigation sites. VARTF has named this GIS tool the Mitigation Priority Area Conservation Tool, or M-PACT. The M-PACT identifies two tiers for consideration. Tier 1 is an integration of TNC's resilient freshwater, terrestrial and coastal systems, prioritizing TNC landscape focal areas where applicable (see Section IV for explanation and further detail). Tier 2 includes the Commonwealth's priorities for protection as reflected in ConserveVirginia, a data-driven, statewide, land conservation strategy that identifies high value lands and conservation sites across the state. Tier 2 also includes already-protected lands. The tiered approach identifies resilient and connected lands as the highest priority, while providing additional consideration and flexibility to align with partner priorities in areas where the highest priority project sites cannot be secured according to program needs.

Stakeholder Involvement in Plan Development[2]

TNC has worked closely with partners and experts throughout its history to develop a conservation vision, set priorities, and to design and implement effective conservation strategies at multiple scales. Collaboration with a wide range of partners from state and federal agencies, NGOs, industry, and academic institutions informs and influences TNC's work while also establishing the alliances necessary to achieve meaningful conservation results.

[2] *CPF Element VIII. A description of any public and private stakeholder involvement in plan development and implementation, including, where appropriate, coordination with federal, state, tribal and local aquatic resource management and regulatory authorities.*

Appendix 1 lists historical partners and contributors to the development of TNC's conservation priorities. Stakeholder involvement in the development of revisions and updates to this CPF has been through contributions of data, review of TNC's resilient and connected network science, and programmatic review and guidance on the CPF itself, as described further below.

- TNC science and conservation experts contributed extensively to the development of the data sets which form the Tier 1 level priorities of the M-PACT, based on resilient and connected lands and waters. This includes more than 10 years of work by more than 100 TNC scientists in collaboration with external partners resulting in seven internally-reviewed report and 11 peer-reviewed journal articles written on this approach, including a special section in the premier science journal "Conservation Biology" that includes overview articles by 33 authors from around the world.
- ConserveVirginia which forms the basis of Tier 2 of M-PACT, was developed collaboratively by Virginia's natural resources, historic resources and agriculture and forestry agencies.
- TNC staff and mitigation experts across the country have contributed to the review and development of this CPF.
- The CPF will be peer-reviewed through the public notice process for approval and Instrument update.
- Federal and state agency members of the Interagency Review Team (IRT) review the CPF document at various stages, including through direct presentations from TNC to the IRT and through a public notice and comment period. The IRT approves the CPF and authorizes the plan as an appendix to the VARTF Program Instrument.
- Through the public notice and comment process, stakeholder involvement reaches any person or organization interested in the VARTF program or the development of the CPF.

TNC also relies on numerous partners and agency support to implement projects pursued as mitigation sites through VARTF (listed in Appendix 1). The Corps and DEQ approve, with IRT support, all VARTF mitigation sites and their compliance with the CPF.

Periodic Evaluation and Reporting Progress[3]

The CPF will be evaluated any time major revisions are made to the VARTF Program Instrument. There is no scheduled time frame for these revisions, though consideration may occur approximately every ten years. It is important for the VARTF CPF to align with and support TNC's organizational priorities. As such priorities are adjusted or refined over time, the CPF may be revised to reflect stronger science, new information, or new or more clearly defined desired outcomes.

There exist a number of mechanisms through which VARTF reports on the progress, success and compliance of the program, including compliance with the CPF. The VARTF Program Instrument[4] requires annual reporting on program activities, mitigation site activity and overall success of the projects and how they contribute to the success of the program. When new mitigation sites are identified and proposed through VARTF, a detailed description of the projects, including alignment with the CPF, is provided in the Annual Report. The VARTF Instrument also requires a financial and programmatic audit at least every five years.

[3] *CPF Element X. A strategy for periodic evaluation and reporting on the progress of the program in achieving the goals and objectives in element V of this section, including a process for revising the planning framework as necessary.*

[4] *Virginia Aquatic Resources Trust Fund (VARTF) 2019 – Amended and Restated Program Instrument*

II. THREATS TO VIRGINIA'S WATER RESOURCES

Historic Loss and Current Conditions of Aquatic Resources in the Program Area[5]

Virginia has experienced significant alterations to its aquatic resources since colonization. It is believed that the Commonwealth has lost approximately 40 percent of its original wetland acreage, the majority of which were located in the Coastal Plain.[6] Much of this loss can be attributed to draining and filling wetlands for agriculture or development. Streams and rivers have also been greatly altered through channelization, hardening, or erosion and are in a fair or degraded state. According to a 2018 study which sampled 260 stream sites across Virginia, data indicated that 47% of stream miles in the state fail to meet biological standards.[7] Though Virginia was historically dominated by a forest matrix, currently about 57% of the Commonwealth contains forests. Much of this reduction in forest habitat is due to conversion to urban land use and agriculture.[8] Aquatic resources with high water quality have been shown to be associated with forested watersheds and riparian buffers; therefore, with the reduction in forest cover, aquatic resource quality has also been reduced.

Much of the research on aquatic resource loss and current trends has been focused on a microcosm rather than state or basin-wide level. For example, several studies were undertaken at a local scale in Southeast Virginia which identified wetland loss statistics within the last several decades. Changes in NWI mapping indicated trends within southeast Virginia as having significant wetland loss, showing 80% of Virginia's forested wetland loss occurred between 1950 and 1970, and nearly 5,000 acres of wetland loss occurred between 1982 and 1989.[9] The study area included four counties and eight cities which make up the greater Hampton Roads area. Additionally, research shows that within a 6-year period (1994-2000), a 1.3% decline of wetlands occurred within Southeastern Virginia.[10] This amounts to a net loss of 2,100 acres of both tidal and non-tidal wetlands. Wetland acreage was largely converted to either upland or estuarine deep-water habitat, depending on wetland type and location. The driving factor for wetland loss was primarily due to residential and commercial development, with some loss attributed to sea-level-rise and subsidence.

Today, it is estimated that Virginia has over 1 million acres of wetlands, of which over 800,000 acres include freshwater wetlands and nearly 237,000 acres include tidal wetlands.[11] Across Virginia, the Coastal Plain contains 71% of this acreage, the Piedmont contains 20%, and the remainder of physiographic provinces contains 9%.[12] There are approximately 100,923 miles of stream or river corridor

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[5] *CPF Element III. An analysis of historic aquatic resource loss in the service area(s). CPF Element IV. An analysis of current aquatic resource conditions in the service area(s), supported by an appropriate level of field documentation.*

[6] *JD Fretwell, JS Williams, and PJ Redman. 1996. United State Geological Survey Water-Supply Paper 2425. United States Geologic Survey, Washington, DC. 444 pp.*

[7] *Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2018: Chapter 2. 2019. VDH, DEQ, DCR. Richmond, VA.*

[8] *Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2018: Chapter 2. 2019. VDH, DEQ, DCR. Richmond, VA.*

[9] *Tiner, R.W. and J.T. Finn. 1986. Status and Recent Trends of Wetlands in Five Mid-Atlantic States: Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. U.S. Fish and Wildlife Service, Region 5, National Wetlands Inventory Project, Newton Corner, MA and U.S. Environmental Protection Agency, Region III, Philadelphia, PA. Cooperative Publication.*

Tiner, R.W., I. Kenenski, T. Nuerminger, J. Eaton, D.B. Foulis, G.S. Smith, and W.E. Frayer. 1994. Recent Wetland Status and Trends in the Chesapeake Watershed (1982 to 1989): Technical Report. U.S. Fish and Wildlife Service, Region 5, Ecological Services, Hadley, MA. Cooperative interagency report prepared for the Chesapeake Bay Program, Annapolis, MD. Chesapeake Bay Program Technical Report.

[10] *Tiner, R.W., J.Q. Swords, and H.C. Bergquist. 2005. Recent Wetland Trends in Southeastern Virginia: 1994-2000. U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA. NWI Wetland Trends Report. 17 pp.*

[11] *Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2018: Chapter 2. 2019. VDH, DEQ, DCR. Richmond, VA.*

[12] *Tiner, R.W. and J.T. Finn. 1986. Status and Recent Trends of Wetlands in Five Mid-Atlantic States: Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. U.S. Fish and Wildlife Service, Region 5, National Wetlands Inventory Project, Newton Corner, MA and U.S. Environmental Protection Agency, Region III, Philadelphia, PA. Cooperative Publication.*

throughout Virginia.[13] The total flow of all freshwater streams is about 25 billion gallons per day.[14] The loss or degradation of wetlands, rivers, and streams (and other aquatic resources or related terrestrial systems) throughout Virginia is incremental and varies across each basin. Statewide statistics and accounting are maintained by Corps and DEQ regulatory staff and relevant databases.

Current and Historic Stresses and Sources of Stress[15]

Virginia's streams and wetlands are currently experiencing multiple stresses that can negatively impact ecosystem function. This is not only detrimental to nature but to people as well. These stressors include alterations to water quality, hydrologic regime, aquatic community composition, and habitat. Additionally, climate change has the potential to amplify the impacts of these stresses. Projects proposed and implemented through VARTF can effectively mitigate many of these stressors through restoration and protection of degraded aquatic systems and preservation of high-quality systems. These projects create, rehabilitate, and protect stable, healthy, and functional wetlands, streams, and upland buffer habitats. These stresses and the sources of stress are described further below and are shown in Table 1 in Appendix 2.

Altered Water Quality

Stresses related to altered water quality can impact an aquatic resource's ability to sustain healthy native species and communities and potentially impact human health and recreation. Point source and non-point source pollution conveys sediment, nutrients, and other contaminants to Virginia's waterways. Sources of point source pollution include household sewage (e.g., straight piping/failing septic systems), urban wastewater, industrial effluent (e.g., mining, paper mills, coal ash ponds), and dumping. Sources of non-point source pollution include runoff from residential and industrial development; increased runoff due to the removal of natural riparian vegetation associated with development, agriculture, and timber extraction; runoff from unpaved roads (especially on steep slopes); contaminants from mineral and energy extraction; fertilizer, pesticides, and animal manure runoff from agricultural land use; acid deposition from automobiles and power plants; and streambank erosion. Climate change is likely to increase the concentration of pollutants in Virginia's waterways through increased frequency and severity of droughts and storm events.

Altered Hydrologic Regime

Alterations to the natural hydrologic regime of streams and wetlands can include reduced water quantity, lowered groundwater levels, dam storage, changes in flow dynamics, and loss of wetland function. Sources of reduced water quantity and lower groundwater levels include withdrawals for agriculture, municipal, and industrial use, and residential wells. Dam storage sources include large hydropower or flood control dams and impoundments. Changing flow dynamics are caused by installation of small impoundments, large hydropower dams, increased runoff from impervious surfaces, and the removal of riparian vegetation associated with land conversion which leads to chronic erosion and incised streams. Sources of stress for loss of wetland function include filling, draining, or damming wetlands for agriculture, residential, industrial, or recreational development. Climate change is likely to amplify these stresses due to the frequency and intensity of storm events. Additionally, droughts will also increase in frequency and severity which will create a hotter and drier climate that will drive increased water usage by humans.

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[13] *Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2018: Chapter 2. 2019. VDH, DEQ, DCR. Richmond, VA.*

[14] *Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2018: Chapter 2. 2019. VDH, DEQ, DCR. Richmond, VA.*

[15] *CPF Element II. A description of the threats to aquatic resources in the service area(s), including how the in-lieu fee program will help offset impacts resulting from those threats.*

Altered Aquatic Community Composition

Alterations to the aquatic community composition of streams and wetlands include the introduction of invasive species and loss of endemic species. Invasive species can be introduced to aquatic systems through recreational fishing and fishery management (e.g., introduction of trout, release of bait buckets) and recreational boating. Loss of endemic species can occur through land use impacts on water quality, water quantity, connectivity and temperature. Warming temperatures resulting from climate change are likely to increase the extent of invasive species and alter habitat availability for endemic species.

Altered Habitat

Alterations to the in-stream, riparian, and wetland habitats of Virginia can include changes in forest or vegetation composition, loss of forested buffers, in-stream habitat destruction, barriers to stream flow, increased water temperatures, and wetland habitat loss or destruction. Changes in forest or vegetation composition can result from forest fire suppression and invasive species. Loss of forested buffers result from incompatible timber and agricultural practices, development, and roads. Sources of in-stream habitat destruction include channelization and straightening of stream beds, and land conversion resulting in physical destruction of stream beds. Barriers to stream flow are associated with large hydropower or flood control dams and impoundments, small dams and impoundments, and culverts and road crossings. Increases in water temperature result from removal of riparian vegetation and resulting loss of shade, power plant water returns, forest pests/pathogens resulting in loss of trees, and impoundments. Wetland habitat loss or destruction results from incompatible timber, agricultural and mining practices, shoreline hardening, development, and roads. The effects of forest fire suppression are likely to be amplified by climate change, because lack of fire alters forest composition in favor of species that use more water (forest mesophication). A warmer climate may also increase invasive species. A hotter, drier climate will drive an increase in human water and energy needs, amplifying the impacts of barriers to stream flow associated with dams and impoundments. Global warming will also exacerbate the effects of increased water temperatures. Dependent on the type of wetland and ecoregion, climate change may also either cause a reduction in wetland hydrology (lower groundwater due to increased heat and water usage) or cause an increase in damaging high water events from intensified and increased storm frequency.

III. ROLE OF VIRGINIA AQUATIC RESOURCES TRUST FUND

VARTF's Vision and Programmatic Objectives[16]

As required by the federal mitigation rule, VARTF projects offset impacts to Virginia's waters by restoring wetland and stream hydrology and establishing communities of desirable native vegetation that comprise or buffer the restored aquatic resource. The primary types of habitats that are restored or protected are non-tidal and tidal wetlands, streams, and upland forest. Mitigation work for these projects include restoration, creation, enhancement, preservation, and long-term management and protection. VARTF takes a landscape-scale approach to mitigation, seeking to ensure the durability of these restoration efforts by identifying compensatory mitigation sites in degraded areas adjacent to high quality habitat. Through this work, VARTF is able to address and ameliorate sources of stress that are listed in the section above.

VARTF's programmatic goal is to provide the best possible compensation projects in terms of both acreage and function at ecologically significant locations. VARTF's objectives in siting projects are to protect and enhance resilient and connected locations with substantial conservation values, biological diversity or habitat, partner support and high likelihood of success, and to utilize the prioritization strategy outlined in this CPF to evaluate and determine potential project locations with the most valuable conservation assets.

VARTF has a long and successful history of identifying and implementing suitable and ecologically significant compensation projects. VARTF identifies and proposes mitigation projects to offset the impacts and credit sales applied to the program. VARTF pools together monies paid into the VARTF account from multiple credit sales, which are generally from small impacts, to fund and implement larger compensation projects. As the Sponsor of the ILF Program, TNC will work with partners, the IRT, and qualified professionals to implement suitable compensation sites in response to impacts and credit sales within each Geographic Service Area. The full details of program operation and project implementation are described in the VARTF Program Instrument[17].

In addition to the programmatic objectives listed above, VARTF seeks to:

- Implement high-level, effective mitigation projects to offset liabilities throughout Virginia;
- Contribute to evidence base for mitigation, wetland, and stream restoration and adaptive management strategies through effective monitoring; and
- Expand and influence mitigation policy, practice and awareness beyond Virginia.

[16] *CPF Element V. A statement of aquatic resource goals and objectives for each service area, including a description of the general amounts, types and locations of aquatic resources the program will seek to provide.*

[17] *https://www.nature.org/en-us/about-us/where-we-work/united-states/virginia/stories-in-virginia/virginia-aquatic-resources-trust-fund/?vu=r.v_vartf.local.na.va*

Geographic Service Areas in Virginia[18]

VARTF works throughout the Commonwealth of Virginia, including the Coastal Plain, Piedmont, and mountain regions. The program addresses threats and impacts to these distinctive regions which have a wide array of habitats and aquatic resource variation. Within Virginia, impacts and projects are organized by Geographic Service Area, which are based on aggregations of major watersheds. These watersheds are designated by DEQ and align with the Watershed Boundary Dataset from the United States Geological Survey (USGS). VARTF is authorized to provide compensatory mitigation required by Corps and DEQ permits within the following specific Geographic Service Areas: Atlantic Ocean, Chesapeake Bay, Chowan River, Lower James River, Middle James River, Upper James River, New River, Potomac River, Rappahannock River, Roanoke River, Shenandoah River, Tennessee River and York River. The Geographic Service Areas are shown in Figure 1 and further described in Part Two of this document.

VARTF tracks and reports program activities, including impacts, payments, and credits based on these Geographic Service Areas. Operationally, the compensation site service areas for specific VARTF projects are often geographically limited within the major river watershed, and generally follow the Code of Virginia Section 62.1-44.15:23 which limits bank and ILF site service areas to the same or adjacent fourth order sub-basin within the same major river watershed, with further limitations based on physiographic province as appropriate and approved by the IRT.

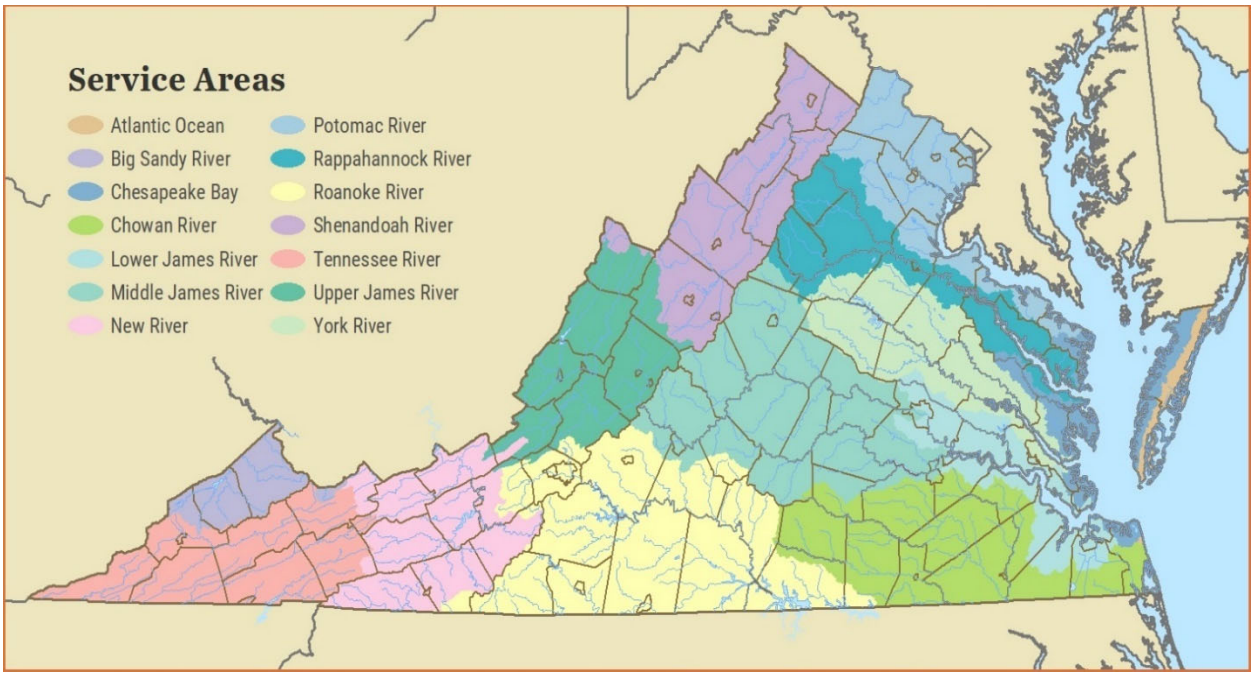

FIGURE 1. VARTF GEOGRAPHIC SERVICE AREAS.

VARTF's Role in Offsetting Impacts to Virginia's Waters

Under the mitigation framework, VARTF is able to effectively address the multiple sources of stress that are impacting Virginia's wetland and streams, thereby improving the function of these ecosystems. Many of the stresses on Virginia's waters, which include alterations to water quality, hydrologic regime, aquatic community composition, and habitat (as described above) are directly addressed within the Service Area. Projects implemented through VARTF create, rehabilitate, and protect stable, healthy, and functional

[18] *CPF Element I. The geographic service area(s), including a watershed-based rationale for the delineation of each service area.*

wetlands, streams, and upland buffer habitats. These mitigation strategies can offset stresses on Virginia's aquatic systems in a number of ways, as described below.

RESTORATION, CREATION, AND ENHANCEMENT STRATEGIES

These mitigation strategies rehabilitate or recreate wetlands, streams, or upland buffers that have been impacted by stressors.

Wetlands (Non-tidal and Tidal)

Lands that were historically wetland but have been converted to upland through ditching, draining, and filling are restored to original wetland conditions through restoration, creation, and enhancement. Construction techniques and environmental management include grading, ditch plugging, drain tile removal, soil discing (creation of microtopography), soil amendments, native planting, and invasive species removal. Depending on the severity of the wetland condition, these techniques are characterized as either restoration or enhancement. In certain instances, a wetland will be created in an area that has historically been classified as upland. Wetland restoration, creation, and enhancement contribute to ecosystem uplift in the following ways:

- Improves flood water storage, abates flood energy, and reduces erosion of coastal and riparian areas. This provides protection to surrounding habitats and human activities.
- Contributes to the replenishment of the water table by serving as groundwater recharge zones.
- Improves the natural sequestration of sediments, nutrients, and contaminants, which improve downstream water quality and habitat.
- Restores critical breeding habitat for aquatic and terrestrial species.
- Helps stabilize surrounding air temperature and humidity, contributes to atmospheric gas cycles, and reduces downstream aquatic temperatures.
- Converts degraded lands to healthy, vegetated ecosystems.

Streams

For channelized, eroded, or hardened waterways, restoration or enhancement involves re-establishing the natural hydrologic and sediment regime so that the stream is properly functioning and stable. Engineering and construction techniques typically include realignment of stream reaches, installation of instream structures, stream bank rehabilitation, and stream bank stabilization using plants. Stream restoration and enhancement contribute to ecosystem uplift in the following ways:

- Stabilizes eroding streambanks and beds, establishes stable stream channel shape and size, and restores a stream's ability to transport water and sediment in a stable manner without eroding or building up excess sediment.
- Establishes stable riffles, pools, and in-stream structures which provide a diversity of healthy habitats.
- Ensures natural dissipation of flow energy and restoration of hydrology through connection of streams to their floodplains.
- Establishes healthy streambank vegetation to reduce bank erosion.
- Reduces excess sediment and associated nutrients in the water, thus improving the ability of aquatic species to find food, ensuring submerged aquatic vegetation receives sufficient sunlight, preventing clogging of fish gills with sediment, preventing the burial of bottom-dwelling species which serve as a food source for many other aquatic species, reducing water temperatures, and reducing algal blooms and associated decreases in dissolved oxygen.

Upland Buffer and Riparian Habitat

Buffers that have been deforested or severely degraded by invasive species are restored or enhanced through native planting and invasive management. Uplift of buffers creates the following benefits:

- Re-establishes native vegetation, restoring healthy diverse forest which increases biological diversity and resilience, help supports native animal species, and can also help combat invasive plants which tend to thrive in disturbed and degraded systems.
- Improves the filtration of pollutants from upland sources, prevents erosion in floodplains, and reduces high flow energy in stream channels, helping to reduce stream bank and bed erosion and habitat destruction.
- Increases vegetative cover which reduces water temperatures and provides vegetative debris needed by aquatic species.
- Can reduce excess freshwater from entering downstream tidal rivers and bays which can damage sensitive saltwater and brackish habitats.

Barrier Removal

Barriers, such as dams, and associated impoundments on streams are removed through barrier removal practices which contribute to the following aquatic improvements:

- Restores natural flows and hydrologic connectivity of streams, tidal and non-tidal wetlands.
- Enables migration of aquatic species.
- Reduces water temperatures.
- Removes excess sediment upstream of the dam which buries organisms and habitats.
- Restores natural transport of sediments, nutrients, and vegetative debris needed by aquatic species to downstream systems.

Livestock Exclusion

Cattle and other livestock often have direct access to aquatic resources for watering needs. This strategy includes the installation of fencing and provision of alternative water sources (troughs) for livestock, or removal of livestock from the property. By doing so, several stresses are relieved:

- Eliminates trampling of streambanks which causes bank and streambed erosion and can lead to unstable channel shape and size. This ultimately restores impacted in-stream habitats.
- Eliminates the direct deposition of livestock effluent which reduces excess sediment, nutrients, and bacteria in the water, thereby improving water quality and habitat.

PRESERVATION STRATEGIES[19]

For sites that remain intact and are comprised of high-quality habitat or aquatic resources, preservation involves placing permanent protection on the site to ensure that these resources continue to provide important physical, chemical, and biological functions, and contribute to the ecological sustainability for the watershed. Without permanent protection, these sites are at risk of future destruction or adverse modification. The following benefits are created from preservation projects:

- Protects healthy vegetated riparian buffers, wetlands, and streams and prevents conversion of natural lands to other uses (urban development, agriculture, mining, and impoundments) which could contribute point or non-point source pollution, cause alterations to natural habitats, and result in reduced water quantity, lowered groundwater levels, dam storage, or flow dynamics.
- Protects healthy and diverse forested wetland and riparian habitats from infestation by invasive species.
- Protects healthy wetland and stream systems that transport water and sediment in a stable manner without eroding or building up excess sediment, maintain natural aquatic community composition, and provide a diversity of healthy habitats.

[19] *CPF Element VII. An explanation of how any preservation objectives identified in element V and addressed in the prioritization strategy in element VI satisfy the criteria for use of preservation in section 332.3(h).*

LONG-TERM PROTECTION AND MANAGEMENT[20]

VARTF is responsible for ensuring long-term protection of each mitigation site through the use of a conservation easement or other protection mechanism acceptable to the IRT. The protection document is recorded in the chain of title for all properties affected by the restriction. Draft real estate protection documents, using a Corps-approved template, are provided for review and approval by the IRT.

VARTF also develops a Long-Term Management and Maintenance Plan to be included in the Site Development Plan for each project, for approval by the IRT. The purpose of the Long-Term Management and Maintenance Plan is to ensure the mitigation site is managed, monitored, and maintained in perpetuity. The Long-Term Management and Maintenance Plan includes long-term stewardship arrangements, monitoring programs, financial assurances, and management strategies. Long-term management tasks are funded through the Long-Term Management Fund. The Long-Term Management Budget is developed using best available information such as the Long-Term Stewardship Costs Calculator developed by TNC[21].

[20] *CPF Element IX. A description of the long-term protection and management strategies for activities conducted by the in-lieu fee program sponsor.*

[21] *https://www.conservationgateway.org/ConservationPlanning/ToolsData/Pages/stewardshipcalculator.aspx*

IV. COMPENSATION PLANNING FRAMEWORK APPROACH

Introduction: The Mitigation Priority Area Conservation Tool (M-PACT) as an Approach to Determining Priority Areas for Identification of Potential VARTF Projects[22]

VARTF has developed a spatial tool to focus strategy implementation where VARTF mitigation projects can provide the best return on investment and maximize benefits to nature and people at multiple scales. The M-PACT (Mitigation Priority Area Conservation Tool) incorporates TNC's regional and state conservation priority areas as well as state-identified priority areas to locate potential mitigation projects. M-PACT uses a two-tiered spatial prioritization approach designed to address both TNC and partner goals.

Tier 1 Priority Areas are based on TNC's priority resilient and connected terrestrial, freshwater and coastal networks (RCN) and the Active River Area (ARA). Both the RCN and ARA are further described below. Areas within RCN that are also within a TNC Landscape Program or regional Focal Landscape will be the highest priority for potential projects. Table 2 depicts the Tier 1 Priority Areas and conservation objectives and provides broad descriptions of how VARTF projects can potentially contribute to achieving those objectives.[23]

Tier 2 Priority Areas will be used when projects cannot be identified in Tier 1 Priority Areas. These include lands and waters depicted in the Commonwealth's ConserveVirginia map,[24] and already-protected lands throughout Virginia.

Individual mitigation projects within Tier 1 and Tier 2 Priority Areas will be selected based on IRT review of proposals brought forward by TNC.

Developing M-PACT

M-PACT Datasets

To develop the M-PACT, VARTF compiled and overlaid numerous GIS data layers from TNC's climate resilience analyses and additional data from the Commonwealth of Virginia. These datasets are described below and listed in Table 3.

TIER 1 PRIORITY AREAS

As described above, the M-PACT's Tier 1 Priority Areas are TNC's spatially identified resilient lands and waters in freshwater, coastal, and terrestrial systems. Areas of high and highest freshwater resilience are prioritized in the M-PACT, and resilient terrestrial sites (including areas important for marsh migration in coastal areas) are considered important as well.

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[22] *CPF Element VI: A prioritization strategy for selecting and implementing compensatory mitigation activities.*

[23] *CPF Element V: A statement of aquatic resource goals and objectives for each service area, including a description of the general amounts, types and locations of aquatic resources the program will seek to provide.*

[24] *https://www.dcr.virginia.gov/conservevirginia/conservevirginia-official-v2.pdf*

THE RESILIENT AND CONNECTED NETWORK

Climate change is expected to alter species distributions, modify ecological processes, and exacerbate environmental degradation.[25] To offset these effects and ensure that the North American landscape will continue to support iconic wildlife and vast botanical diversity, and provide the wealth of materials, food, medicines, and clean water and air people depend on, TNC undertook to identify resilient systems capable of conserving biological diversity and maintain ecological functions, despite climate-driven changes in community composition and species locations.[26] Resilient systems possess greater than average geophysical variability and local connectedness. These attributes allow species/ communities to shift and transform in response to climate stresses.

Resilient Terrestrial[27] and Coastal Systems[28] (Figure 3) include climate-resilient sites, confirmed biodiversity locations, and species movement areas (zones and corridors), stratified by ecoregion, to prioritize a conservation portfolio that naturally aligns these features into a network of resilient terrestrial sites and species movement zones,[29] integrated with identified resilient coastal sites (tidal complex areas with the greatest ability to accommodate sea level rise and resulting habitat migration).[30]

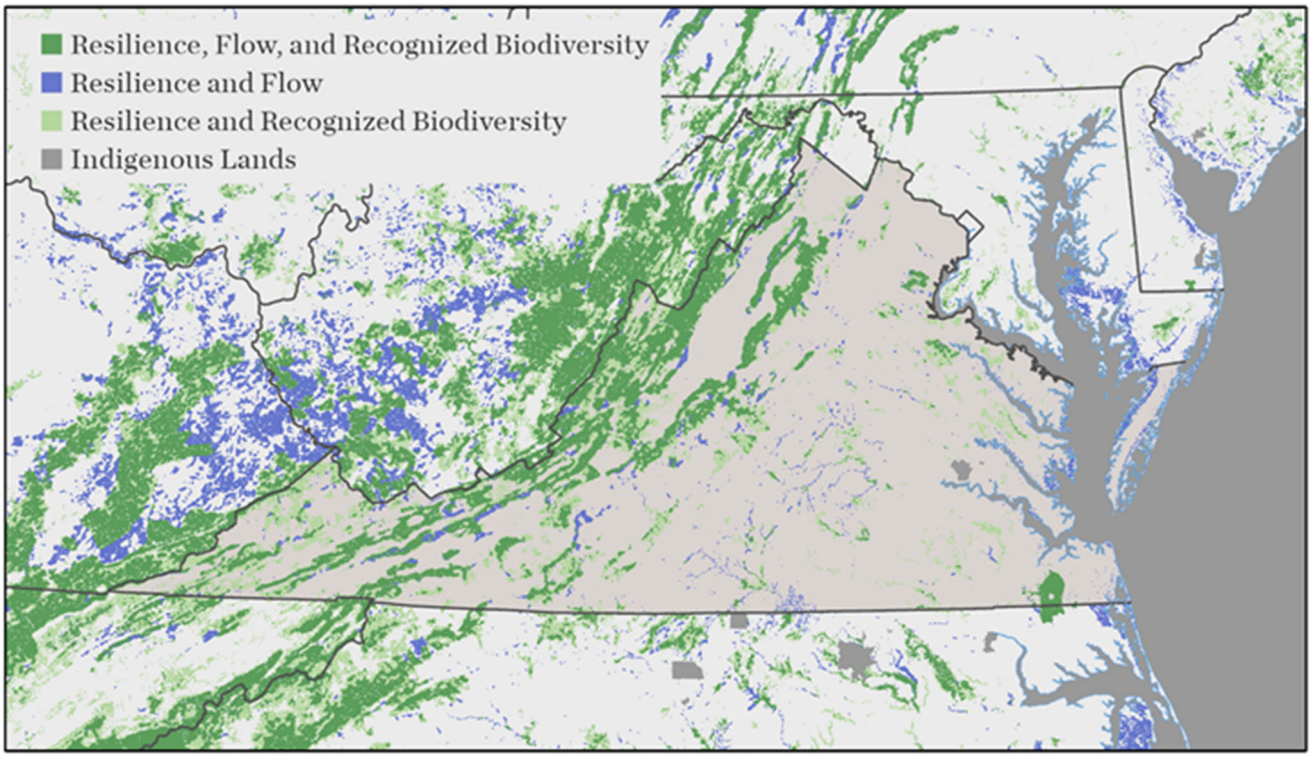

FIGURE 3. VIRGINIA'S PRIORITY RESILIENT TERRESTRIAL AND COASTAL SYSTEMS.

[25] *Pachauri, R. K., and A. Reisinger. 2007. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, R. K. Pachauri, and A. Reisinger, editors. IPCC, Geneva, Switzerland.*

[26] *Pressey, R. L., M. Cabeza, M. E. Watts, R. M. Cowling, and K. A. Wilson.2007. Conservation planning in a changing world. TRENDS in Ecology and Evolution 22(11):583–592.*

[27] *Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.*

[28] *Anderson, M.G. and Barnett, A. 2017. Resilient Coastal Sites for Conservation in the Northeast and Mid-Atlantic US. The Nature Conservancy, Eastern Conservation Science.*

[29] *Resilient and Connected Landscapes Data and Reports on Conservation Gateway and RCN Map Viewer*

[30] *Resilient Coastal Sites Data and Reports on Conservation Gateway*

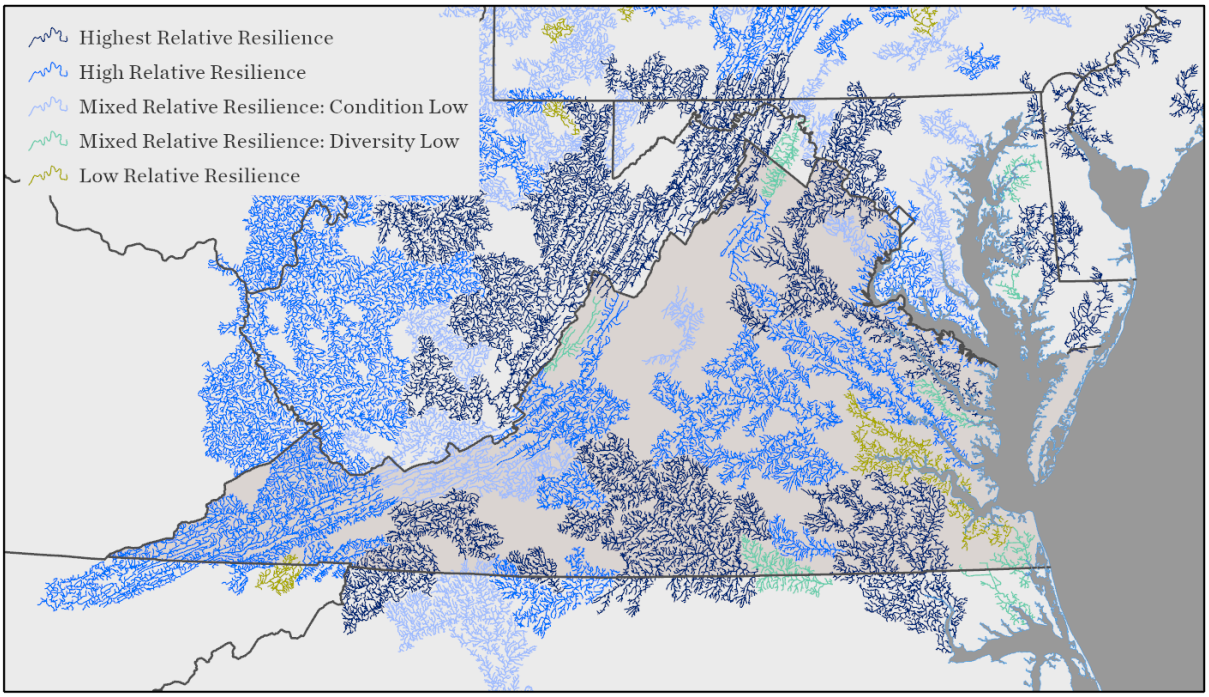

FIGURE 4. VIRGINIA'S RESILIENT FRESHWATER SYSTEMS.

Resilient Freshwater Systems[31] (Figure 4) include connected stream networks in the Northeast and Mid-Atlantic, scored for resilience based on physical properties (network length, and number of size, gradient, and temperature classes) and condition characteristics (risk of hydrologic alterations, natural cover in the floodplain, and amount of impervious surface in the watershed)[32]. Based on scores for physical properties and condition characteristics, stream networks were categorized as having the highest relative resilience (scores far above average), high relative resilience (scores above average), mixed relative resilience (above average for condition but not physical properties (diversity) or vice versa), or low relative resilience (scores below average).

Additional details about TNC's resilience analyses can be found in Appendix 2.

The Active River Area[33] (ARA) was used to identify riparian corridors adjacent to resilient freshwater streams. The ARA conservation framework (Figure 5) provides a conceptual and spatially explicit basis for the assessment, protection, management, and restoration of freshwater and riparian ecosystems. The ARA framework is based upon dominant processes and disturbance regimes to identify areas within which important physical and ecological processes of the river or stream occur.

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[31] *Anderson, M.G., A. Olivero Sheldon, C. Apse, A. Bowden, A. Barnett, B. Beaty, C. Burns, D. Crabtree, D Bechtel, J. Higgins, J. Dunscomb, and P. Marangelo. 2013. Assessing Freshwater Ecosystems for Their Resilience to Climate Change. The Nature Conservancy, Eastern Conservation Science.*

[32] *Freshwater Resilience Data and Reports on Conservation Gateway*

[33] *Smith, M.P., Schiff, R., Olivero, A. and MacBroom, J.G., 2008. THE ACTIVE RIVER AREA: A Conservation Framework for Protecting Rivers and Streams. The Nature Conservancy, Boston, MA.*

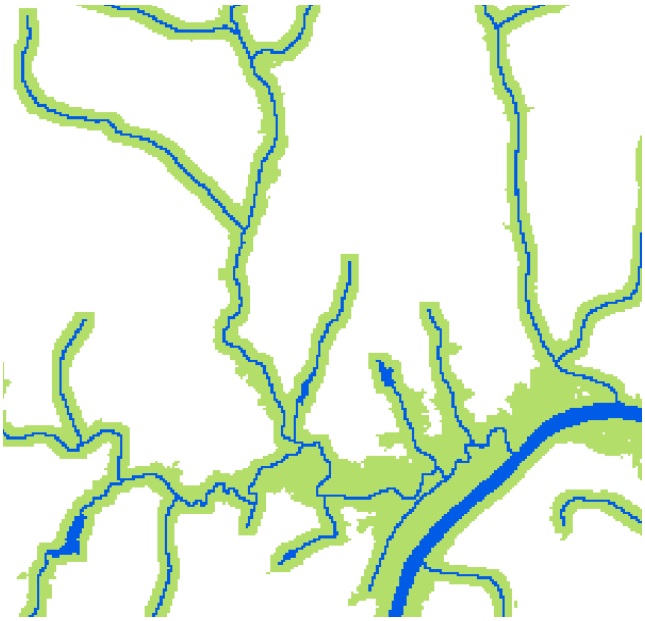


FIGURE 5. EXAMPLE OF ACTIVE RIVER AREA (GREEN AREAS) FOR A STREAM NETWORK.

Landscape Programs and Focal Landscapes[34]

In Virginia, TNC focuses conservation efforts for resilient and connected systems in four spatially defined Landscape Programs: (1) the Clinch Valley, (2) the Alleghany Highlands, (3) the Virginia Pinelands, and (4) the Volgenau Virginia Coast Reserve (VVCR) (Figure 6). These landscape programs represent geographies within which TNC has invested deeply over decades to conserve rare species and restore and maintain representative ecosystems.

Focal Landscapes are identified through an iterative assessment of available spatial data and local expertise and represent areas that contain (a) high conservation value (i.e., concentrations of high priority species, communities, or natural systems), (b) high vulnerability (i.e., urgency or need for conservation action), and (c) high opportunity (e.g., history of TNC or partner engagement and readiness for near-term action toward objectives). Focal Landscapes are nested within larger "Whole Systems" (i.e. The Central Appalachians and Longleaf Pine Whole Systems) that span multiple states and are intended to be reassessed (at both TNC state chapter and division levels), via adaptive management guidance set forth in CBD planning process and organizational frameworks. Appendix 2 provides more details about these Focal Landscapes and their conservation priorities.

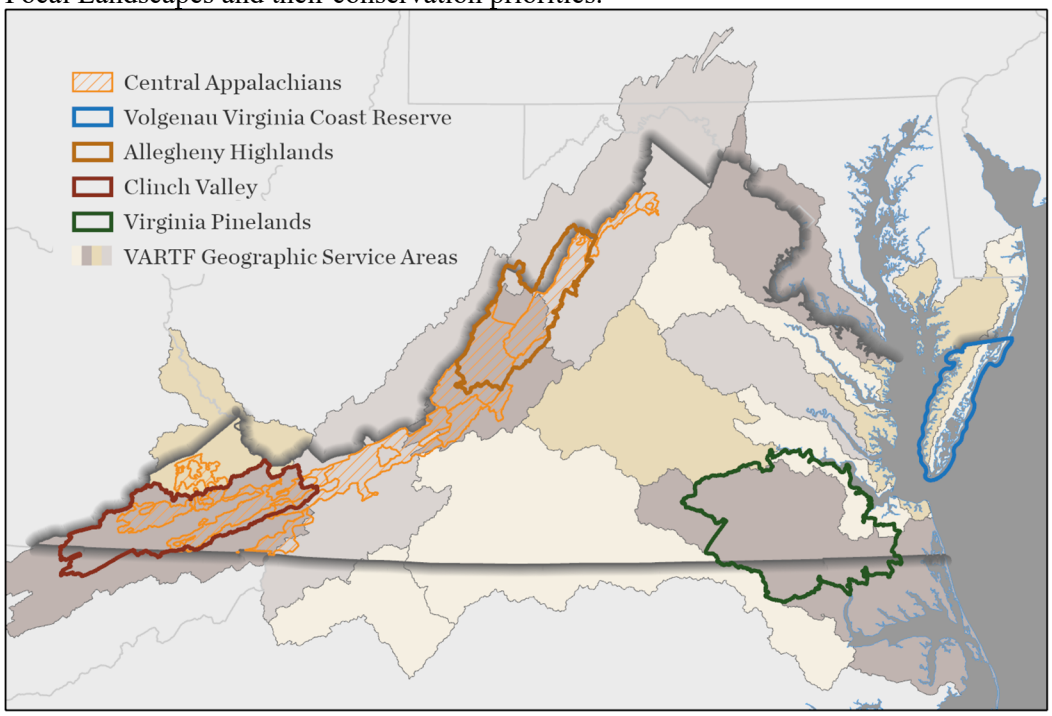


FIGURE 6. FOCAL LANDSCAPES.

[34] *See Appendix 2 for more information about Conservation by Design planning approach, Resilient and Connected Landscapes, and details about the identified Focal Landscapes in Virginia.*

TIER 2 PRIORITY AREAS

As noted above, in instances where projects cannot be identified in Tier 1 Priority Areas, the M-PACT's Tier 2 Priority Areas include the lands and waters identified in the Commonwealth of Virginia's ConserveVirginia map (Figure 9) as well as already-protected lands throughout Virginia.

CONSERVEVIRGINIA

In addition to TNC's priorities, TNC values the expertise of state partners and supports the Commonwealth's efforts to prioritize areas that achieve multiple conservation goals. ConserveVirginia is a data-driven, statewide approach to land conservation. ConserveVirginia's central feature is a living "smart map" that at the time this document was written identified approximately 6.9 million acres of priority lands for conservation.

The ConserveVirginia map synthesizes 21 data inputs summarized into seven categories, each representing a different overarching conservation value (Table 3)[35]. ConserveVirginia's seven conservation categories are:

- Agriculture & Forestry
- Natural Habitat & Ecosystem Diversity
- Floodplains & Flooding Resilience
- Cultural & Historic Preservation
- Scenic Preservation
- Protected Landscapes Resilience
- Water Quality Improvement

Outdoor recreation is also an important component of the ConserveVirginia strategy and is addressed across the seven categories.

PROTECTED LANDS

Many already-protected lands still have substantial restoration needs, and VARTF may be able to provide funding to pursue much-needed restoration and management on these properties. Therefore, protected Lands throughout Virginia are also included in Tier 2 Priority Areas.

Data Analysis

The various resilience datasets were processed using raster analysis in ArcGIS. Freshwater resilience data were in a vector format (based on stream networks from the National Hydrography Dataset); however, a combination of the ARA and watersheds (12-digit Hydrologic Units) were used to represent these data in the analysis. The ARA data already existed in a raster format and 12-digit hydrologic units were vector polygons that were converted to raster. Resilient terrestrial and coastal sites were also natively in a raster format. Polygon boundaries (often hydrologic unit boundaries) around stream networks with both high/highest and mixed freshwater resilience network scores were used to extract the raster ARA data. These rasters were then mosaicked with raster hydrologic unit data to capture both the ARA and surrounding watershed. The rasters representing freshwater resilience were also overlaid with the terrestrial resilience raster to identify areas of overlap and thus highest priority areas (Figure 7).

[35] *https://www.dcr.virginia.gov/conservevirginia/*

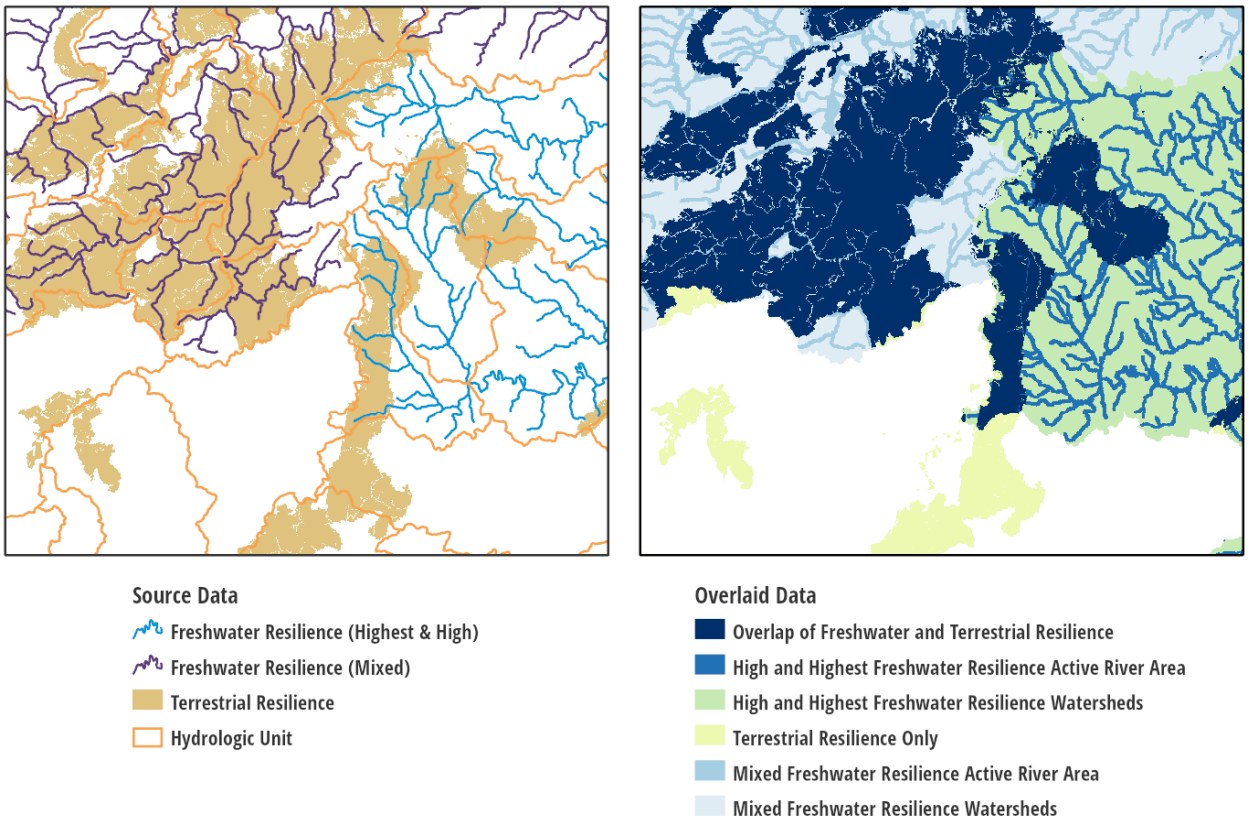


FIGURE 7. EXAMPLE OF INPUT DATA AND OVERLAY PROCESS.

Applying M-PACT

Using Model Outputs

When evaluating individual project opportunities, the M-PACT serves as a screening tool to determine if further site-specific priority assessment is appropriate. In determining where to target mitigation funds or prioritize multiple project opportunities, Tier 1 areas with overlap between freshwater and terrestrial resilience are most preferred, and areas mixed freshwater resilience are the lowest priority . The Tier 1 statewide model and prioritization are is illustrated in Figure 8. For Tier 2 priorities, equal consideration is given to all areas. The Tier 2 statewide model is shown in Figure 9. Basin specific maps are shown in Part 2.

Other Prioritization Requirements and Considerations

Once a potential project is determined to align with the CPF, the following criteria will be considered when selecting compensation sites. These criteria will be used to select project sites with the intention of increased success and quality of aquatic resource restoration and preservation.

1. ***Likelihood of success:*** Projects must demonstrate a high likelihood of success through a sound restoration concept. Water sources for wetland restoration sites should be reliable and capable of functioning with little or no human intervention. Project location in the watershed should be considered in evaluating likelihood of success. Threats from invasive species, site constraints, and landowner requirements should be manageable. Projects should be evaluated for their ability to result in successful and sustainable ecological function with limited maintenance.

2. ***Functional uplift:*** Projects including higher amounts of restoration and enhancement are intended to receive priority due to the higher lift in function that can be achieved. Projects that provide the greatest improvements at a watershed scale should be prioritized for restoration.

3. ***Multiple objectives:*** Projects will be evaluated for their ability to address multiple functions and services such as improvement of wildlife habitat, support for at-risk species, flood attenuation, water quality improvements, ability to serve as demonstration project or leverage toward other high priority conservation projects, and educational values. Projects should target native plant community diversity and natural processes. Greater functional gains should be given preference.

4. ***Compatibility with local land use objectives and plans:*** Projects should be located where mitigation activities will be compatible with local land use planning objectives.

5. ***Site selection that meets the 2008 Compensatory Mitigation Rule requirements:*** The compensatory mitigation project site must be ecologically suitable for providing the desired aquatic resource functions. In determining the ecological suitability of the compensatory mitigation project site, the following factors must be considered:
   (i) Hydrological conditions, soil characteristics, and other physical and chemical characteristics;
   (ii) Watershed-scale features, such as aquatic habitat diversity, habitat connectivity, and other landscape scale functions;
   (iii) The size and location of the compensatory mitigation site relative to hydrologic sources (including the availability of water rights) and other ecological features;
   (iv) Compatibility with adjacent land uses and watershed management plans;
   (v) Reasonably foreseeable effects the compensatory mitigation project will have on ecologically important aquatic or terrestrial resources (e.g., shallow sub-tidal habitat, mature forests), cultural sites, or habitat for federally- or state-listed threatened and endangered species; and
   (vi) Other relevant factors including, but not limited to, development trends, anticipated land use changes, habitat status and trends, the relative locations of the impact and mitigation sites in the stream network, local or regional goals for the restoration or protection of particular habitat types or functions (e.g., re-establishment of habitat corridors or habitat for species of concern), water quality goals, floodplain management goals, and the relative potential for chemical contamination of the aquatic resources.

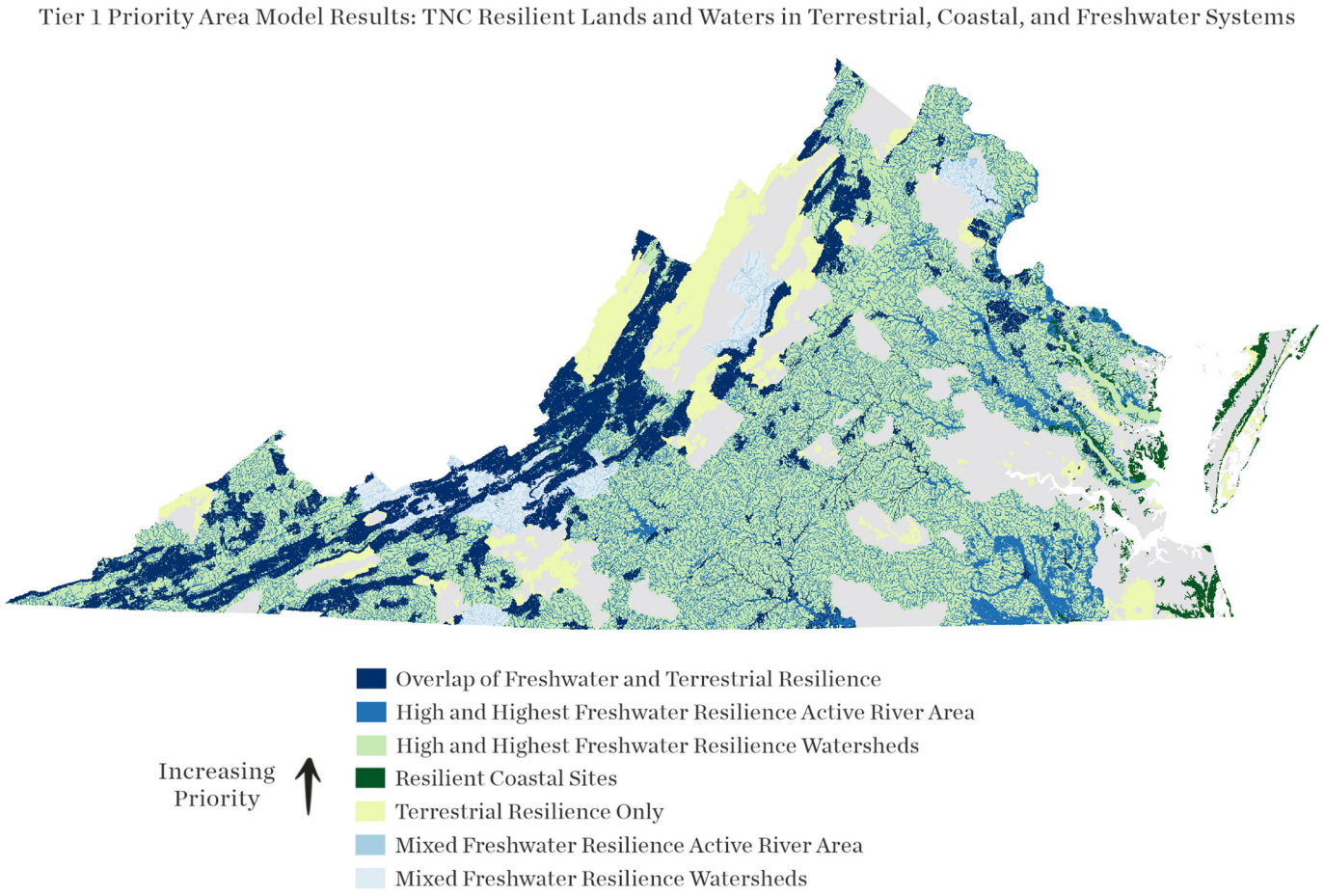


FIGURE 8. TIER 1 PRIORITY AREA MODEL RESULTS: TNC RESILIENT LANDS AND WATERS IN TERRESTRIAL, COASTAL, AND FRESHWATER SYSTEMS.

TABLE 2. VARTF CONTRIBUTIONS TO TIER 1 PRIORITY AREA OBJECTIVES

Tier 1 M-PACT Priority Areas	Type/ System of Focus for Conservation Action		Primary Interests within Focal Landscapes *(for which VARTF can help achieve objectives)*	Conservation Objectives of Primary Interests	Potential Contribution of VARTF Projects
Resilient and Connected Systems	Freshwater Resilient Network Terrestrial Resilient and Connected Network Coastal Resilient Network			Maintain and enhance resiliency and connectivity of network.	Compensation projects can contribute to maintenance or enhancement of resilient sites through preservation or restoration that protects or restores the natural condition and/or function and adaptive capacity of upland or aquatic resources within the network.
Focal Landscapes	Virginia Pinelands		Pine Savanna Habitats; Nottoway River and tributary streams below the fall-line; Albemarle Sound forests and marshes	Increase the area of pine savanna habitat and associated species/ Protect priority tracts to avoid risk of forest ownership fragmentation and facilitate riparian forest restoration. Reduce the loss of resilient and connected riparian forest/ Reduce volume of timber harvest in riparian areas. Increase the contribution of sustainable natural resource-based activities to the regional economy. Preserve flood risk reduction services provided by Albemarle Sound portion of VA Beach and Chesapeake.	Compensation projects can contribute to permanently protected acres, and help facilitate restoration, of resilient southern pine savanna habitat that can efficiently be managed with fire to support a self-sustaining and resilient population of red-cockaded woodpeckers, prevent incompatible timber harvest in riparian areas, help establish connections to the Longleaf system of the southern region, and protect/ restore forests and marshes to preserve flood risk reduction services to people. Restoration/enhancement activities of flatwoods, vernal pools, seeps, etc. would be beneficial where this enhances the habitat matrix/ heterogeneity.
	Central Appalachians (including Clinch Valley and Allegheny Highlands)	Matrix Forest Systems	Central Oak-Pine Forests	Restore forest complexity and diversity to more closely resemble the natural range of variation. Maintain oak or pine as the dominant component of the landscape, depending on site-specific conditions.	Compensation projects, including forest restoration/management (e.g., invasive species control, native vegetation establishment) and preservation projects can (1) improve and maintain forest complexity, diversity, connectivity, functionality, and carbon sequestration, (2) enhance and protect habitat and climate adaptation for rare forest-dependent wildlife, including forest interior neotropical migratory birds, golden-winged warblers, and rare bats, (3) can protect against fragmentation and development through protection of priority forested lands, and (4) maintain/ protect/restore the hydrology of montane alluvial wetlands/bogs.
			Cove Forests	Increase the benefits that forests provide to people and nature (i.e., wildlife habitat, air and water quality, recreation, forest products, and carbon sequestration).	
			Spruce-fir and Northern Hardwood and Conifer	Maintain the functionality of evergreen riparian tree canopy.	
			S. Ridge and Valley/ Cumberland Dry Calcareous and Alkaline Glades	Maintain extent and maximize connectivity (where possible) of small patch forest communities as a component of complexity and diversity in the landscape, and minimize impacts from fragmentation, invasive species/pests and pathogens.	
			Acidic Barrens and Glades		
			Forest Interior Birds	Maximize diversity of, and maintain suitable nesting and foraging habitats for, forest interior neotropical migratory birds.	
			Rare Bats	Minimize loss of bat populations due to white-nose syndrome (WNS) and maintain suitable habitat for recovery efforts.	
			Golden-winged Warbler	Maintain extant populations of golden-winged warbler in Bath and Highland counties, and other critical populations as identified within Virginia.	

Tier 1 M-PACT Priority Areas	Type/ System of Focus for Conservation Action		Primary Interests within Focal Landscapes *(for which VARTF can help achieve objectives)*	Conservation Objectives of Primary Interests	Potential Contribution of VARTF Projects
		Caves and Karst Systems	Rare Cave Invertebrates	Minimize hydrological alterations and stress to karst and groundwater recharge systems. Minimize localized impacts to cave conservation sites and maintain persistence of rare and endemic cave invertebrate communities. Increase the extent of natural vegetation in karst recharge zones and around cave openings (to improve water quality and habitat conditions for cave-dwelling species).	Compensation projects, including livestock exclusion and stream, wetland, and buffer restoration and enhancement projects can enhance hydrology and quality of waters linked to key karst systems. Preservation and land protection can (1) protect important cave systems and species, and (2) prevent habitat fragmentation or land conversion in karst recharge zones. Mitigation projects can also provide locations for research to better understand impacts of agriculture and biological conditions of cave-dwelling communities.
		Freshwater Systems	Large Rivers	Minimize nutrient and sediment inputs into rivers and tributaries.	Livestock exclusion, stream/ wetland/ buffer restoration and enhancement projects can reduce nutrient and sediment inputs into rivers and tributaries and increase or preserve natural land cover and connectivity of priority riparian areas.
			Headwater Streams	Maximize forested buffers/ riparian zones along headwater streams.	
			Montane Non-Alluvial Wetlands	Maintain extent and maximize connectivity (where possible) of montane, non-alluvial wetland communities as a component of complexity and diversity in the landscape.	Projects can aid in maintaining extent/ maximizing connectivity of montane non-alluvial wetlands.
			Endemic Cumberlandian Mussel Assemblage	Recover self-sustaining, diverse mussel assemblages throughout the Clinch, Powell, and North Fork Holston rivers.	Preservation projects can protect waterways harboring priority mussel assemblages and fish populations, and restoration projects can support recovery and adaptive management of these priority fauna.
			Upper Tennessee River Fish Assemblage	Maintain current fish diversity and increase fish population densities by connecting and improving habitat in the Clinch, Powell and North Fork Holston rivers.	
	Volgenau Virginia Coast Reserve		Tidal Creeks	Maximize water quality in tidal creeks, Atlantic coastal bays, and seaside coastal bays.	Restoration, preservation, and land protection can contribute to (1) increasing extent and connectivity of forest and scrub-shrub land cover, (2) expanding and protecting available habitat for migratory land birds, (3) restoring and/or protecting wetlands which can prevent fragmentation, provide opportunities for marsh migration, and minimize risk of and exposure to sea-level rise, flooding, and surge, and (4) prevent conversion of forested lands, and ensure connectivity between uplands and floodplain/marshes, in particular in riparian zones, groundwater recharge areas, swamps, and floodplains. Livestock exclusion and stream, wetland, and buffer restoration and enhancement projects can improve water quality in tidal creeks, Atlantic coastal bays, and seaside coastal bays. In specific locations, compensation projects can potentially support restoration of oyster reefs, eelgrass, submerged aquatic vegetation, and bay scallops.
			Mainland Marshes	Maximize opportunities of mainland marsh migration landward on both bayside and seaside.	
			Oyster Reefs	Maximize oyster reef habitat on seaside and bayside.	
			Bay Scallops	Maximize self-sustaining bay scallop population on seaside.	
			Eelgrass Meadows	Maximize eelgrass meadows in seaside coastal bays.	
			Migratory Land Birds Shorebirds, Water Birds	Maximize viable populations of shorebirds and water birds.	
			Forest and Scrub Shrub	Maximize land protection and restoration opportunities. Minimize risk of and exposure to sea-level rise, flooding, and surge for homes and infrastructure. Maintain sustainable and productive natural resource-based working lands that protect water quality.	

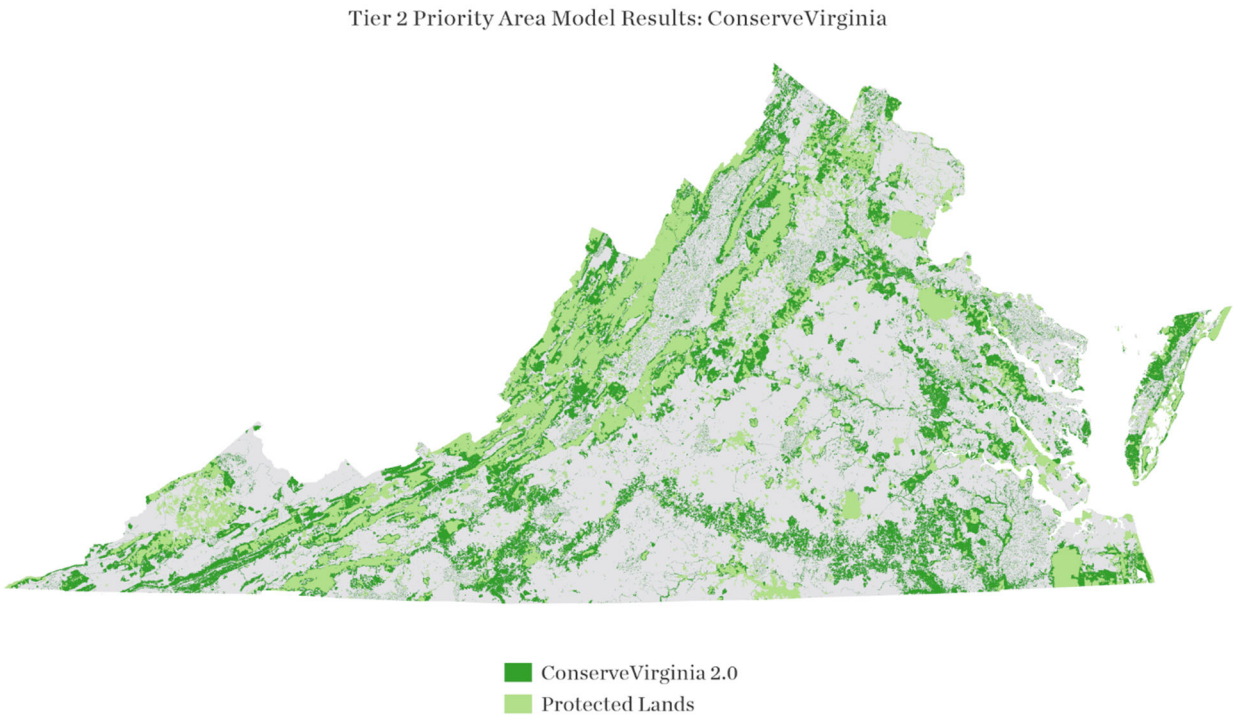


FIGURE 9. TIER 2 PRIORITY AREA MODEL RESULTS: CONSERVEVIRGINIA AND PROTECTED LANDS.

TABLE 3. SPATIAL DATA INCLUDED IN M-PACT PRIORITIZATION MODEL.

M-PACT Tier	Category	Spatial Data
Tier 1 (TNC Resilient & Connected Systems)	TNC Freshwater Resilience	ARA that intersects highest & high rank from freshwater resilient network
	TNC Freshwater Resilience	Remainder of 12-digit hydrologic units with highest & high freshwater resilience
	TNC Freshwater Resilience	ARA that intersects mixed rank (with condition low) from freshwater resilient network
	TNC Freshwater Resilience	Remainder of 12-digit hydrologic units with mixed/condition low freshwater resilience
	TNC Terrestrial and Coastal Resilience	Terrestrial Resilient and Connected Network (including coastal)
Tier 1 (TNC Focal Landscapes)	Virginia Pinelands	Priority blocks for Longleaf pine management/restoration
	Central Appalachians	Central Appalachians critical habitats (includes Matrix Forests, Caves and Karst, and Freshwater)
	Volgenau Virginia Coast Reserve	Volgenau Virginia Coast Reserve program boundary
Tier 2 (DCR ConserveVirginia)	Agriculture & Forestry	Virginia Department of Conservation and Recreation - Virginia ConservationVision Agricultural Model
		Virginia Department of Forestry - Forest Conservation Value (FCV) Model
	Natural Habitat & Ecosystem Diversity	Virginia Department of Conservation and Recreation - Virginia Natural Landscape Assessment, Outstanding category cores
		Virginia Department of Conservation and Recreation - Virginia Natural Landscape Assessment, Landscape Corridors
		The Nature Conservancy - Resilient and Connected Landscapes
		Virginia Department of Conservation and Recreation - Natural Heritage Conservation Sites
		Virginia Department of Wildlife Resources - Brook Trout Streams
	Floodplains & Flooding Resilience	Virginia Department of Emergency Management - Commonwealth of Virginia Hazard Mitigation Plan
		Virginia Department of Conservation and Recreation - Virginia ConservationVision Wetlands Catalog
		The Nature Conservancy - coastal ecological resiliency map model
		Virginia Institute of Marine Science - coastal wetlands map model
	Cultural & Historic Preservation	Virginia Department of Historic Resources - unprotected National Historic Landmarks, Priority 1 Class A Battlefield Study Areas, Priority 1 Class B Battlefield Core Areas, National Register of Historic Places, and sites on the Virginia Landmarks Register or with potential for eligibility in these registers
		Civil War Trails - USCT-African American Units Involvement Battlefields
	Scenic Preservation	Virginia Department of Conservation and Recreation - statewide map of national and state designated scenic byways, state designated scenic rivers, All-American roads, national scenic trails, national historic trails, national millennium trails, and national recreational trails
	Protected Landscapes Resilience	U.S. Fish and Wildlife Service, National Park Service, Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation and Virginia Department of Forestry - priority lands and waters around existing protected lands
	Water Quality Improvement	Virginia Department of Conservation and Recreation, Virginia Department of Environmental Quality - priority buffers mapped for protection using Chesapeake Bay Program Phase 6 Watershed Model (CAST-2017d) and Virginia Water Quality Assessment, and with consideration of the goals of the Chesapeake Bay Watershed Implementation Plan (WIP III)
	Outdoor recreation - addressed across the seven categories	Virginia Department of Conservation and Recreation - all public access lands and trails, along with access points to these lands and trails (terrestrial component)
		Virginia Department of Conservation and Recreation - boat launches, public fishing lakes, stocked trout reaches, public beaches and other non-pool swimming access, along with access points to these and other public waters (aquatic component)
Tier 2 (Protected Lands)	Conservation Lands Database	Virginia Department of Conservation and Recreation - a digital compilation of all protected lands in the Commonwealth (https://www.dcr.virginia.gov/natural-heritage/clinfo), continually reviewed and updated by the Virginia Department of Conservation and Recreation, with data publicly available through the Natural Heritage Data Explorer online mapping tool (https://vanhde.org/content/map)

Improving M-PACT

The M-PACT is a GIS-based spatial tool and new data and updates to data layers are expected in the future. As updates or further refinements to spatial priorities occur over time, VARTF intends to update the tool to reflect the most up-to-date spatial data available.

M-PACT currently compiles available conservation values into one "asset map" identifying high value areas to help inform where VARTF pursues potential project development. TNC is interested in using finer scale data the Geographic Service Areas to analyze specific needs for improvement of watershed health and stream connectivity, such as the lack of adequate riparian buffers, the existence of barriers that if removed could enhance longitudinal connectivity, etc. Other improvements to explore include methods to identify opportunities to expand existing protected lands how restoration may increase resilience.

V. CONCLUSION

With a 25-year history and as a leader among in-lieu fee mitigation programs in the country, VARTF exceeds requirements for no net loss for impacts to wetlands and streams. By utilizing conservation strategies developed by TNC scientists, VARTF protects and restores high-quality, resilient habitats that support rare species, sensitive communities, and ecological integrity. This Compensation Planning Framework aims to identify ecologically significant sites in order to provide habitat uplift and water quality improvement to Virginia's most important natural communities and corridors.

VARTF has identified priority areas for siting future compensatory mitigation projects through a tiered approach incorporating both TNC and partner focal areas for conservation and restoration. Multiple spatial datasets have been ranked and combined to create the M-PACT for the evaluation of potential mitigation sites. The Tier 1 Priority Areas include lands and waters identified by TNC as Resilient and Connected Systems, which are areas that are expected to support biodiversity and maintain function in response to climate change, and those landscape priorities that focus conservation efforts on critical habitats in Virginia. Tier 2 Priority Areas reflect partner priorities, which include agency partners' aquatic conservation and restoration initiatives identified through ConserveVirginia and already-protected lands. Locating compensatory mitigation projects within Tier 1 Priority Areas will be the top priority for siting future projects, though Tier 2 provides VARTF additional opportunities for project identification where mitigation needs exist, and a project cannot be acquired within Tier 1.

Potential future work on the M-PACT tool includes refinements to incorporate updated data as they are developed, development of "action maps" to identify potential projects within the M-PACT priority areas, and identification of opportunities to expand existing protected lands. VARTF also plans to explore TNC's climate resilience modeling with the aim of answering questions around how restoration may increase resilience.

As this Compensation Planning Framework incorporates the most relevant and available science for conserving resilient lands and waters as well as the collaborative conservation priorities of statewide partners, it can serve as a model for other states and ILF programs across the country. With the expectations to utilize the most up to date and relevant data, this framework can also serve as a watershed approach to be used by all mitigation providers in Virginia, to collectively advance the protection and restoration of the highest environmental targets within the state.

PART TWO. OVERVIEW OF PRIORITY CONSERVATION AREAS BY GEOGRAPHIC SERVICE AREA[36]

A description for each Geographic Service Area (GSA) of VARTF is provided in the following section. Each GSA contains a general description, including the 8-digit Hydrologic Unit Codes (HUCs) represented within the GSA, and some general statistics for the area. The table in each GSA represents which priority conservation areas may be present in all or portions of the GSA. The maps in each section show the spatial distribution of priority areas within the two tiers of the M-PACT.

GEOGRAPHIC SERVICE AREA 1. ATLANTIC OCEAN

DESCRIPTION

The Atlantic Ocean GSA is found along the seaside of the Eastern Shore of Virginia located on the lower Delmarva Peninsula, and is part of Northampton and Accomack counties. In Virginia, the Atlantic Ocean basin is comprised of two HUCs (02040303 and 02040304). The Atlantic Ocean basin is approximately 336 square miles in area or approximately 0.8 percent of the Commonwealth's total land area. The watershed divide on the Eastern Shore runs roughly along Highway 13 where creeks and streams drain into the coastal bays on the east side of the highway. The seaside of the Eastern Shore is of both ecoregional and global importance for its remarkable estuarine, coastal and marine habitats and spectacular populations of migratory and breeding shorebirds, colonial waterbirds, landbirds and raptors. The coastal lagoons and barrier islands are largely unaltered by human impact and are considered the best remaining Atlantic coast wilderness. The Eastern Shore's enormous ecological value is recognized through its designation as a site within the United Nation's international "Man and the Biosphere Reserve Program," the U.S. Department of the Interior's National Natural Landmark, a National Science Foundation Long Term Ecological Research Site, and a Western Hemisphere International Shorebird Reserve Network Site.

Protected lands on the Eastern Shore of Virginia (including both the Atlantic Ocean basin and Chesapeake Bay basin portions) comprise roughly 128,400 acres or 31% of the total area of the Eastern Shore in Virginia (approximately 419,000 acres total). The Commonwealth of Virginia is the largest landowner, owning about one-third of the total protected lands, or roughly 43,500 acres. The Nature Conservancy is the largest private landowner with 21,376 acres in preserves and 16,272 acres in other land holdings, equaling almost 9% of the total Eastern Shore area. The U.S. Fish and Wildlife Service (USFWS) owns and manages 4 National Wildlife Refuges that collectively equal 16,500 acres.

About 25 percent of the Atlantic Ocean basin is forested, while nearly 26 percent is in cropland and pasture/hay. Approximately 1.2 percent is considered developed. The Eastern Shore of Virginia is still considered a largely rural, agrarian refuge on the heavily populated mid-Atlantic seaboard. It historically has been a quiet, sparsely populated land of fishermen and farmers. However, though still a modest 45,500 people in size, the Eastern Shore is rapidly changing with the increasing development of second homes and resorts due to the booming population of the Hampton Roads area.

Tier 1 Priority Areas within the Atlantic Ocean GSA include terrestrial and coastal resilient and connected systems. The Volgenau Virginia Coast Reserve TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia

[36] *Please note that geographic service area descriptions except for Atlantic Ocean are adapted from Virginia DEQ, DCR, and VDH's draft report "Virginia Water Quality Assessment 305(b)/303(d) Integrated Report 2020."*

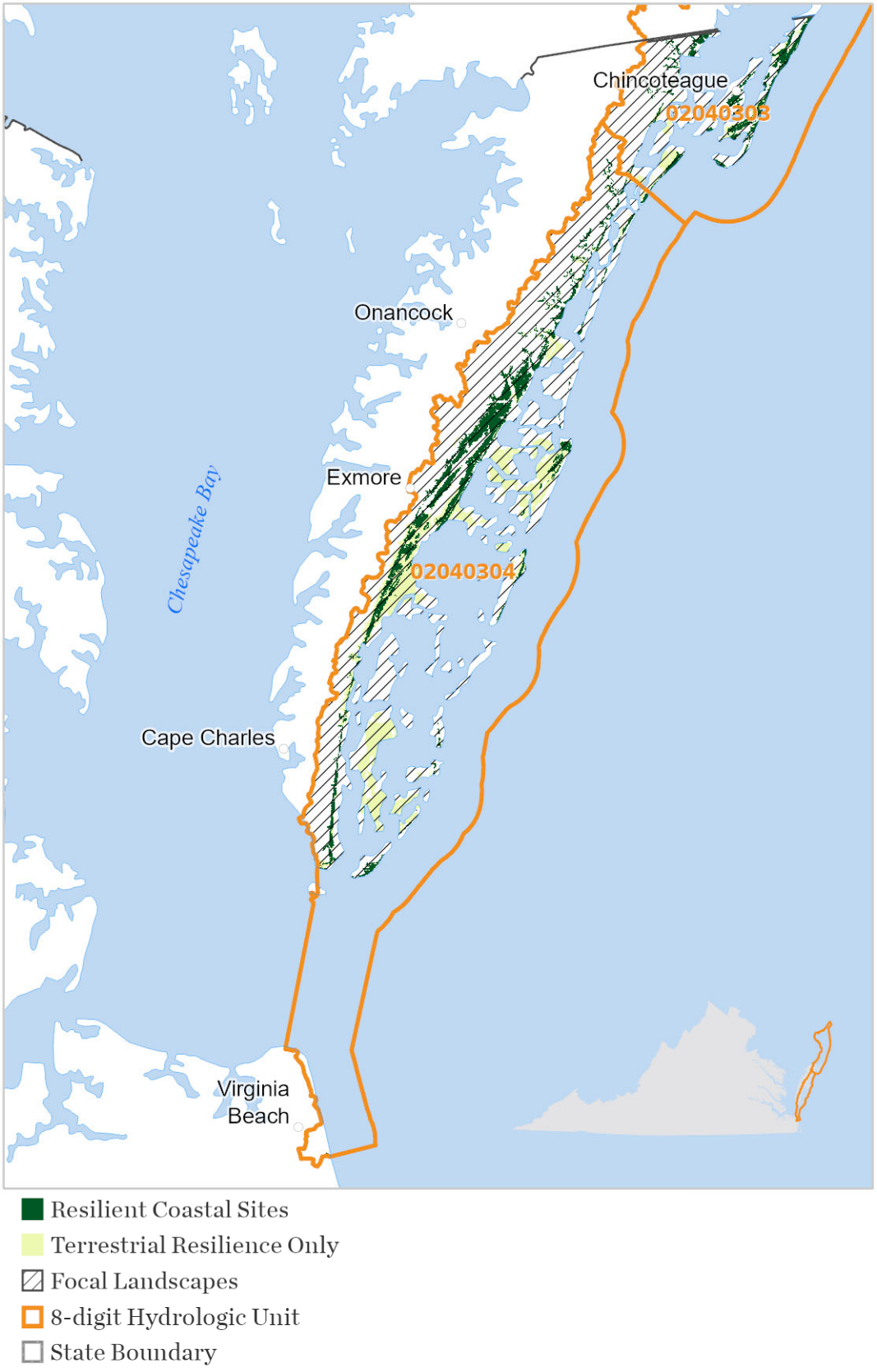
map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 1 – 2)

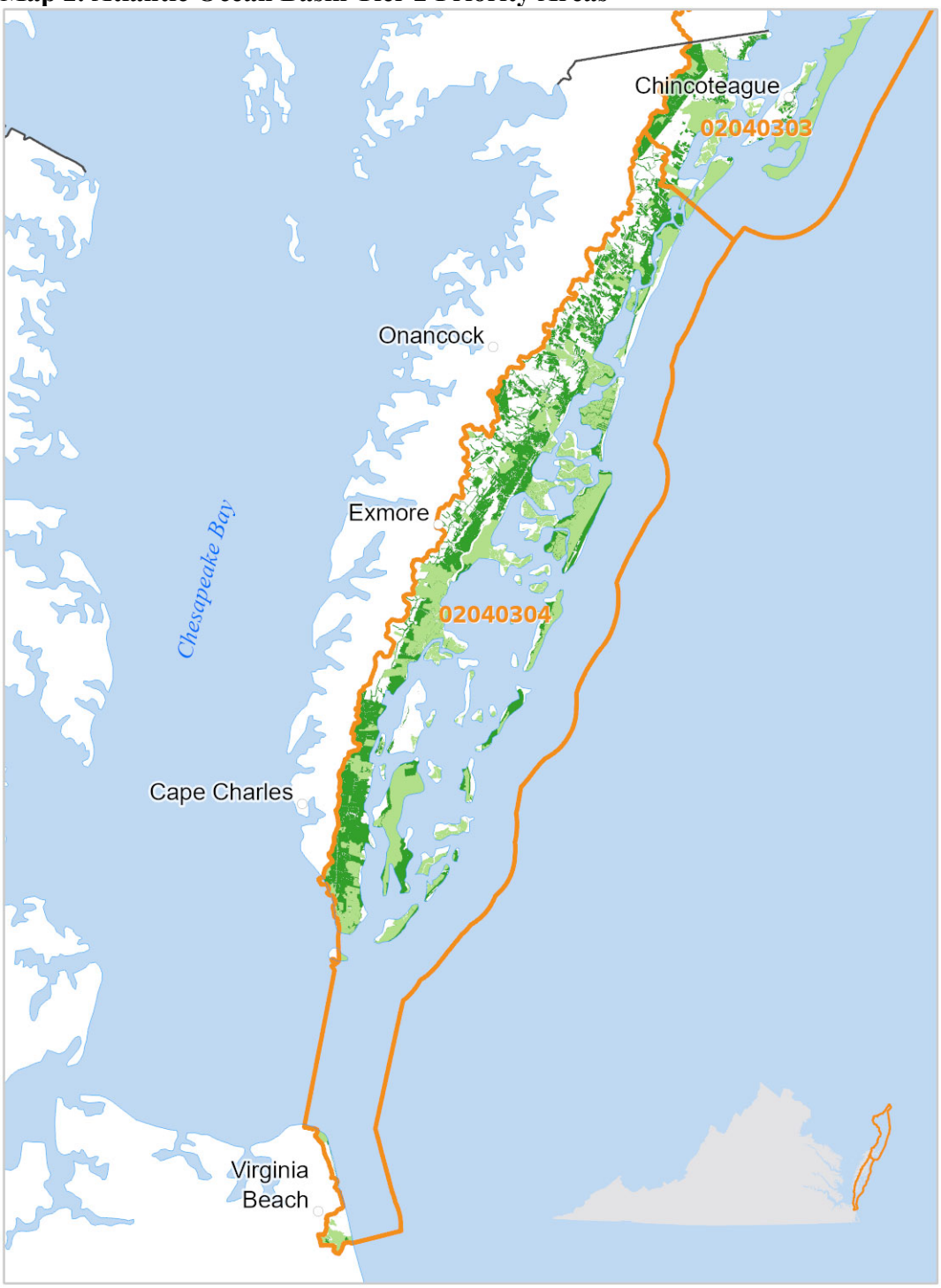
Atlantic Ocean Basin Priority Areas

Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
Focal Landscapes	Volgenau Virginia Coast Reserve	Migratory Land Birds
		Tidal Creeks
		Mainland Marshes
		Oyster Reefs
		Bay Scallops
		Eelgrass Meadows
		Shorebirds and Water Birds
		Forest and Scrub Shrub
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	Other TNC Ownership	
	State Lands	
	TNC Preserve	

Map 1. Atlantic Ocean Basin Tier 1 Priority Areas



Map 2. Atlantic Ocean Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 2. CHESAPEAKE BAY

DESCRIPTION

The Chesapeake Bay GSA is located in the eastern part of Virginia and covers 1,006 square miles or approximately 2.4 percent of the Commonwealth's total land area. In Virginia, this basin is comprised of five HUCs (02080101, 02080102, 02080108, 02080110, and 02080111). The basin encompasses the small bays, river inlets, islands and shoreline immediately surrounding the Chesapeake Bay and the southern tip of the Delmarva Peninsula. This basin also includes the Chesapeake Bay itself. The Chesapeake Bay basin is defined by both hydrologic and political boundaries. The Potomac River Basin, the Rappahannock River Basin, the York River Basin, the James River Basin and the Chowan River Basin border the basin to its west. The Eastern Shore portion is bordered on the west by the Chesapeake Bay, on the north by Maryland, and on the east by the Atlantic Ocean. The topography of the Chesapeake Bay basin varies little. The entire basin lies within the outer Coastal Plain Physiographic Province where elevations average no more than a few feet above sea level. More significant elevation occurs along the central spine of the Eastern Shore portion, which forms a plateau about 45 feet above sea level. Much of the Chesapeake Bay basin is marshland.

Tributaries in the Chesapeake Bay basin drain into the Chesapeake Bay or the Atlantic Ocean. Major tributaries flowing into the Chesapeake Bay from the western shore are the Great Wicomico River, Piankatank River, Fleets Bay, Mobjack Bay including the East, North, Ware, and Severn Rivers, Poquoson River, Back River and Lynnhaven River. Tributaries in the Eastern Shore portion that drain into the Bay are Pocomoke, Onancock, Pungoteague, Occohannock, and Nassawadox Creeks. Machipongo River, Assawoman Creek, Parker Creek, Folly Creek, and Finney Creek drain east directly into the Atlantic Ocean.

About 52 percent of the Chesapeake Bay basin is forested, while nearly 20 percent is in cropland and pasture. Approximately 3.4 percent is considered urban. All or portions of the following jurisdictions lie within the basin: Counties – Accomack, Gloucester, King and Queen, Lancaster, Matthews, Middlesex, Northampton, Northumberland, and York; Cities – Chesapeake, Hampton, Newport News, Norfolk, Poquoson, and Virginia Beach.

Tier 1 Priority Areas within the Chesapeake Bay GSA include terrestrial and coastal resilient and connected systems. The Volgenau Virginia Coast Reserve TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

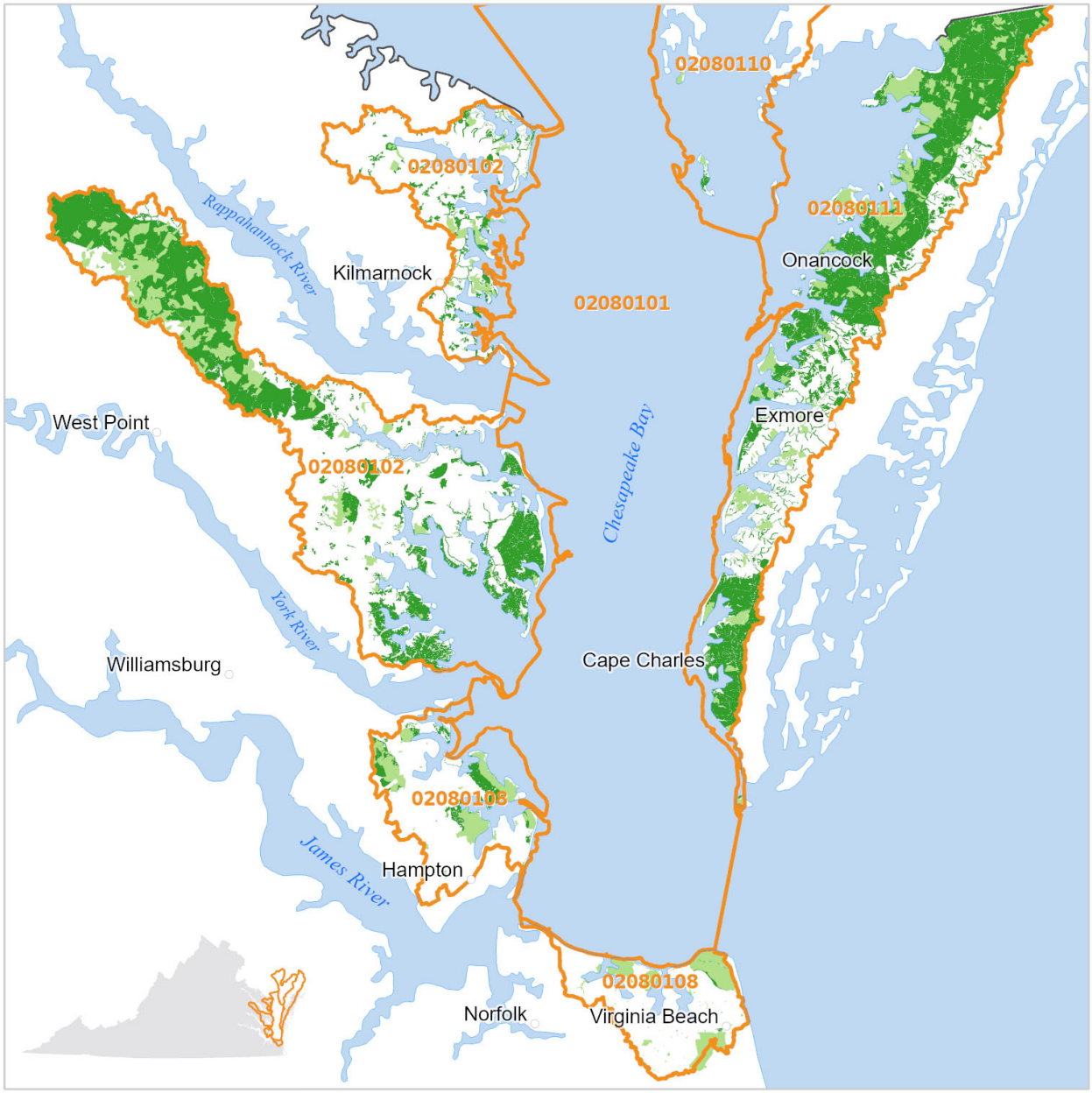
PRIORITY CONSERVATION AREAS (SEE MAPS 3 – 4)

Chesapeake Bay Basin Priority Areas

Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
Focal Landscapes	Volgenau Virginia Coast Reserve	Migratory Land Birds
		Tidal Creeks
		Mainland Marshes
		Oyster Reefs
		Shorebirds and Water Birds
		Forest and Scrub Shrub
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	Other TNC Ownership	
	State Lands	
	TNC Preserve	

Map 3. Chesapeake Bay Basin Tier 1 Priority Areas

Map 4. Chesapeake Bay Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 3. CHOWAN RIVER

DESCRIPTION

The Chowan River GSA is located in the southeastern portion of Virginia and covers 4,144 square miles or approximately 10 percent of the Commonwealth's total area. In Virginia, this basin is comprised of five HUCs (03010201, 03010202, 03010203, 03010204, and 03010205). The basin extends eastward from Charlotte County to the Chesapeake Bay. The Chowan River basin in Virginia is defined by both hydrologic and political boundaries – the James River basin to the north, the Chesapeake/Atlantic and Small Coastal River basins to the east, the Roanoke River basin to the west and the Virginia/North Carolina state line to the south. The basin is approximately 145 miles in length and varies from 10 to 50 miles in width.

The Chowan River basin flows through the Piedmont and Coastal Plain Physiological Provinces. The Chowan portion flows 130 miles from west to east, crossing both the Piedmont and Coastal Plain, while the Dismal Swamp lies entirely within the Coastal Plain. The Piedmont portion is characterized by rolling hills, steeper slopes and somewhat more pronounced stream valleys. The Coastal Plain, in contrast, is nearly flat with a descending series of terraces. Major tributaries of the Chowan River are the Meherrin, the Nottoway and the Blackwater. The Nottoway and the Blackwater join at the Virginia/North Carolina state line to form the Chowan River. The Dismal Swamp portion is mostly flat with many swamp and marshland areas.

The Chowan River basin is mostly rural with approximately 62 percent of its land covered by forest. Cropland and pasture make up another 20 percent, while only about 0.6 percent is classified as urban. The 2010 population for the Chowan River Basin was approximately 597,900. All or portions of the following 13 counties and 6 cities lie within the basin: counties – Brunswick, Charlotte, Dinwiddie, Greensville, Isle of Wight, Lunenburg, Mecklenburg, Nottoway, Prince Edward, Prince George, Southampton, Surry, and Sussex; Cities – Chesapeake, Emporia, Franklin, Petersburg, Suffolk, and Virginia Beach.

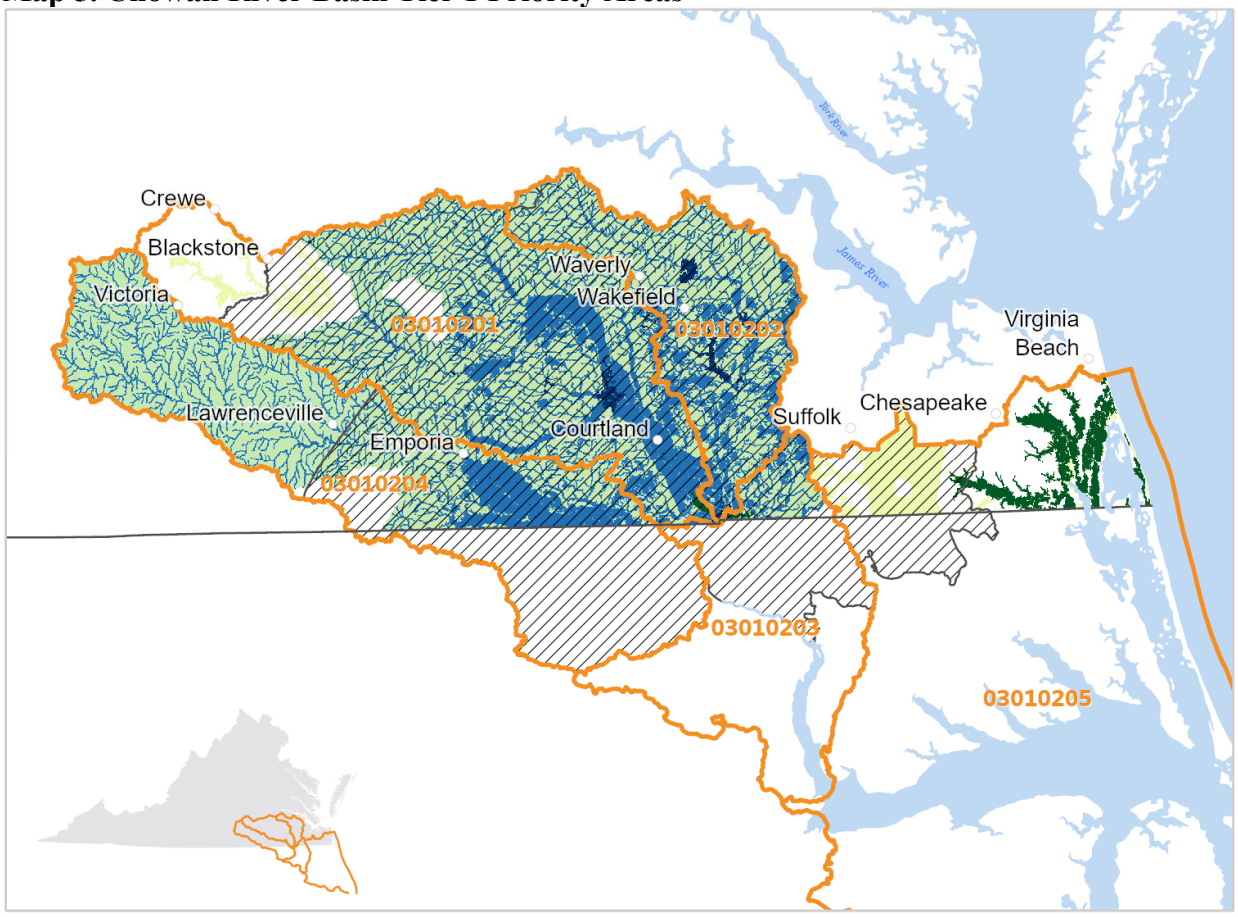
Tier 1 Priority Areas within the Chowan River GSA include freshwater, terrestrial, and coastal resilient and connected systems. The Virginia Pinelands TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 5 - 6)

Chowan River Basin Priority Areas

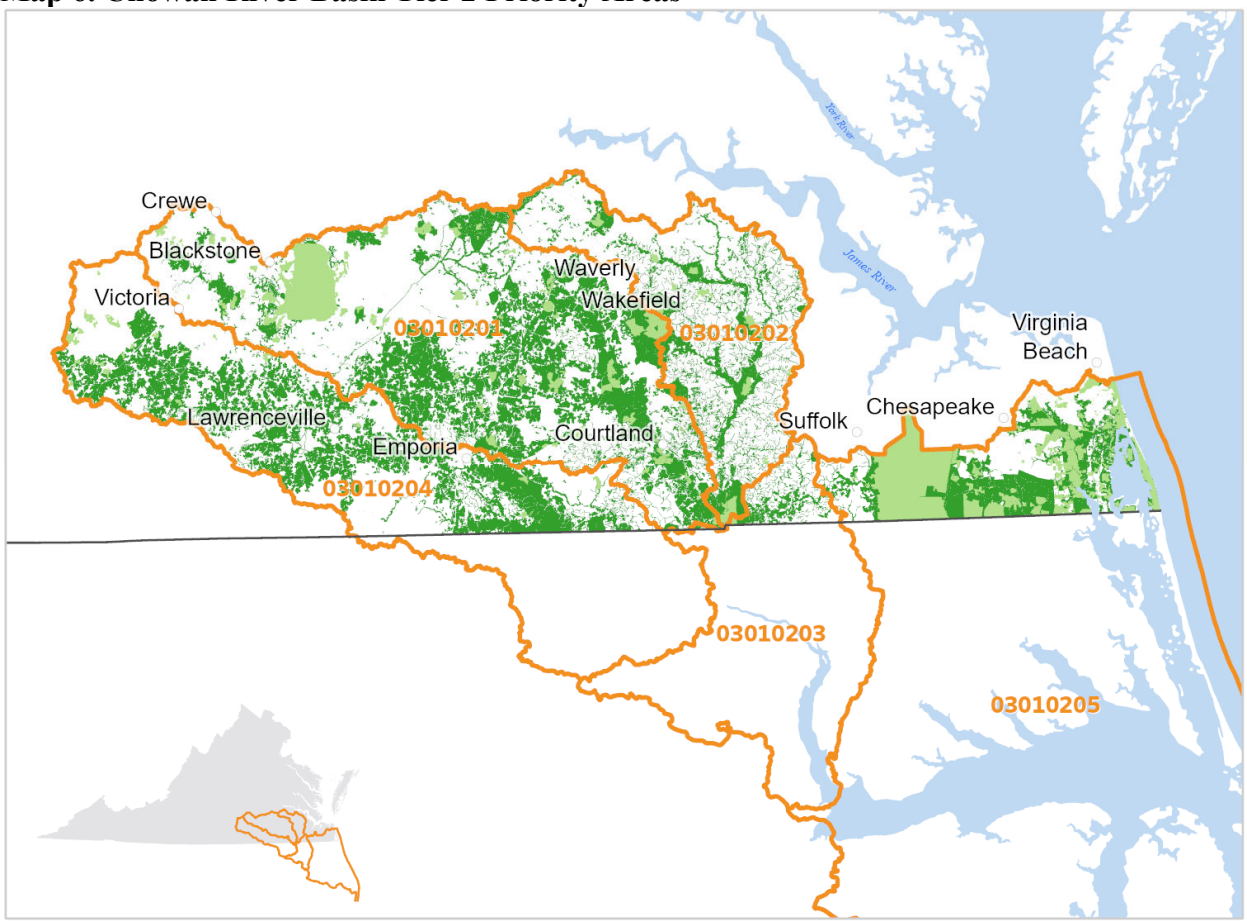
Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
Focal Landscapes	Virginia Pinelands	Pine Savanna Habitats
		Nottoway River and Tributary Streams Below the Fall-Line
		Albemarle Sound Forests and Marshes
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	Other TNC Ownership	
	State Lands	
	TNC Preserve	

Map 5. Chowan River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Resilient Coastal Sites
- Terrestrial Resilience Only
- Focal Landscapes
- 8-digit Hydrologic Unit
- State Boundary

Map 6. Chowan River Basin Tier 2 Priority Areas



ConserveVirginia 2.0
Protected Lands
8-digit Hydrologic Unit
State Boundary

GEOGRAPHIC SERVICE AREA 4. LOWER JAMES RIVER

DESCRIPTION

The Lower James River GSA occupies the central portion of Virginia and covers 1,657 square miles or approximately 4% of the Commonwealth's total land area. It is bounded by the York River basin to the north and the Chowan basin to the south. The Lower James River flows from the Fall Line in Richmond for 111 miles before entering the Chesapeake Bay. The Fall Zone is a three-mile stretch of river running through Richmond where the river descends 84 feet as it flows from the resistant rocks of the Piedmont to the softer sediments of the Coastal Plain. This basin is comprised of two HUCs (02080206 and 02080208).

Over 50 percent of the James River basin is forested, with 13 percent in cropland and pasture. Almost 8% percent is considered urban. The Lower James basin is home to Hampton Roads, one of the biggest population centers in Virginia, and basin-wide the population totals roughly 1.5 million people. All or portions of the following counties and cities lie within the basin: Charles City, Chesterfield, Chesapeake, Hampton City, Hanover, Henrico, Hopewell City, Isle of Wight, James City, New Kent, Newport News city, Norfolk city, Portsmouth, Prince George, Richmond city, Suffolk city, Surry, Virginia Beach, Williamsburg and York.

Tier 1 Priority Areas within the Lower James River GSA include terrestrial and coastal resilient and connected systems. There are no Focal Landscapes within this basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

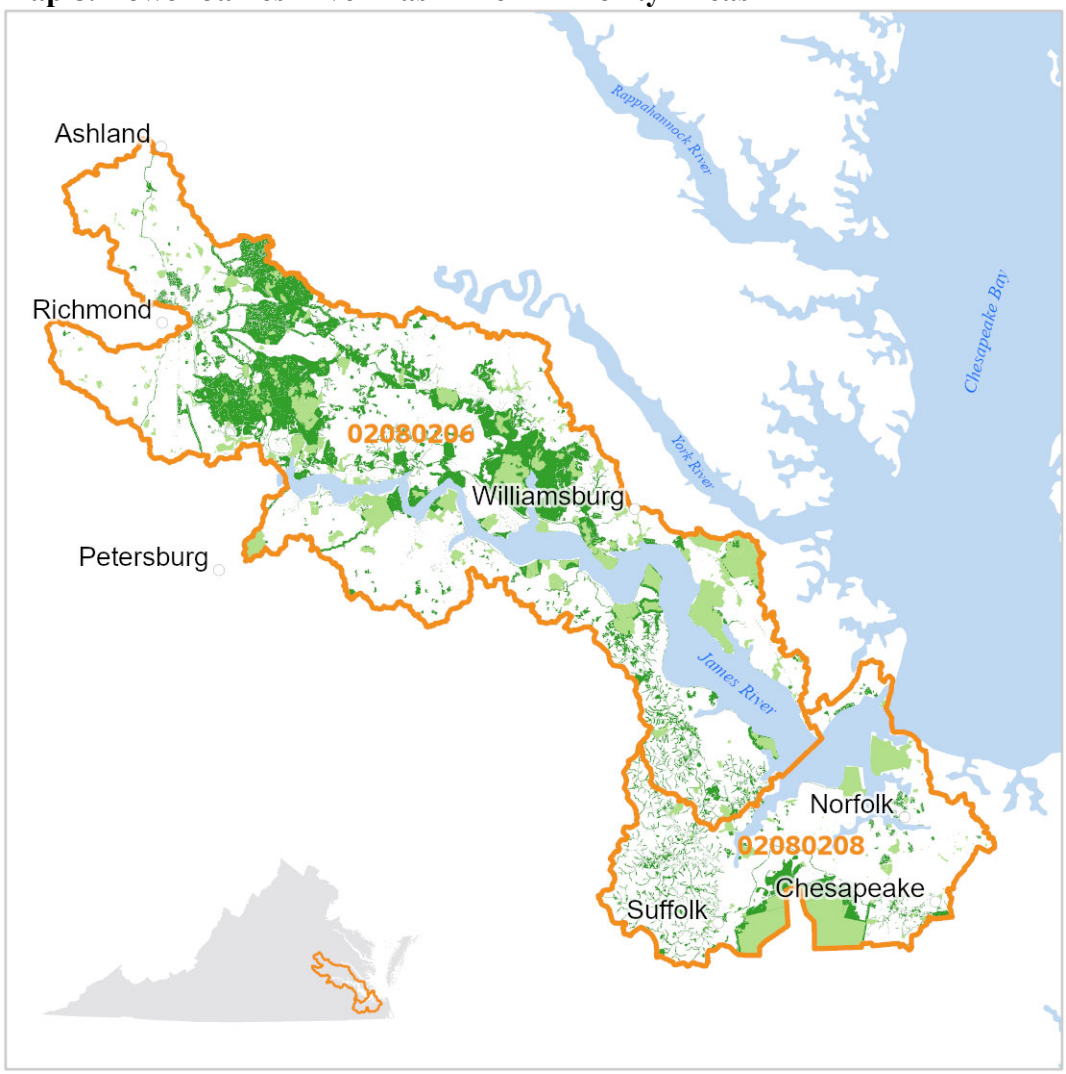
PRIORITY CONSERVATION AREAS (SEE MAPS 7 - 8)

Lower James River Basin Priority Areas

Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
Focal Landscapes	Virginia Pinelands	Pine Savanna Habitats
		Nottoway River and Tributary Streams Below the Fall-Line
		Albemarle Sound Forests and Marshes
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	Other TNC Ownership	
	State Lands	
	TNC Preserve	

Map 7. Lower James River Basin Tier 1 Priority Areas

Map 8. Lower James River Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 5. MIDDLE JAMES RIVER

DESCRIPTION

The Middle James River GSA is approximately 5,291 square miles in area or approximately 12.4 percent of the Commonwealth's total land area. The Middle James River basin is bound by 5 major river basins: the Shenandoah, Rappahannock and York to the north and the Roanoke and Chowan to the south. The Middle James River flows between the Blue Ridge Mountains and the Fall Line, through the Piedmont which has scattered hills and small mountains to the west which give way to gently rolling slopes and lower elevation in the eastern Piedmont. This basin is comprised of four HUCs (02080203, 02080204, 02080205 and 02080207).

Nearly 70 percent of the Middle James River basin is forested, with roughly 15 percent in cropland and pasture. Approximately one percent is considered urban. The population is concentrated in the Richmond, Petersburg, Lynchburg and Charlottesville areas, with over 1.1 million people basin-wide. All or portions of the following counties and cities lie within the basin: Albemarle, Amelia, Amherst, Appomattox, Augusta, Bedford, Botetourt, Buckingham, Campbell, Charlottesville city, Chesterfield, Colonial Heights city, Cumberland, Dinwiddie, Fluvanna, Goochland, Greene, Hanover, Henrico, Hopewell city, Louisa, Lunenburg, Lynchburg city, Nelson, Nottoway, Orange, Petersburg city, Powhatan, Prince Edward, Prince George, Richmond city, Rockbridge, Rockingham.

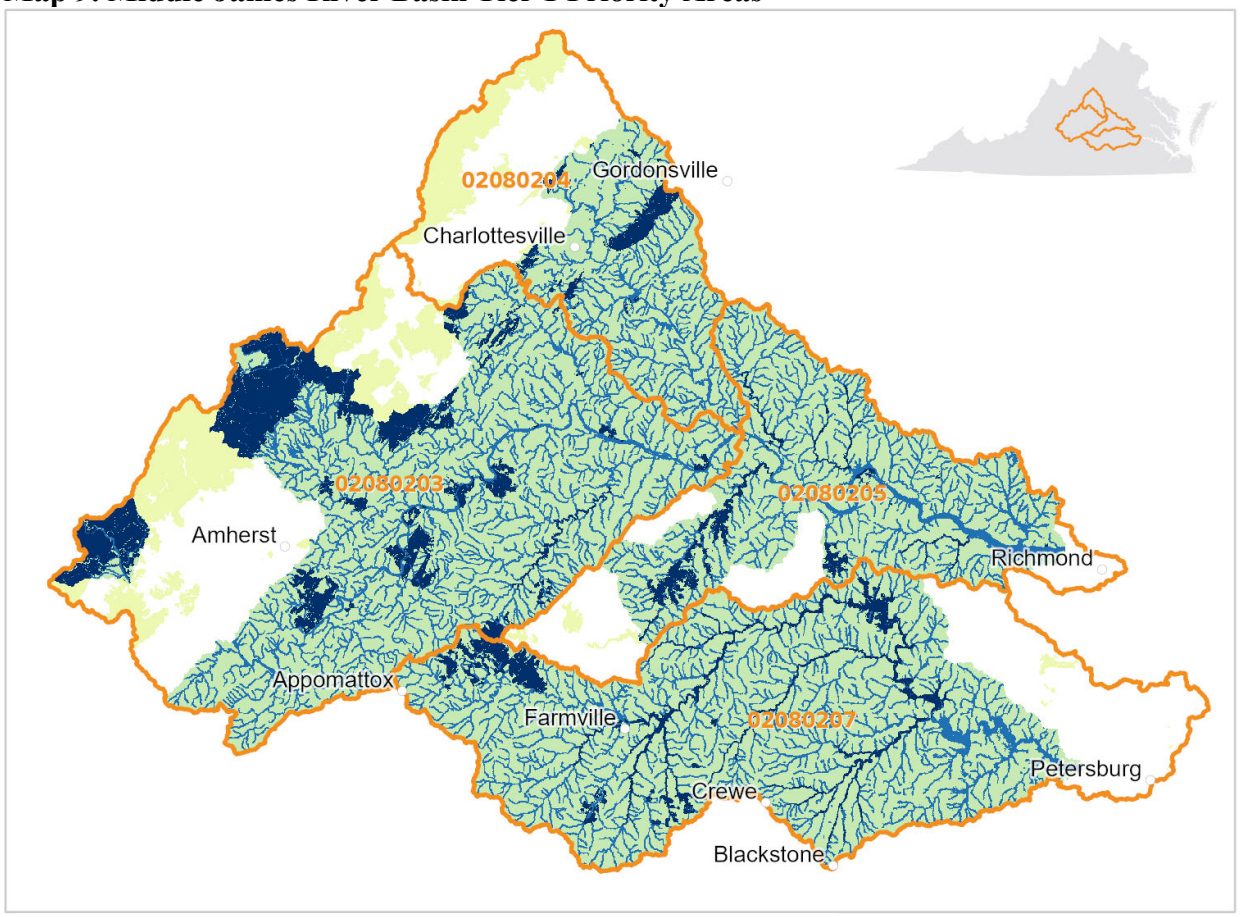
Tier 1 Priority Areas within the Middle James River GSA include freshwater and terrestrial resilient and connected systems. There are no Focal Landscapes within this basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 9 - 10)

Middle James River Basin Priority Areas

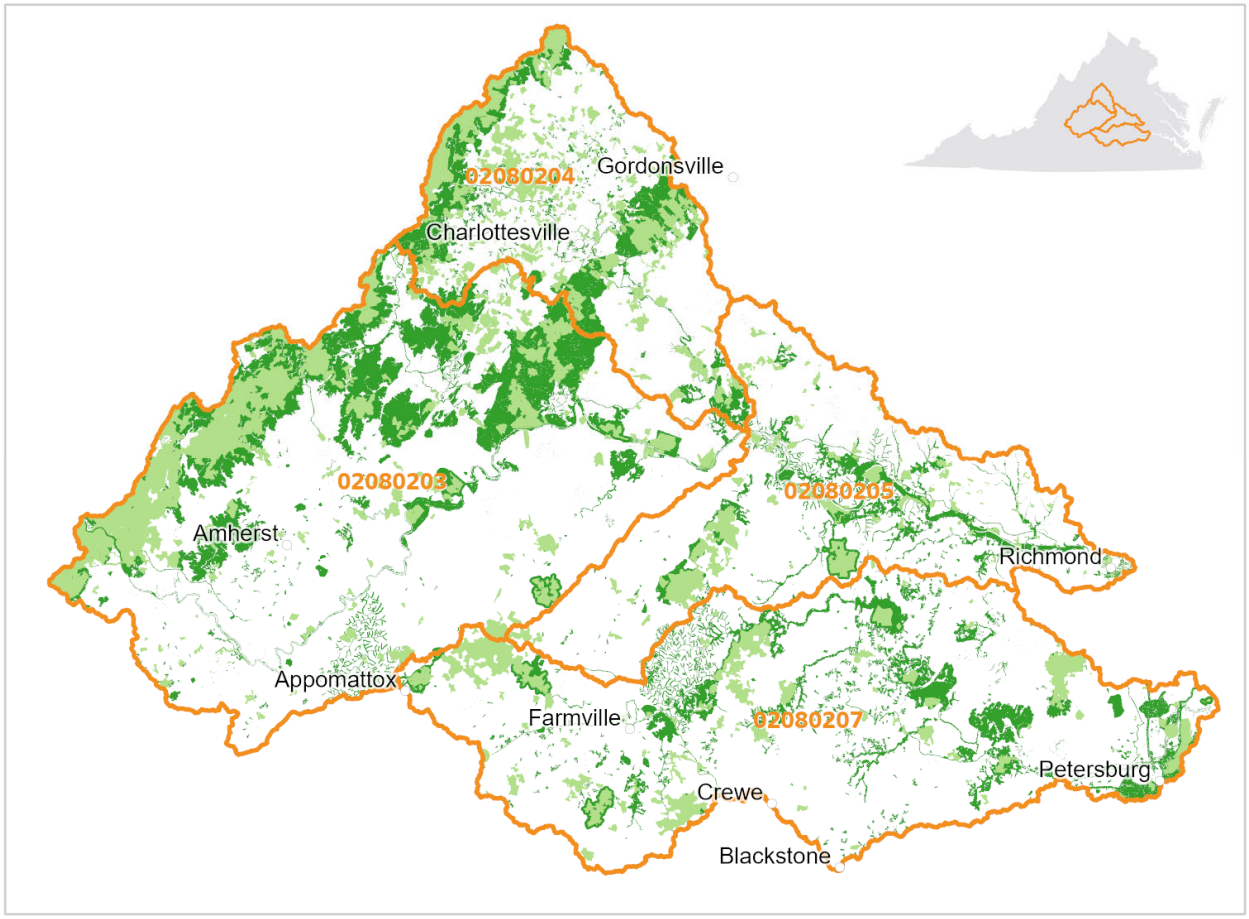
Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	State Lands	
	TNC Preserve	

Map 9. Middle James River Basin Tier 1 Priority Areas



Overlap of Freshwater and Terrestrial Resilience
High and Highest Freshwater Resilience Active River Area
High and Highest Freshwater Resilience Watersheds
Terrestrial Resilience Only
8-digit Hydrologic Unit

Map 10. Middle James River Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 6. UPPER JAMES RIVER

DESCRIPTION

The Upper James River GSA is approximately 2,962 square miles in area or approximately 7 percent of the Commonwealth's total land area. The Upper James River basin is bounded by the Shenandoah River basin to the north and the New River and Roanoke basins to the south. The headwaters originate along the Virginia/West Virginia state line beginning in the Alleghany Mountains and flowing in a southeasterly direction. The James River is formed by the confluence of the Jackson and Cowpasture rivers. This basin is comprised of two HUCs (02080201 and 02080202). The Upper James River runs through the Valley and Ridge Province to the Blue Ridge Mountains, an area dominated by narrow ridges and valleys running in a northeast/southwest direction.

Over 80 percent of the James River basin is forested, with 12 percent in cropland and pasture. Approximately 0.3 percent is considered urban. The James River basin is mostly rural and forested with a large portion owned by the US Forest Service. All or portions of the following jurisdictions lie within the basin: Counties - Alleghany, Bath, Craig, Highland, and Rockbridge; and Cities – Buena Visit, Clifton Forge, and Lexington.

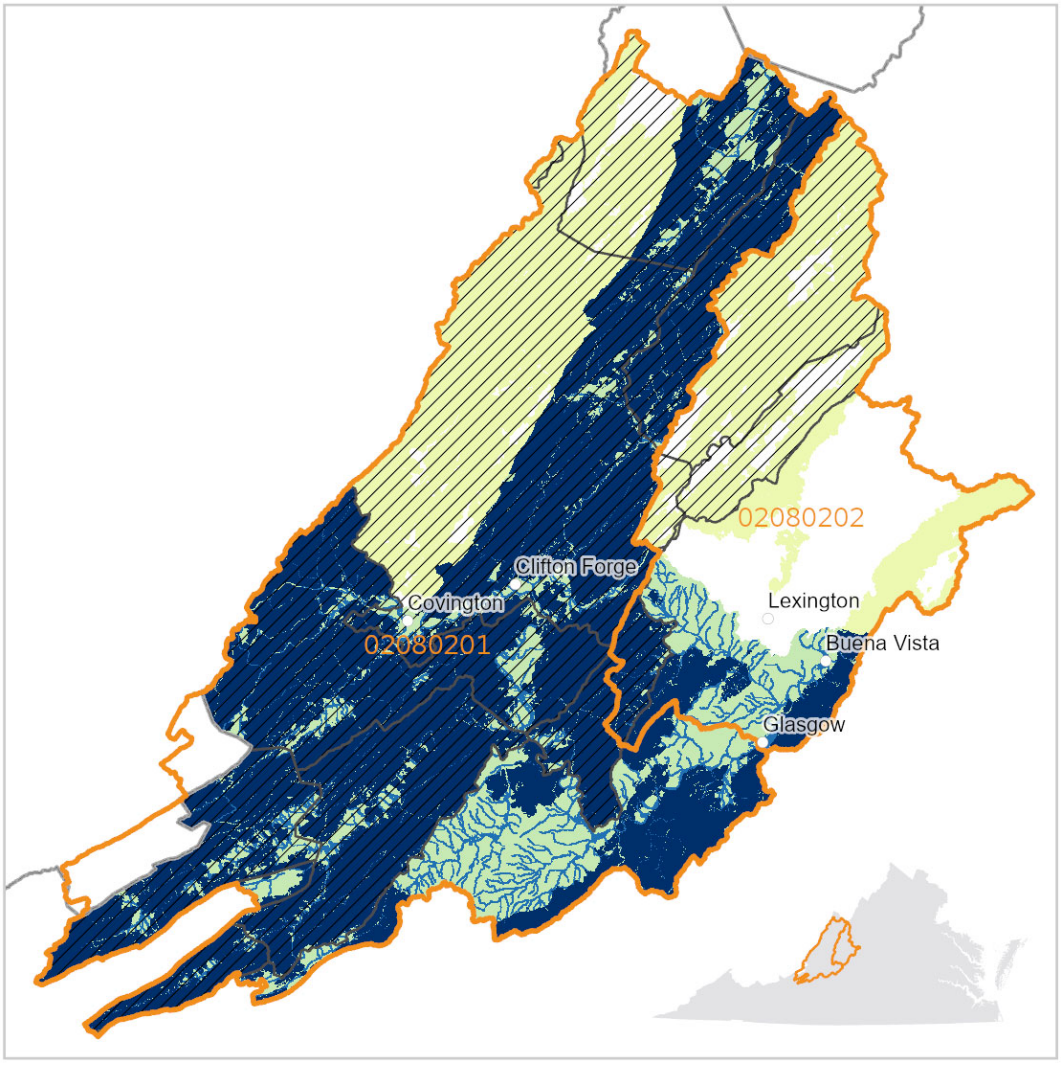
Tier 1 Priority Areas within the Upper James River GSA include freshwater and terrestrial resilient and connected systems. The Central Appalachians TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 11 - 12)

Upper James River Basin Priority Areas

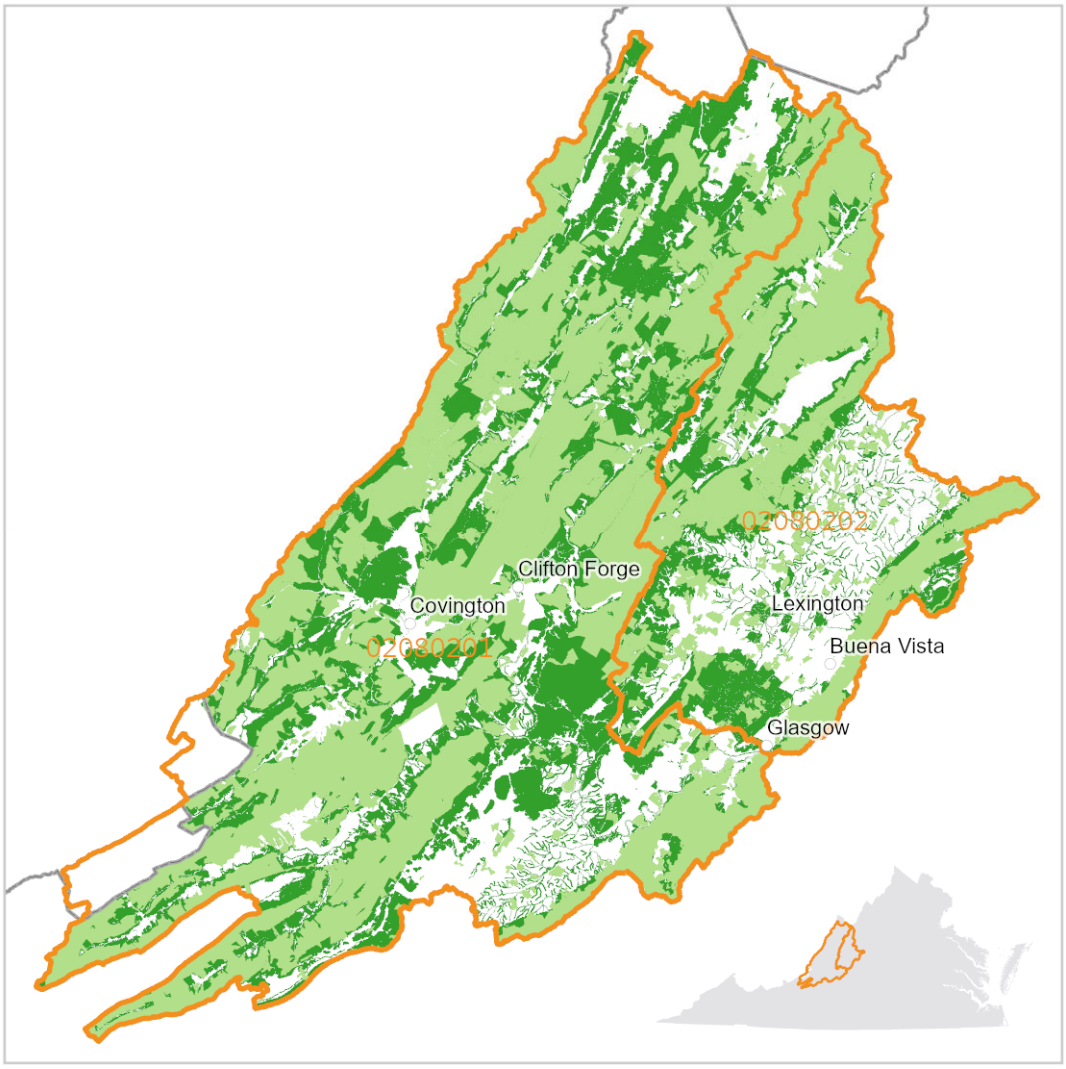
Priority Areas	Type/System of Focus for Conservation Action		Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network		
	Terrestrial Resilient and Connected Network		
Focal Landscapes	Central Appalachians	Matrix Forest Systems	Central Oak-Pine Forests
			Cove Forests
			Spruce-fir and Northern Hardwood & Conifer
			S. Ridge & Valley/ Cumberland Dry Calcareous & Alkaline Glades
			Acidic Barrens & Glades
			Forest Interior Birds
			Rare Bats
			Golden-winged Warbler
		Caves and Karst Systems	Rare Cave Invertebrates
		Freshwater Systems	Large Rivers
			Headwater Streams
			Wetlands (Montane, non-alluvial)
ConserveVirginia	Agriculture & Forestry		
	Natural Habitat & Ecosystem Diversity		
	Floodplains & Flooding Resilience		
	Cultural & Historic Preservation		
	Scenic Preservation		
	Protected Landscapes Resilience		
	Water Quality Improvement		
Protected Lands	Conservation Easement		
	Federal Lands		
	Local Park		
	Miscellaneous Private		
	State Lands		
	TNC Preserve		

Map 11. Upper James River Basin Tier 1 Priority Areas



Overlap of Freshwater and Terrestrial Resilience
High and Highest Freshwater Resilience Active River Area
High and Highest Freshwater Resilience Watersheds
Terrestrial Resilience Only
Focal Landscapes
8-digit Hydrologic Unit
State Boundary

Map 12. Upper James River Basin Tier 2 Priority Areas



ConserveVirginia 2.0
Protected Lands
8-digit Hydrologic Unit
State Boundary

GEOGRAPHIC SERVICE AREA 7. YORK RIVER

DESCRIPTION

The York River GSA lies in the central and eastern section of Virginia and covers 2,548 square miles or 6 percent of the Commonwealth's total area. The basin is bound by the Rappahannock River basin to the north, the James River basin to the south and west and the Chesapeake Bay/Atlantic Ocean and small coastal basins to the east. This basin is comprised of three HUCs (02080105, 02080106, and 02080107). The headwaters of the York River begin in Orange County and flow in a southeasterly direction for approximately 220 miles to its mouth at the Chesapeake Bay. The basin's width varies from five miles at the mouth to 40 miles at its headwaters. Lying in the Piedmont and Coastal Plain physiographic provinces, the basin's topography is characterized by slightly rolling hills at the headwaters or extreme western portion, to gently sloping hills and flat farmland near its mouth. Tributaries in the central Piedmont exhibit moderate and near constant profiles. Their flat slope largely characterizes streams in the Coastal Plain.

The basin is comprised of the York River and its two major tributaries, the Pamunkey and the Mattaponi Rivers. The York River itself is only about 30 miles in length. The Pamunkey River's major tributaries are the North and South Anna Rivers and the Little River, while the major Mattaponi tributaries are the Matta, Po and Ni Rivers.

Approximately 66 percent of the land area in the York River basin is forest. Farmland and pasture account for approximately 17 percent of the land area. Approximately 0.5 percent of the basin land area is urban. The 2010 population for the York River basin was approximately 435,400. The majority of the population is rural and is evenly distributed throughout the basin. The only major city that falls within this basin is a portion of Williamsburg. All or portions of the following thirteen counties lie within the basin: Albemarle, Caroline, Fluvanna, Gloucester, Goochland, Hanover, James City, King and Queen, King William, Louisa, New Kent, Orange, Spotsylvania, and York.

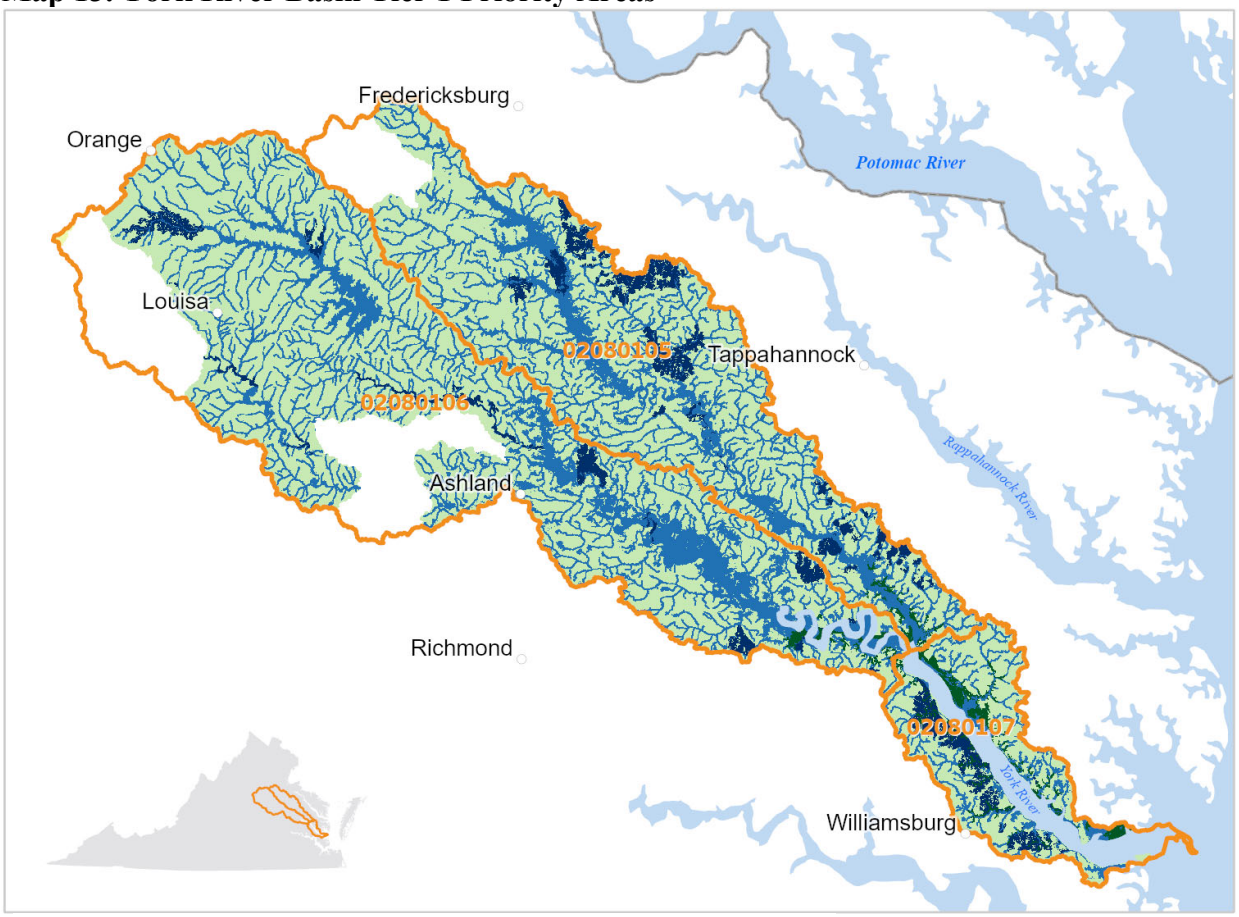
Tier 1 Priority Areas within the York River GSA include freshwater, terrestrial, and coastal resilient and connected systems. There are no Focal Landscapes within this basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 13 - 14)

York River Basin Priority Areas

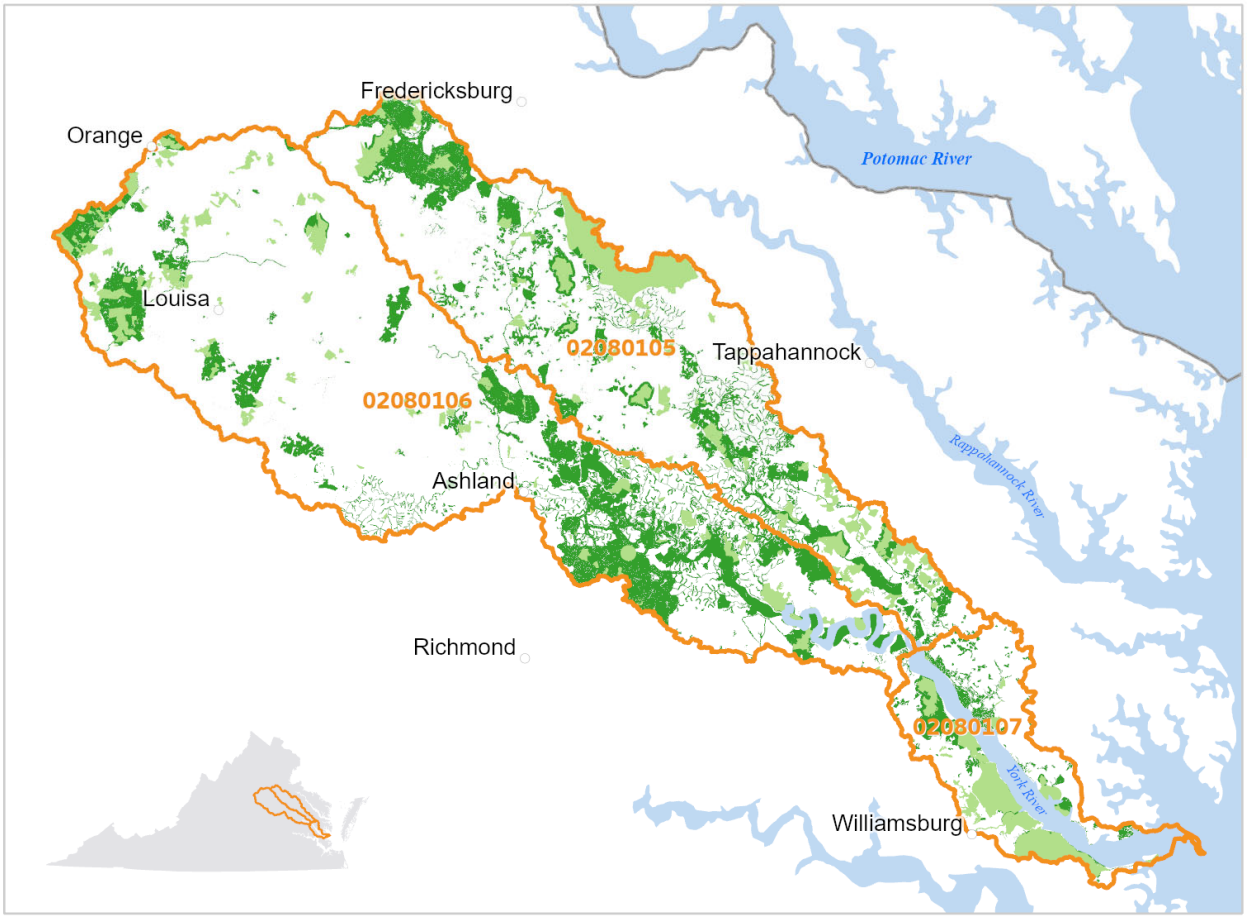
Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	Other TNC Ownership	
	State Lands	
	TNC Preserve	

Map 13. York River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Resilient Coastal Sites
- 8-digit Hydrologic Unit
- State Boundary

Map 14. York River Basin Tier 2 Priority Areas



ConserveVirginia 2.0
Protected Lands
8-digit Hydrologic Unit
State Boundary

GEOGRAPHIC SERVICE AREA 8. POTOMAC RIVER

DESCRIPTION

The Potomac River GSA is approximately 2,224 square miles in area or approximately 5 percent of the Commonwealth's total land area. The Potomac River basin headwaters begin in Highland County. The river then flows in a northeasterly direction through West Virginia and Maryland before joining the Shenandoah at Harper's Ferry, West Virginia. The Potomac River continues as the border between Maryland and Virginia. These waters flow approximately 200 miles in a southeasterly direction along Loudoun and Fauquier counties to their confluence with the Chesapeake Bay in Northumberland County. Approximately 2,289 of the 14,700 square miles of the Potomac River basin drainage area lie in Virginia. The rest covers four states and the District of Columbia. In Virginia, the basin is comprised of three HUCs (02070008, 02070010, and 02070011). Gently sloping hills and valleys from Harpers Ferry to approximately 45 miles downriver characterize the topography of the upper Piedmont region of the Potomac River basin. In the central Piedmont area, the profile is rather flat until it nears the fall line at Great Falls, where the stream elevation rapidly descends from over 200 feet to sea level. Tributaries in the central Piedmont exhibit moderate and near constant profiles. Their flat slope largely characterizes streams in the Coastal Plain area.

Approximately 47 percent of the Potomac River basin is forested, 24 percent is farmland and pasture and an estimated 6 percent is urban. All or part of the following jurisdictions lie within the basin: Counties – Arlington, Fairfax, Fauquier, Frederick, King George, Loudoun, Northumberland, Prince William, Stafford, and Westmoreland; Cities – Alexandria, Fairfax, Falls Church, Manassas, Manassas Park.

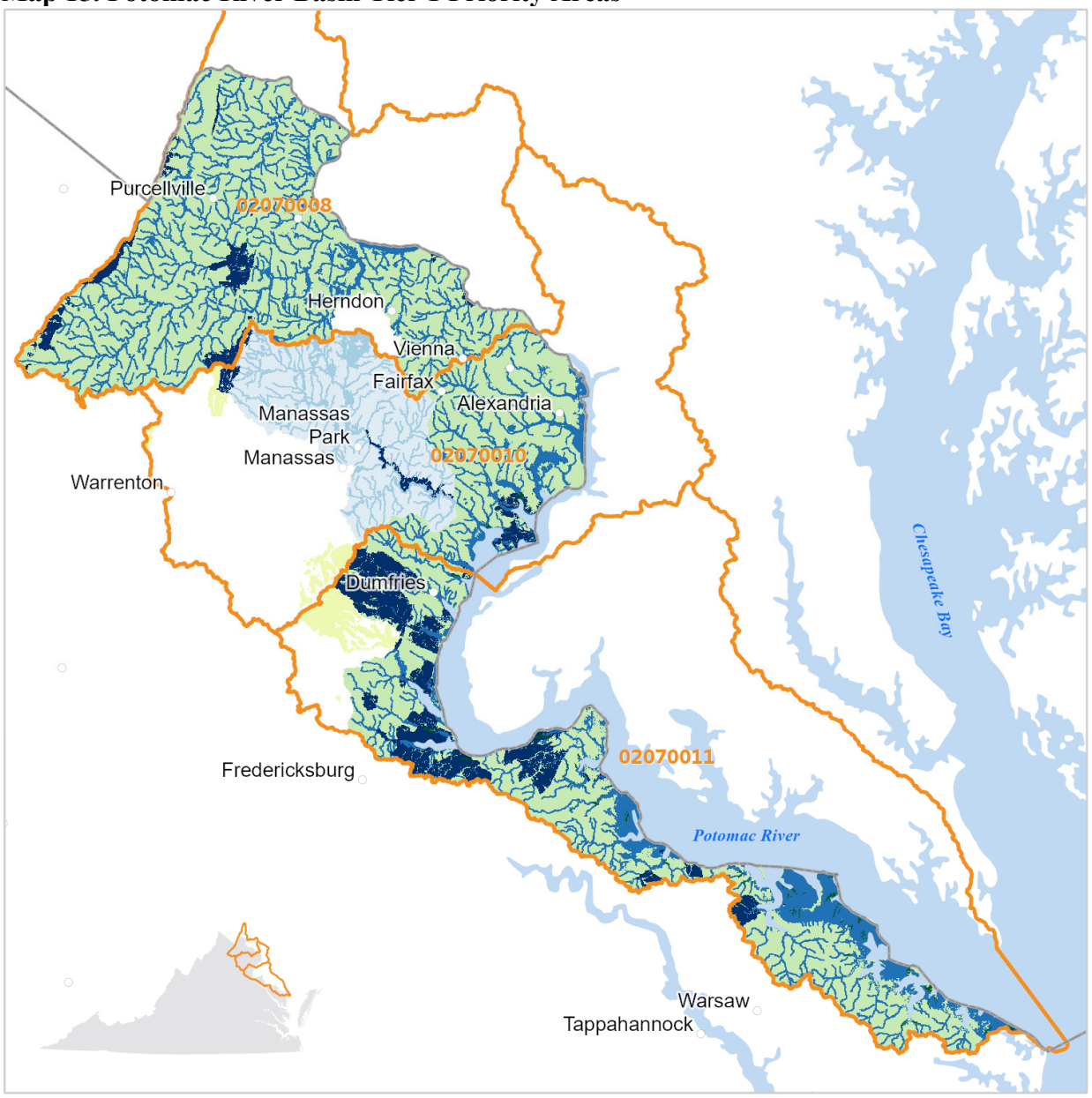
Tier 1 Priority Areas within the Potomac River GSA include freshwater, terrestrial, and coastal resilient and connected systems. There are no Focal Landscapes within this basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map except Water Quality Improvement along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 15 - 16)

Potomac River Basin Priority Areas

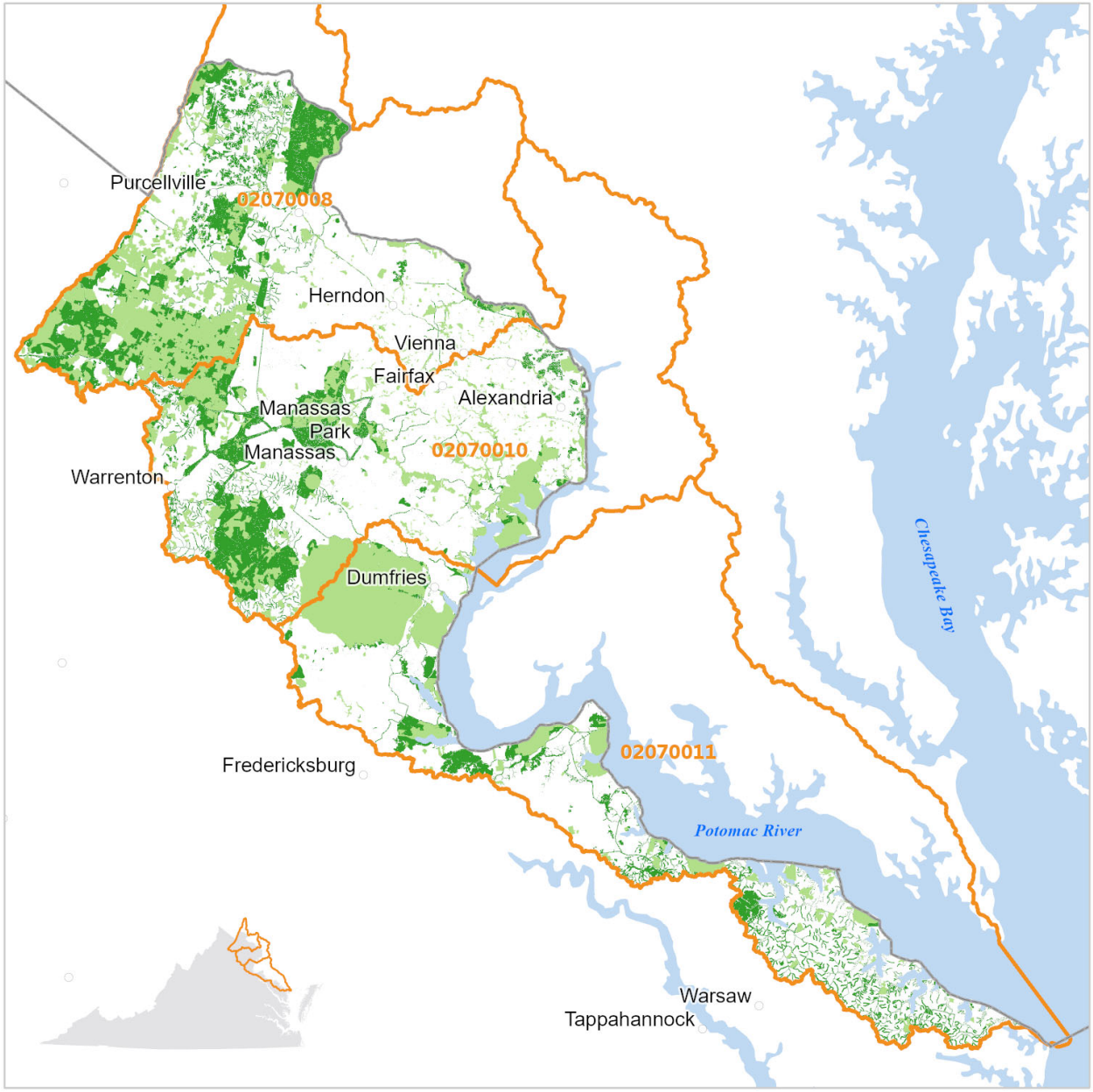
Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	Other TNC Ownership	
	State Lands	
	TNC Preserve	

Map 15. Potomac River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Resilient Coastal Sites
- Terrestrial Resilience Only
- Mixed Freshwater Resilience Active River Area
- Mixed Freshwater Resilience Watersheds
- 8-digit Hydrologic Unit
- State Boundary

Map 16. Potomac River Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 9. SHENANDOAH RIVER

DESCRIPTION

The Shenandoah River GSA headwaters begin in Augusta County and flow in a northeasterly direction for approximately 100 miles to the West Virginia state line. The basin averages 30 miles in width and covers 3,369 square miles, or 8 percent of the Commonwealth's total land area. In Virginia, this basin is comprised of four HUCs (02070004, 02070005, 02070006, and 02070007). The topography of the Shenandoah River basin is characterized by rolling hills and valleys bordered by the Appalachian Mountains to the west and the Blue Ridge Mountains to the east. The Massanutten Mountain Range divides the Shenandoah River into the North and South forks. Tributaries of the Shenandoah River exhibit steep profiles as they drain the surrounding mountain ridge. The main stem of the Shenandoah exhibits a moderately sloping profile with occasional riffles and pools.

Approximately 57 percent of the land area in the Shenandoah River basin is forested due to the large amount of federally-owned land and the steep topography. Farmland and pasture account for 33 percent of the land area, while 1.2 percent is urban. All or part of the following jurisdictions lie within the basin: Counties – Augusta, Clarke, Frederick, Highland, Page, Rockingham, Shenandoah, Warren; Cities – Harrisonburg, Staunton, Waynesboro, and Winchester.

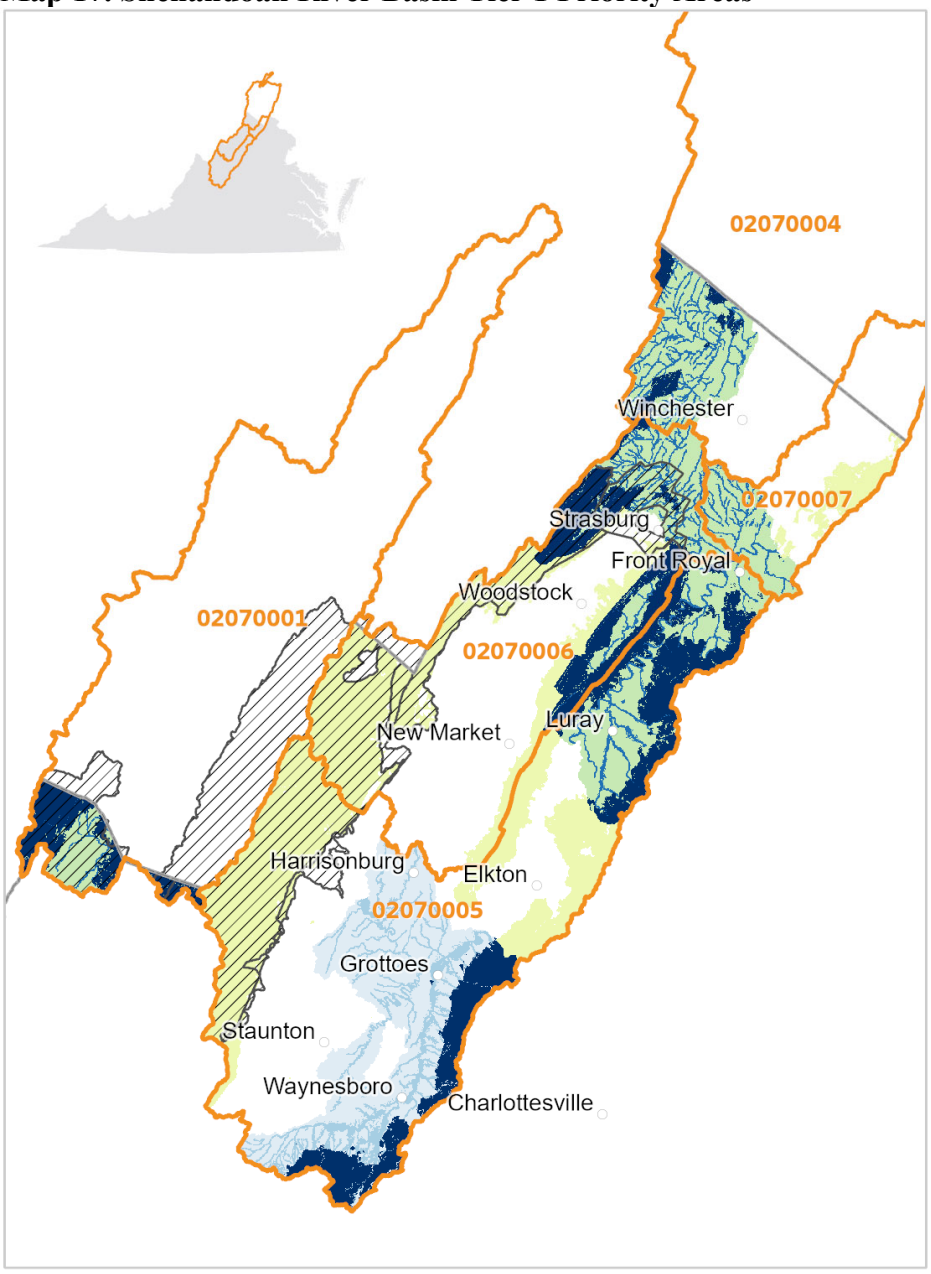
Tier 1 Priority Areas within the Shenandoah River GSA include freshwater and terrestrial resilient and connected systems. The Central Appalachians TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 17 - 18)

Shenandoah River Basin Priority Areas

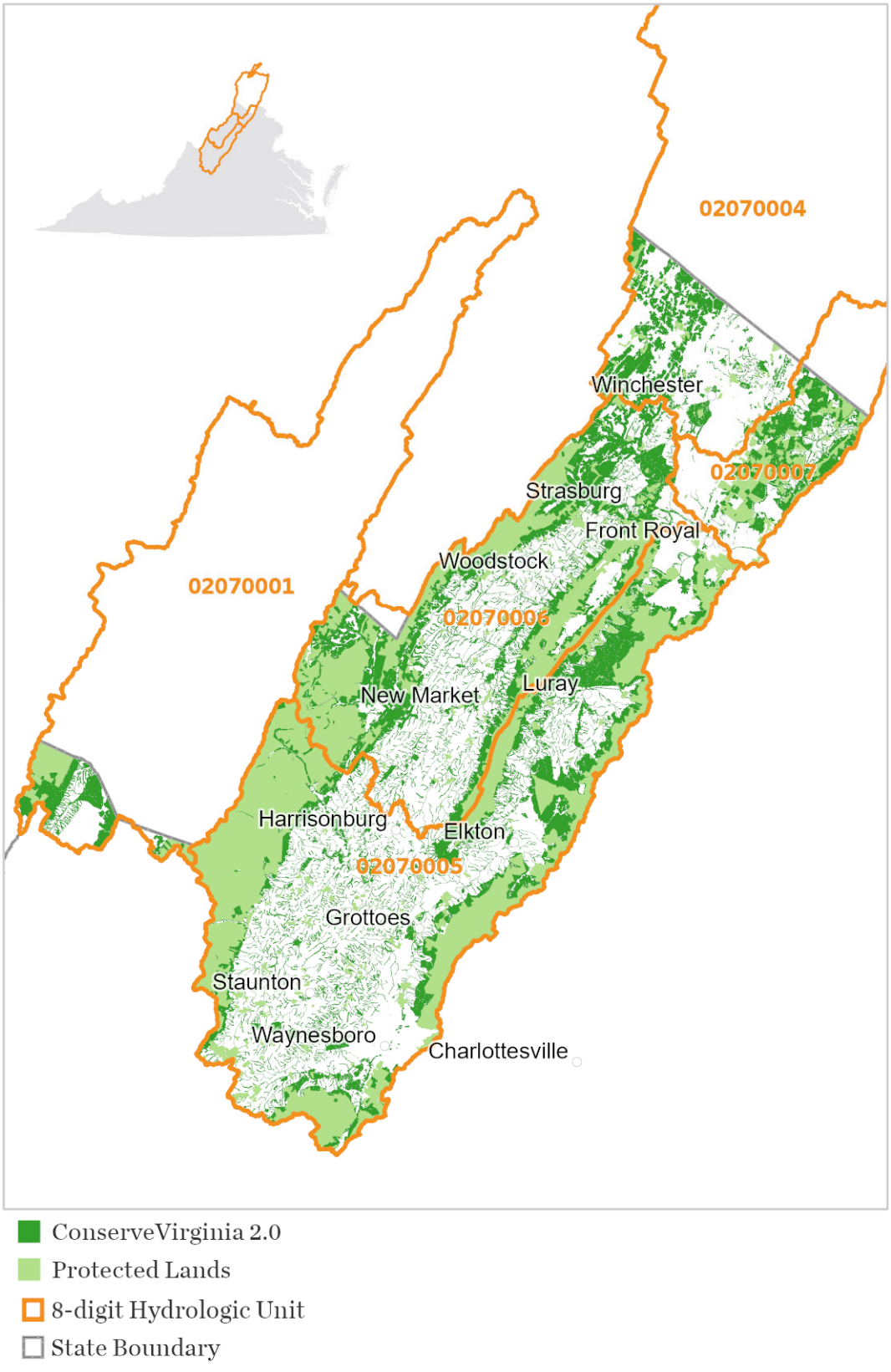
Priority Areas	Type/System of Focus for Conservation Action		Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network		
	Terrestrial Resilient and Connected Network		
Focal Landscapes	Central Appalachians	Matrix Forest Systems	Central Oak-Pine Forests
			Cove Forests
			Spruce-fir and Northern Hardwood & Conifer
			S. Ridge & Valley/ Cumberland Dry Calcareous & Alkaline Glades
			Acidic Barrens & Glades
			Forest Interior Birds
			Rare Bats
			Golden-winged Warbler
		Caves and Karst Systems	Rare Cave Invertebrates
		Freshwater Systems	Large Rivers
			Headwater Streams
			Wetlands (Montane, non-alluvial)
ConserveVirginia	Agriculture & Forestry		
	Natural Habitat & Ecosystem Diversity		
	Floodplains & Flooding Resilience		
	Cultural & Historic Preservation		
	Scenic Preservation		
	Protected Landscapes Resilience		
	Water Quality Improvement		
Protected Lands	Conservation Easement		
	Federal Lands		
	Local Park		
	Miscellaneous Private		
	State Lands		
	TNC Preserve		

Map 17. Shenandoah River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Mixed Freshwater Resilience Active River Area
- Mixed Freshwater Resilience Watersheds
- Terrestrial Resilience Only
- Focal Landscapes
- 8-digit Hydrologic Unit
- State Boundary

Map 18. Shenandoah River Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 10. RAPPAHANNOCK RIVER

DESCRIPTION

The Rappahannock River GSA is located in the northeastern portion of Virginia and covers 2,542 square miles or approximately 6 percent of the Commonwealth's total area. This basin is comprised of two HUCs (02080103 and 02080104). The Rappahannock River basin is bordered by the Potomac-Shenandoah basin to the north and the York River basin and Chesapeake/Atlantic Coastal basin to the south and east. The headwaters lie in Fauquier and Rappahannock Counties and flow in a southeasterly direction to its confluence with the Chesapeake Bay between Lancaster and Middlesex counties. The Rappahannock River basin is 184 miles in length and varies in width from 20 to 50 miles. The basin's major tributaries are the Hazel River, Thornton River, Mountain Run, Rapidan River, Robinson River, Cat Point Creek, and the Corotoman River. The topography of the Rappahannock River basin changes from steep to flat as it flows from the Blue Ridge Mountains to the Chesapeake Bay. Most of the Rappahannock River basin lies in the eastern Piedmont and Coastal Plain areas of the Commonwealth while its headwaters, located on the eastern slopes of the Blue Ridge, are considered to be in the northern and western Piedmont section.

About 51 percent of the basin land is forest, while pasture and cropland make up another 29 percent. Only about 0.8 percent of the land area is considered urban. The 2010 population of the Rappahannock River basin was approximately 483,770. The basin is mostly rural in character with Fredericksburg, Spotsylvania, and Stafford as the main population centers. In recent years, the basin has seeing increasing urban pressure from the influence of metropolitan Washington in the Fredericksburg and Fauquier areas of the basin. All or portions of the following 17 counties and one city lie within the basin: Albemarle, Caroline, Culpeper, Essex, Fauquier, Greene, King George, Lancaster, Madison, Middlesex, Northumberland, Orange, Rappahannock, Richmond, Spotsylvania, Stafford, and Westmoreland; Cities - Fredericksburg.

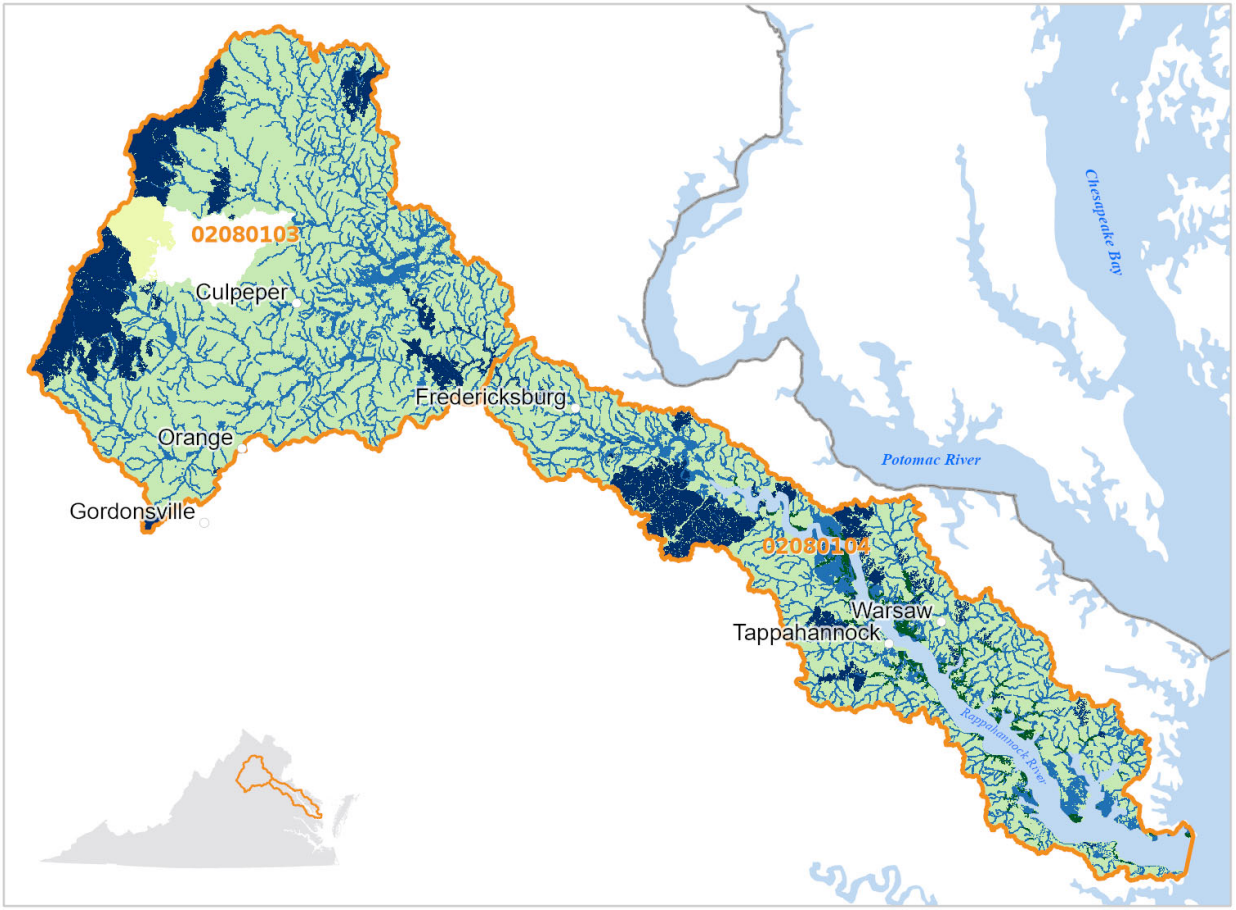
Tier 1 Priority Areas within the Rappahannock River GSA include freshwater, terrestrial, and coastal resilient and connected systems. There are no Focal Landscapes within this basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 19 - 20)

Rappahannock River Basin Priority Areas

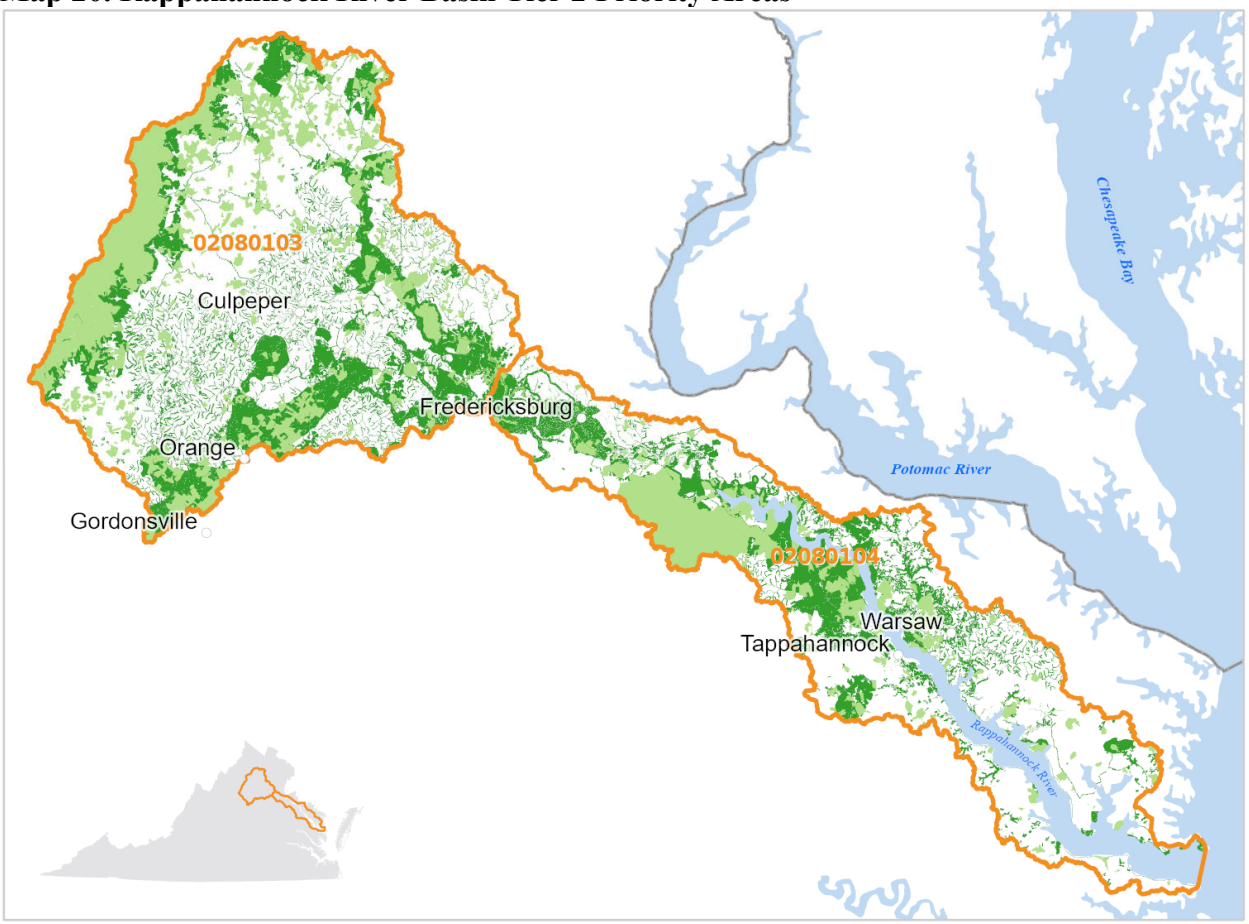
Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
	Coastal Resilient and Connected Network	
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Military Lands	
	Miscellaneous Private	
	State Lands	
	TNC Preserve	

Map 19. Rappahannock River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Resilient Coastal Sites
- Terrestrial Resilience Only
- 8-digit Hydrologic Unit
- State Boundary

Map 20. Rappahannock River Basin Tier 2 Priority Areas



ConserveVirginia 2.0
Protected Lands
8-digit Hydrologic Unit
State Boundary

GEOGRAPHIC SERVICE AREA 11. NEW RIVER

DESCRIPTION

The New River basin is located in southwest Virginia and covers 3,048 square miles or approximately 7 percent of the Commonwealth's total land area. The New River flows from its headwaters in Watauga County, North Carolina in a northeasterly direction to Radford, Virginia, and then in a northwesterly direction to Glen Lyn, where it exits into West Virginia. There it flows to the confluence of the Gauley River forming the Kanawha River, a tributary to the Ohio River. In Virginia, this basin is comprised of two HUCs (05050001 and 05050002). The New River basin in Virginia is bordered by the James River basin and Roanoke River basin to the east, and the Big Sandy River basin and Tennessee River basin to the west. The southern boundary of the Virginia portion is the North Carolina state line and its northwest boundary is the West Virginia state line. The New River basin runs 115 miles in length from Blowing Rock, North Carolina to Bluestone Dam near Hinton, West Virginia with a maximum basin width of 70 miles near Rural Retreat, Virginia. The Virginia portion of the New River basin is 87 miles in length. The topography of the New River basin is generally rugged; the upper reaches of its tributaries are extremely steep. High mountains, narrow valleys and steep ravines characterize the basin. There are ten tributaries in the Upper New River basin each having more than 100 square miles in drainage area and many others with forty or more square miles.

The higher elevations of the New River basin have steep slopes and are thickly forested, while the mount bases are mostly used for agriculture. Approximately 63 percent of its land is forested. Cropland and pasture make up another 27 percent, with approximately 0.8 percent considered urban. The 2010 population for the New River basin was approximately 412,900. All or portions of the following localities lie within the basin: Bland, Carroll, Craig, Floyd, Giles, Grayson, Montgomery, Pulaski, Smyth, Tazewell, Wythe, and the cities of Galax and Radford.

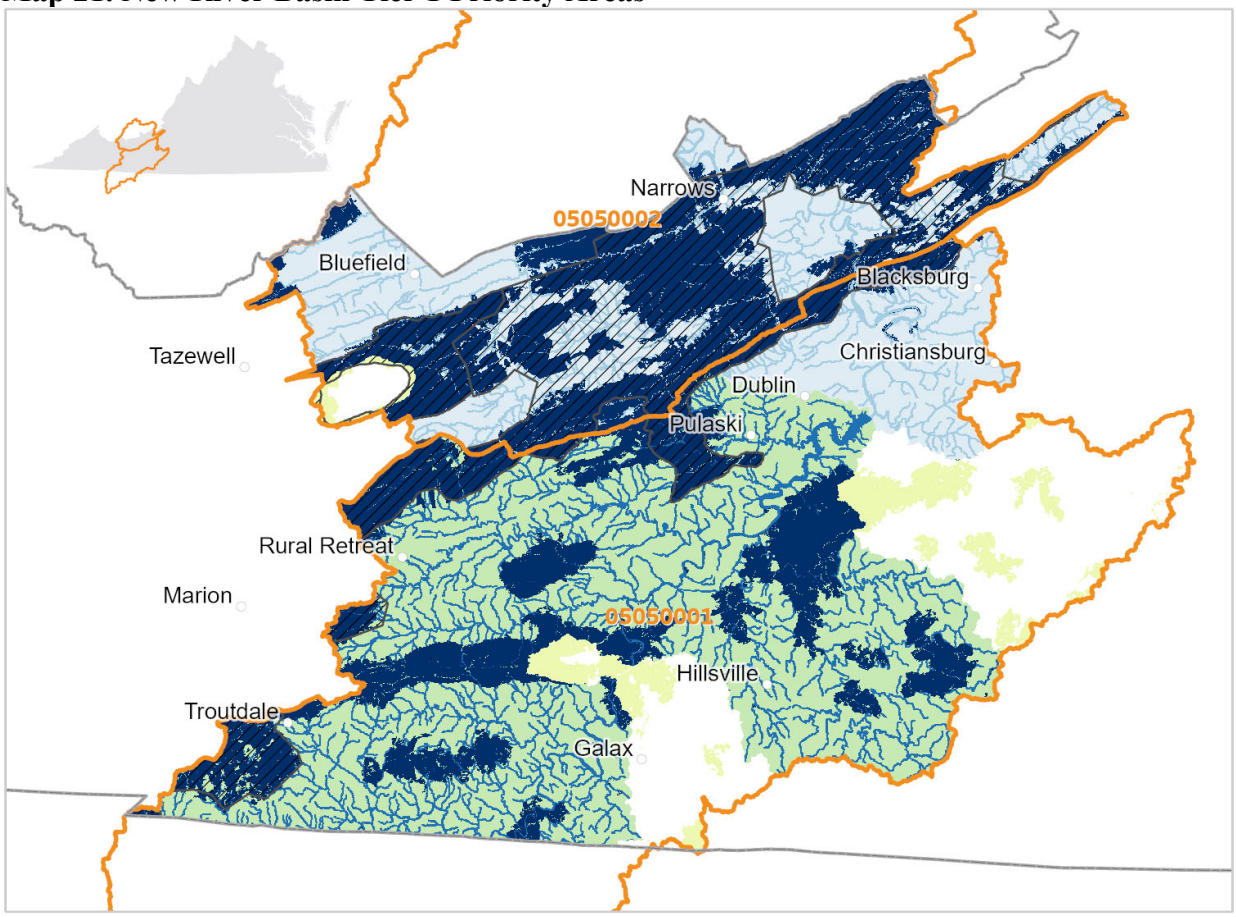
Tier 1 Priority Areas within the New River GSA include freshwater and terrestrial resilient and connected systems. The Central Appalachians TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 21 - 22)

New River Basin Priority Areas

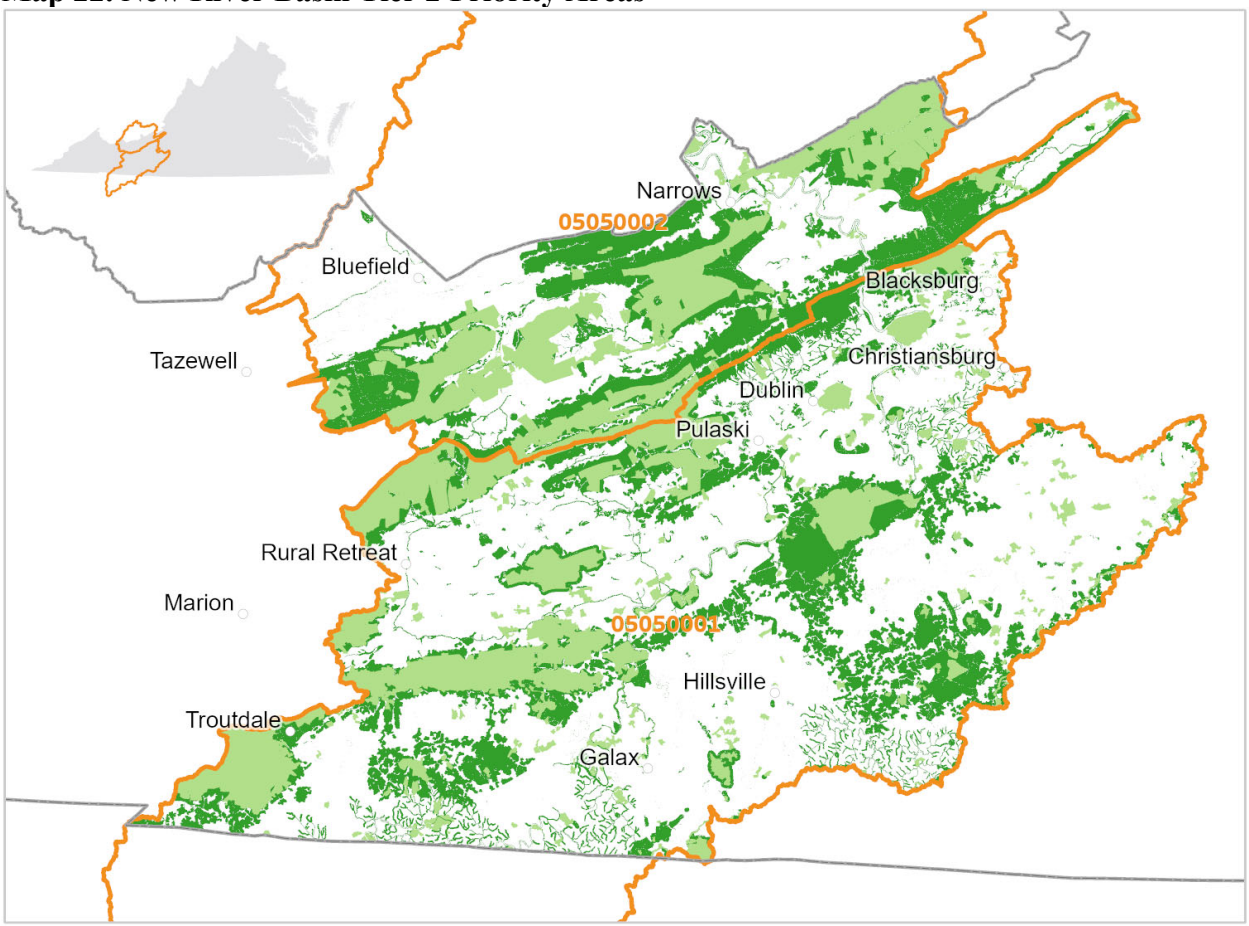
Priority Areas	Type/System of Focus for Conservation Action		Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network		
	Terrestrial Resilient and Connected Network		
Focal Landscapes	Central Appalachians	Matrix Forest Systems	Central Oak-Pine Forests
			Cove Forests
			Spruce-fir and Northern Hardwood & Conifer
			S. Ridge & Valley/ Cumberland Dry Calcareous & Alkaline Glades
			Acidic Barrens & Glades
			Forest Interior Birds
			Rare Bats
			Golden-winged Warbler
		Caves and Karst Systems	Rare Cave Invertebrates
ConserveVirginia	Agriculture & Forestry		
	Natural Habitat & Ecosystem Diversity		
	Floodplains & Flooding Resilience		
	Cultural & Historic Preservation		
	Scenic Preservation		
	Protected Landscapes Resilience		
	Water Quality Improvement		
Protected Lands	Conservation Easement		
	Federal Lands		
	Local Park		
	Military Lands		
	Miscellaneous Private		
	Other TNC Ownership		
	State Lands		
	TNC Preserve		

Map 21. New River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Terrestrial Resilience Only
- Mixed Freshwater Resilience Active River Area
- Mixed Freshwater Resilience Watersheds
- Focal Landscapes
- 8-digit Hydrologic Unit
- State Boundary

Map 22. New River Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 12. ROANOKE RIVER

DESCRIPTION

The Roanoke River GSA covers 6,148 square miles or approximately 14 percent of the Commonwealth's total area. The basin is bound by the James River basin on the north, to the east by the Chowan River basin, and to the west by the New River basin. The southern boundary of the basin is the Virginia/North Carolina State line. This basin is comprised of seven HUCs (03010101, 03010102, 03010103, 03010104, 03010105, 03010106 and 0304010). The topography of the Roanoke River basin ranges from steep slopes and valleys in the Valley and Ridge Province to gently sloping terrain east of the mountains in the Piedmont Province. The Roanoke River basin headwaters begin in the mountainous terrain of eastern Montgomery County and flow in a southeasterly direction to the Virginia/North Carolina state line. The Roanoke basin passes through three physiographic provinces – the Valley and Ridge Province to the northwest, and the Blue Ridge and Piedmont Provinces to the southeast.

The Roanoke watershed is large enough to accommodate two major reservoirs, Smith Mountain and Leesville lakes to the north and Kerr Reservoir and Lake Gaston located at the junction of the Roanoke River and the North Carolina state line. These reservoirs range in size from the 33,300-acre Kerr Reservoir to the 2,600-acre Leesville Lake. These impoundments are used for both recreation and hydroelectricity. Major tributaries in the northern section of the basin are the Little Otter and Big Otter Rivers along with the Blackwater and Pigg Rivers. Major tributaries in the southern portion include the Dan River, Smith River, and Banister River.

Over 62 percent of the Roanoke River basin is forested, while nearly 21 percent is in cropland and pasture. Approximately 0.9 percent is considered urban. The 2010 population for the Roanoke River basin was approximately 943,200. All or portions of the following 17 counties and 4 cities lie within the basin: Counties – Appomattox, Bedford, Botetourt, Brunswick, Campbell, Carroll, Charlotte, Floyd, Franklin, Grayson, Halifax, Henry, Mecklenburg, Montgomery, Patrick, Pittsylvania, and Roanoke; Cities – Danville, Martinsville, Roanoke, and Salem.

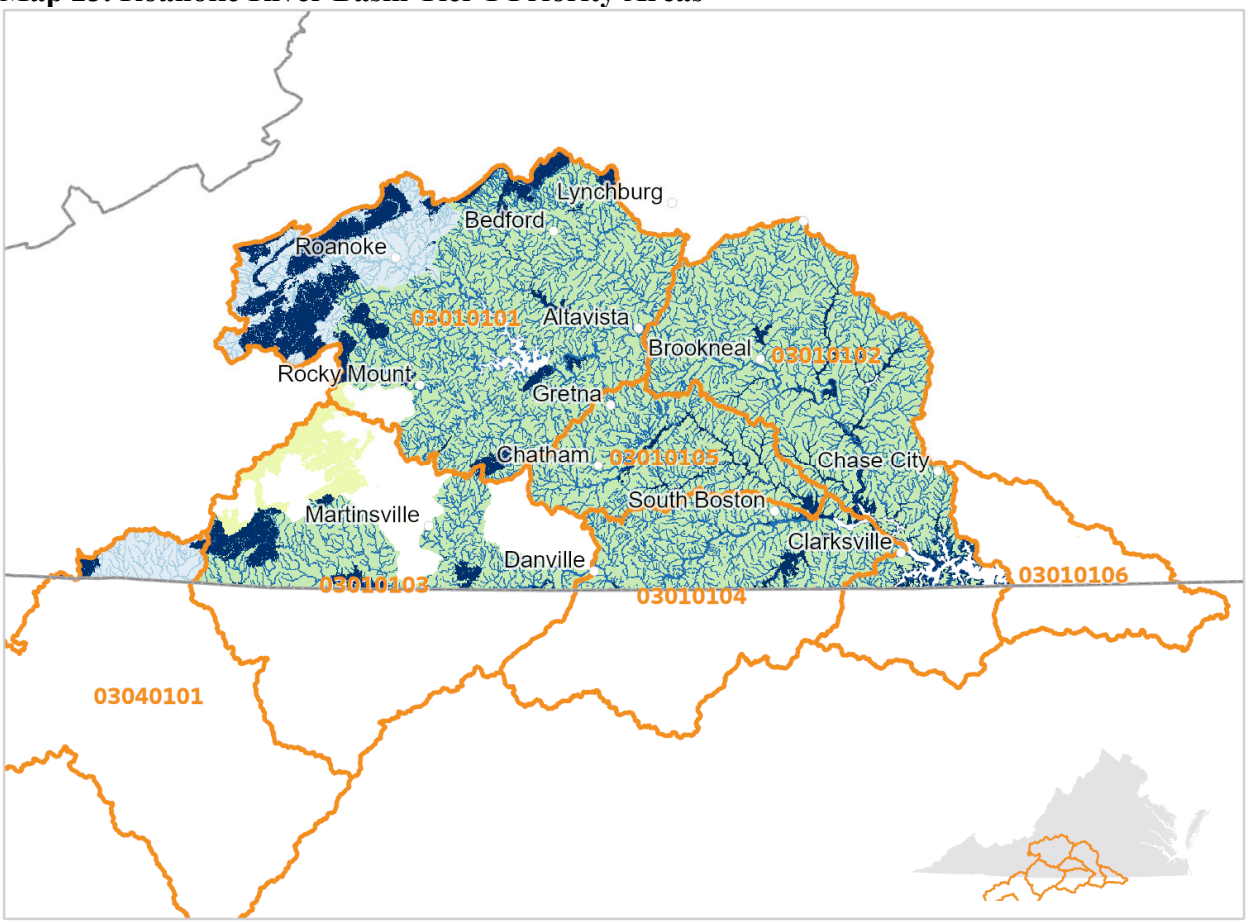
Tier 1 Priority Areas within the Roanoke River GSA include freshwater and terrestrial resilient and connected systems. There are no Focal Landscapes within this basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 23 - 24)

Roanoke River Basin Priority Areas

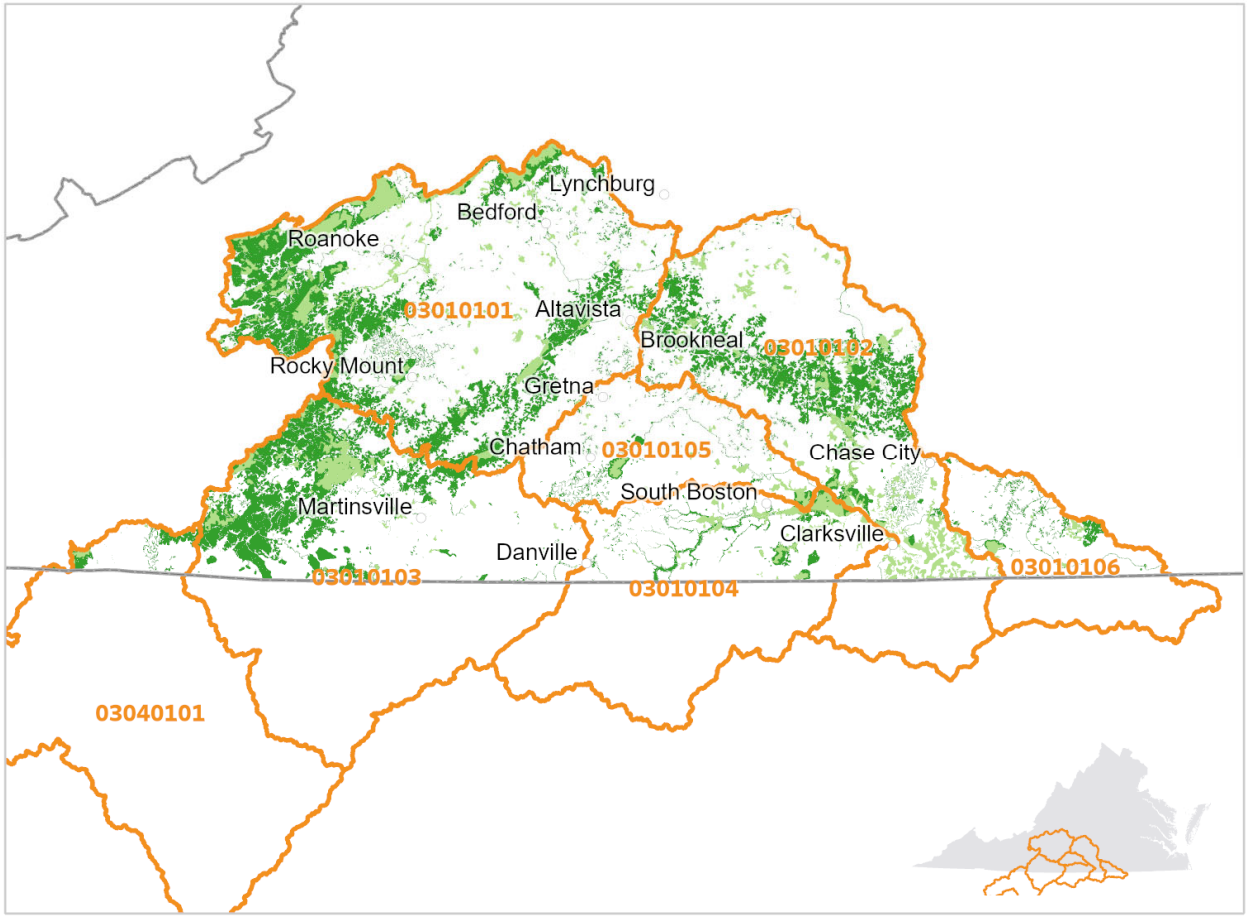
Priority Areas	Type/System of Focus for Conservation Action	Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network	
	Terrestrial Resilient and Connected Network	
ConserveVirginia	Agriculture & Forestry	
	Natural Habitat & Ecosystem Diversity	
	Floodplains & Flooding Resilience	
	Cultural & Historic Preservation	
	Scenic Preservation	
	Protected Landscapes Resilience	
	Water Quality Improvement	
Protected Lands	Conservation Easement	
	Federal Lands	
	Local Park	
	Miscellaneous Private	
	State Lands	
	TNC Preserve	

Map 23. Roanoke River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Mixed Freshwater Resilience Active River Area
- Mixed Freshwater Resilience Watersheds
- Terrestrial Resilience Only
- 8-digit Hydrologic Unit
- State Boundary

Map 24. Roanoke River Basin Tier 2 Priority Areas



ConserveVirginia 2.0
Protected Lands
8-digit Hydrologic Unit
State Boundary

GEOGRAPHIC SERVICE AREA 13. TENNESSEE RIVER

DESCRIPTION

The Tennessee River GSA in is made up of the Holston, Clinch, and Powell watersheds. The Tennessee River basin is located in the extreme southwest portion of Virginia and covers 3,124 square miles in area or approximately 7 percent of the Commonwealth's total land area. In Virginia, this basin is comprised of four HUCs (06010205, 06010206, 06010101, and 06010102). The Virginia portion of the Tennessee River basin is defined by both hydrologic and political boundaries. The Big Sandy River basin and West Virginia state line lie to the north, Kentucky lies to the west, and Tennessee lies to the south. The New River basin makes up the eastern boundary. The southwestward flowing Holston, Clinch, and Powell tributaries form the Tennessee River in Tennessee which eventually empties into the Gulf of Mexico via the Mississippi River. The Tennessee River basin crosses three physiographic provinces: the Cumberland Plateau, Valley and Ridge, and the Blue Ridge. Parallel valleys and ridges running in a northeast to southwest direction characterize the Tennessee, lying in the Valley and Ridge Province. A small portion, located in the Blue Ridge Province, is more like a plateau with no single, prominent ridge that characterizes the province to the southeast.

Within Virginia, approximately 67 percent of the Tennessee River basin is forested, while cropland and pasture make up another 21 percent. Urban areas make up only 0.8 percent of the total land area. All or parts of the following jurisdictions lie within the basin: counties – Buchanan, Dickinson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe; Cities – Bristol and Norton.

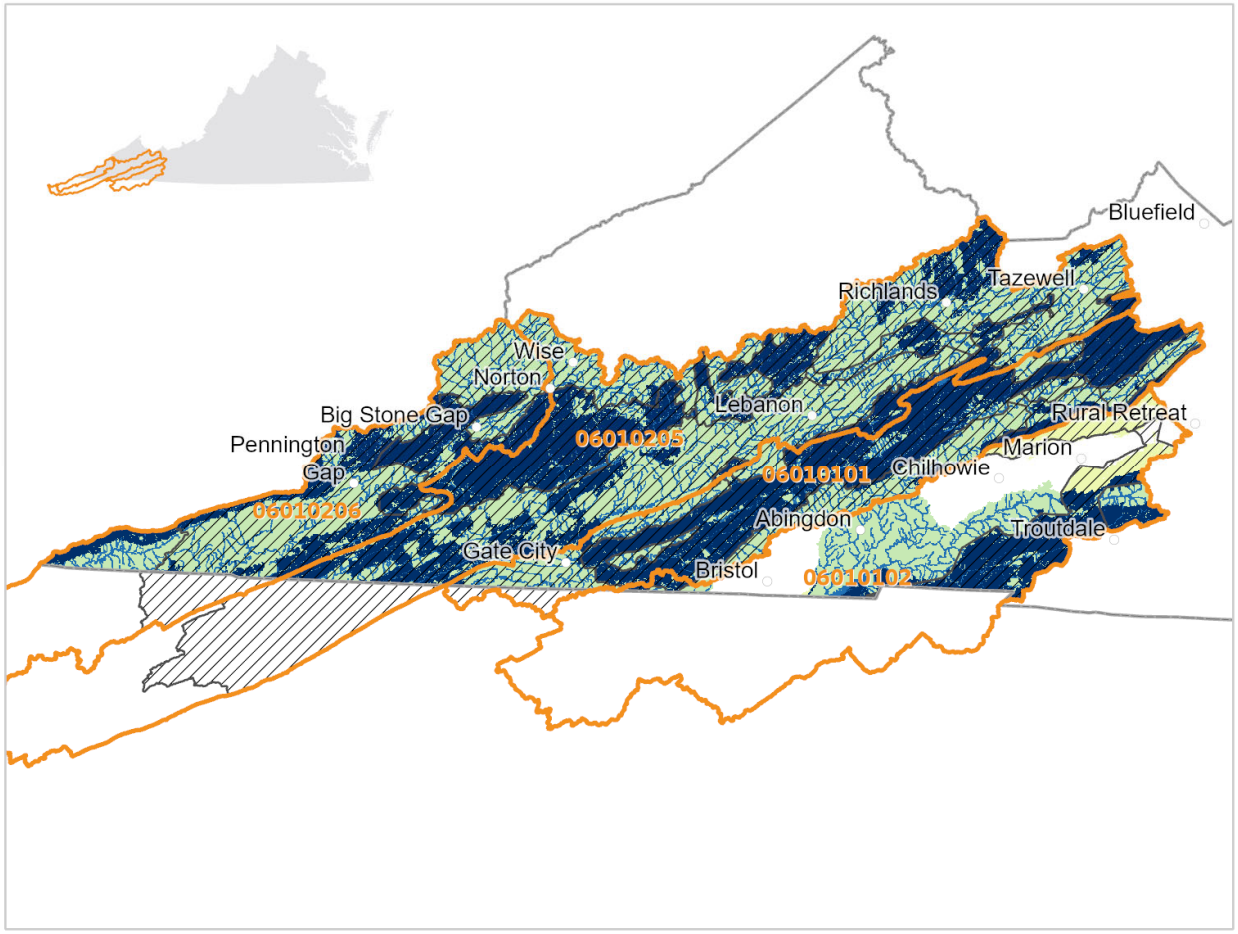
Tier 1 Priority Areas within the Tennessee River GSA include freshwater and terrestrial resilient and connected systems. The Central Appalachians TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 25 - 26)

Tennessee River Basin Priority Areas

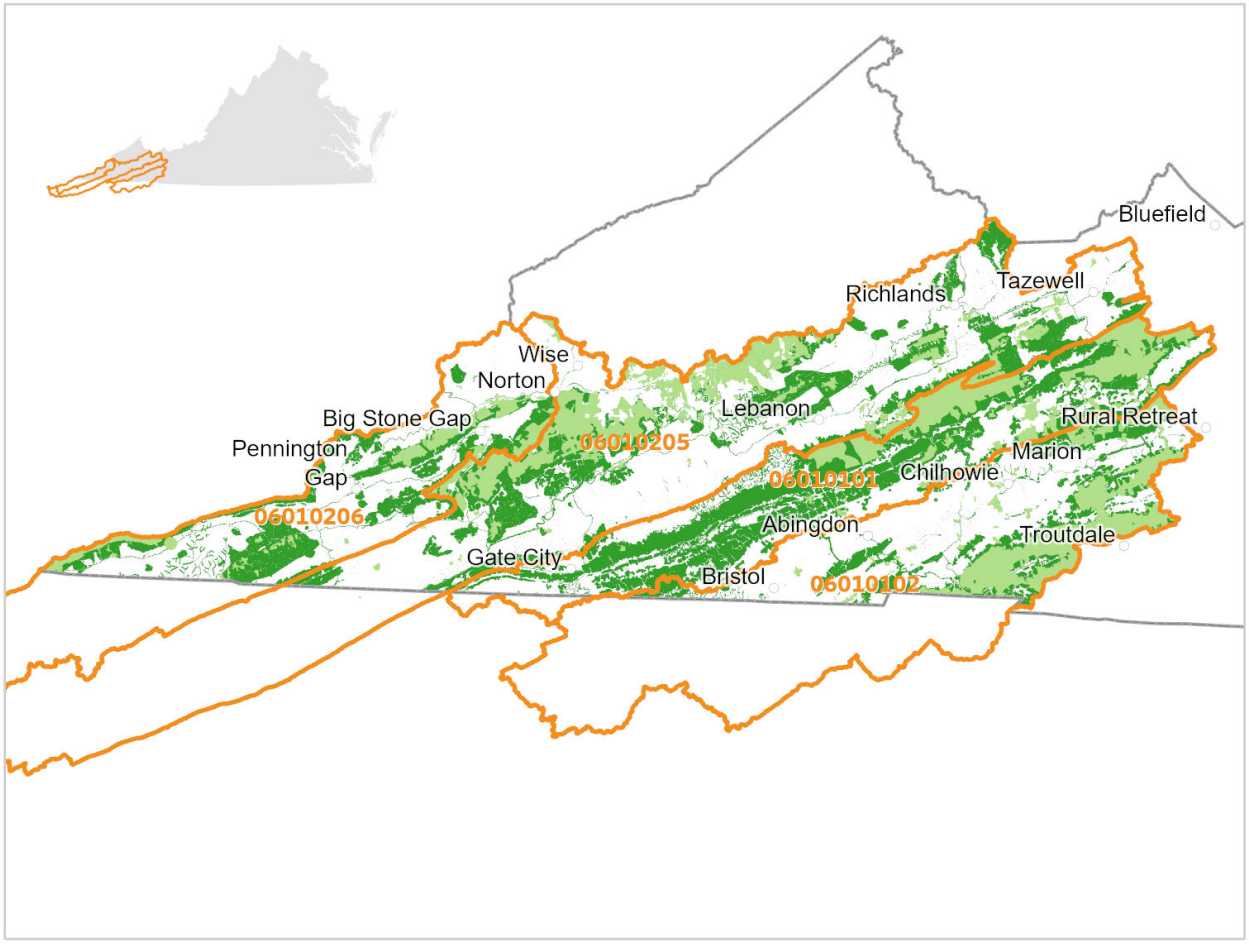
Priority Areas	Type/System of Focus for Conservation Action		Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network		
	Terrestrial Resilient and Connected Network		
Focal Landscapes	Central Appalachians	Matrix Forest Systems	Central Oak-Pine Forests
			Cove Forests
			Spruce-fir and Northern Hardwood & Conifer
			S. Ridge & Valley/ Cumberland Dry Calcareous & Alkaline Glades
			Acidic Barrens & Glades
			Forest Interior Birds
			Rare Bats
			Golden-winged Warbler
		Caves and Karst Systems	Rare Cave Invertebrates
		Freshwater Systems	Large Rivers
			Endemic Cumberlandian Mussel Assemblage
			Upper Tennessee River Fish Assemblage
ConserveVirginia	Agriculture & Forestry		
	Natural Habitat & Ecosystem Diversity		
	Floodplains & Flooding Resilience		
	Cultural & Historic Preservation		
	Scenic Preservation		
	Protected Landscapes Resilience		
	Water Quality Improvement		
Protected Lands	Conservation Easement		
	Federal Lands		
	Local Park		
	Miscellaneous Private		
	Other TNC Ownership		
	State Lands		
	TNC Preserve		

Map 25. Tennessee River Basin Tier 1 Priority Areas



Overlap of Freshwater and Terrestrial Resilience
High and Highest Freshwater Resilience Active River Area
High and Highest Freshwater Resilience Watersheds
Terrestrial Resilience Only
Focal Landscapes
8-digit Hydrologic Unit
State Boundary

Map 26. Tennessee River Basin Tier 2 Priority Areas



GEOGRAPHIC SERVICE AREA 14. BIG SANDY RIVER

DESCRIPTION

The Big Sandy River GSA is approximately 997 square miles in area or approximately 2 percent of the Commonwealth's total land area. The Big Sandy River basin is located in the extreme southwest portion of Virginia. This basin contains the Levisa and Tug Forks that flow northward into Kentucky forming the Big Sandy River which eventually empties into the Gulf of Mexico via the Ohio and Mississippi rivers. In Virginia, this basin is comprised of two HUCs (05070201 and 05070202). The Virginia portion of the Big Sandy River basin is defined by both hydrologic and political boundaries. The Kentucky state line lies to the northwest and West Virginia lies to the northeast. The Tennessee River basin makes up the southern boundary. The Big Sandy River basin lies within the Appalachian Plateau. This province is characterized as rugged, with mountainous terrain and steep valleys.

The Virginia portion of the Big Sandy River basin is approximately 86 percent forest, with only about 2 percent in cropland and pasture. Urban areas make up only 0.2 percent of the total land area. All or parts of the following jurisdictions lie within the basin: Buchanan, Dickinson, Tazewell and Wise.

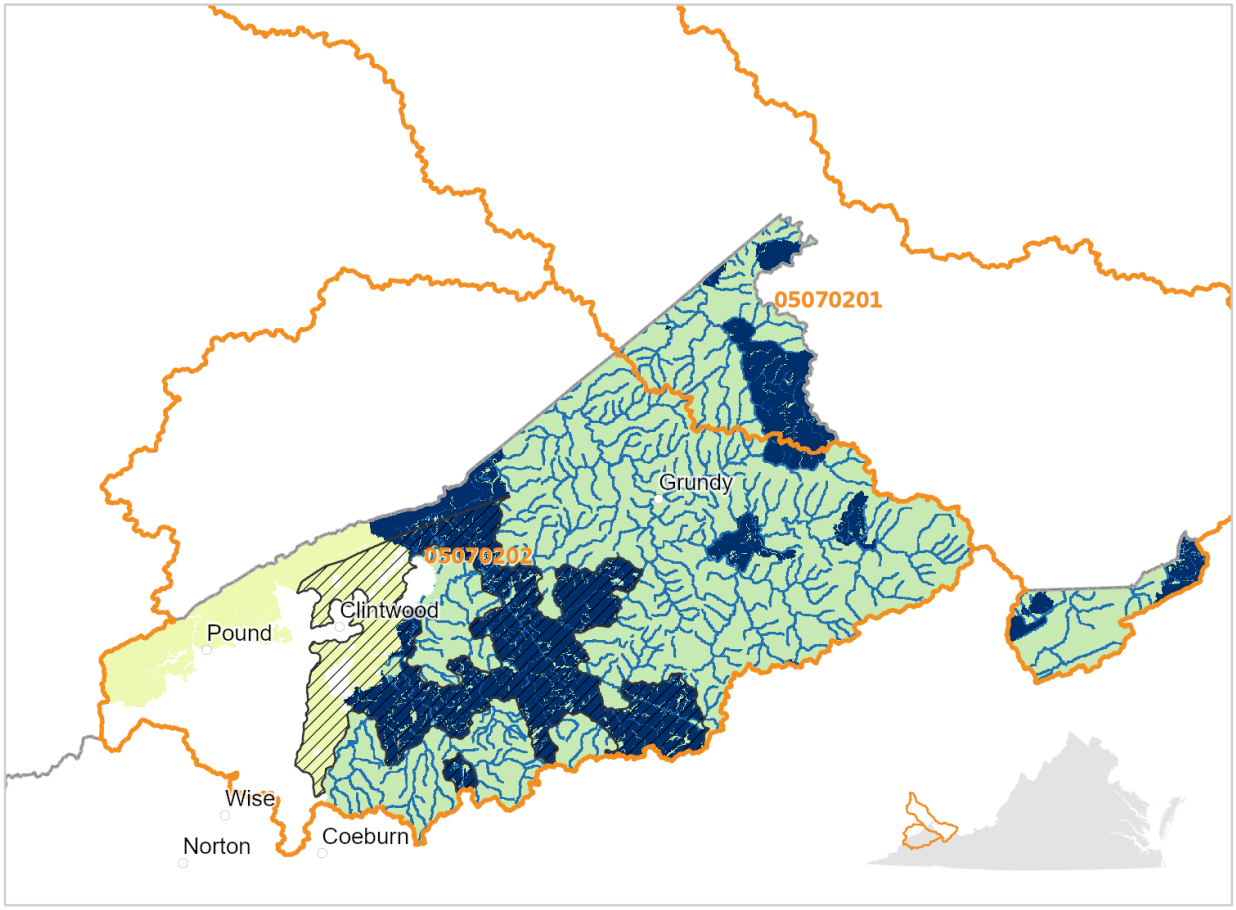
Tier 1 Priority Areas within the Big Sandy River GSA include freshwater and terrestrial resilient and connected systems. The Central Appalachians TNC Focal Landscape is also located within the basin. Tier 2 Priority Areas include all seven of the conservation categories in the ConserveVirginia map except Water Quality Improvement along with Protected Lands. Additional information on these priority areas can be found in Part One and Appendix 2 of this document.

PRIORITY CONSERVATION AREAS (SEE MAPS 27 - 28)

Big Sandy River Basin Priority Areas

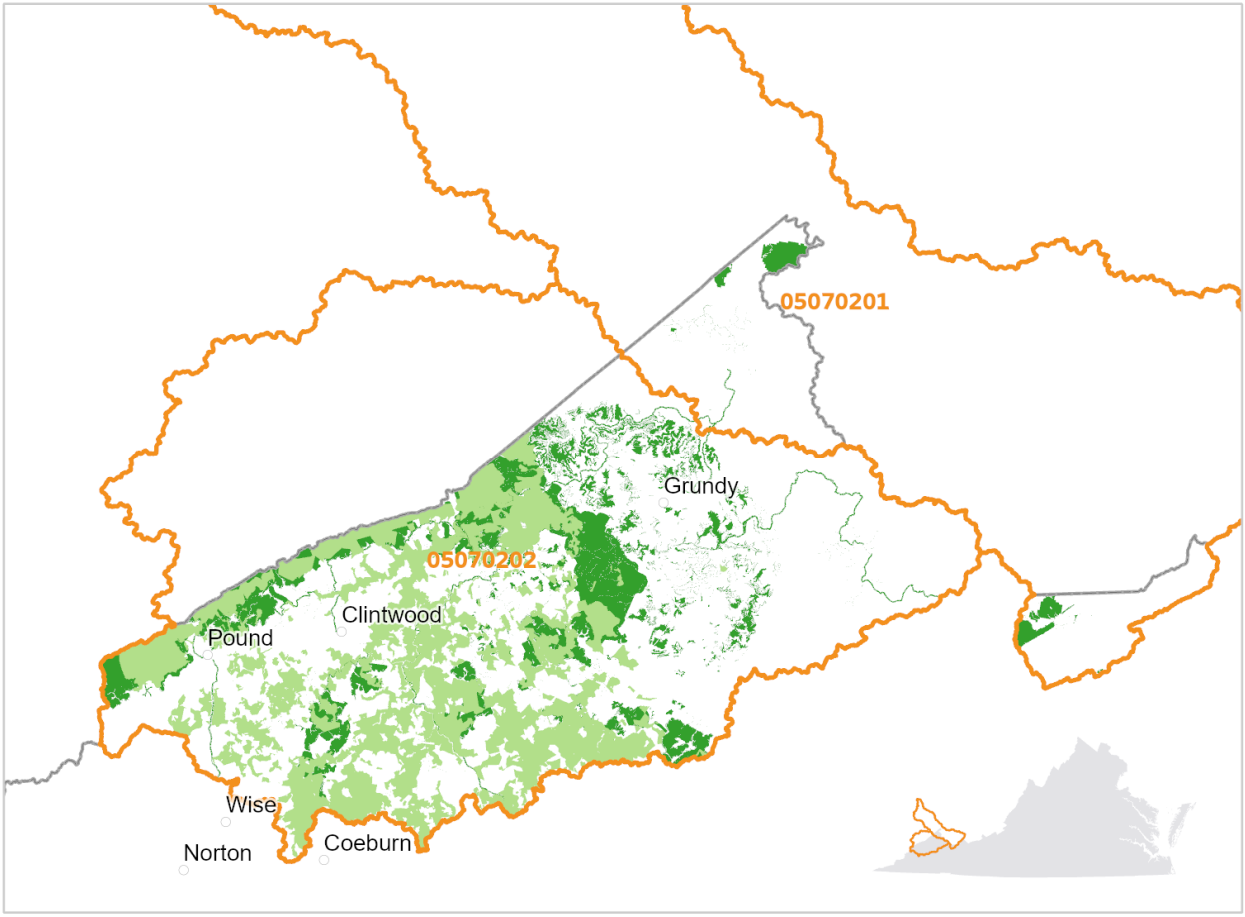
Priority Areas	Type/System of Focus for Conservation Action		Primary Interests within Focal Landscapes
Resilient and Connected Systems	Freshwater Resilient and Connected Network		
	Terrestrial Resilient and Connected Network		
Focal Landscapes	Central Appalachians	Matrix Forest Systems	Central Oak-Pine Forests
			Cove Forests
			Spruce-fir and Northern Hardwood & Conifer
			S. Ridge & Valley/ Cumberland Dry Calcareous & Alkaline Glades
			Acidic Barrens & Glades
			Forest Interior Birds
			Rare Bats
			Golden-winged Warbler
		Caves and Karst Systems	Rare Cave Invertebrates
ConserveVirginia	Agriculture & Forestry		
	Natural Habitat & Ecosystem Diversity		
	Floodplains & Flooding Resilience		
	Cultural & Historic Preservation		
	Scenic Preservation		
	Protected Landscapes Resilience		
Protected Lands	Conservation Easement		
	Federal Lands		
	Other TNC Ownership		
	State Lands		

Map 27. Big Sandy River Basin Tier 1 Priority Areas



- Overlap of Freshwater and Terrestrial Resilience
- High and Highest Freshwater Resilience Active River Area
- High and Highest Freshwater Resilience Watersheds
- Terrestrial Resilience Only
- Focal Landscapes
- 8-digit Hydrologic Unit
- State Boundary

Map 28. Big Sandy River Basin Tier 2 Priority Areas



ConserveVirginia 2.0
Protected Lands
8-digit Hydrologic Unit
State Boundary

APPENDICES

Appendix 1. VARTF Stakeholders and Partners

Key partners for implementing conservation strategies in Virginia.

Federal Agencies
Atlantic States Marine Fisheries Commission (ASMFC)
Environmental Protection Agency (EPA)*
Department of Defense – U.S. Army, Fort A.P. Hill
National Aeronautics and Space Administration (NASA)
National Oceanic and Atmospheric Administration (NOAA)
National Park Service (NPS)*
U.S. Army Corps of Engineers (ACE)*
U.S. Department of Agriculture Natural Resources Conservation Service (NRCS)*
U.S. Department of Agriculture Forest Service (USDA-FS)
U.S. Geological Survey (USGS)
U.S. Naval Research Laboratory (NRL)
U.S. Fish and Wildlife Service (USFWS)*
State Agencies
Virginia Department of Conservation and Recreation (VDCR)*
Virginia Department of Environment Quality (DEQ)*
DEQ-Coastal Resources Management (DEQ-CRM)
Virginia Department of Game and Inland Fisheries (DGIF)*
Virginia Marine Resources Commission (VMRC)*
Virginia Department of Forestry (DOF)*
Virginia Department of Historic Resources (DHR)*
Virginia Department of Agriculture and Consumer Affairs (VDACS)
Virginia Department of Mines, Minerals and Energy (DMME)
Virginia Outdoors Foundation (VOF)*
Local Government
Soil and Water Conservation Districts
Planning District Commissions
County board of supervisors/city councils
Local government staff*
Universities/Research Centers
Christopher Newport University*
College of William and Mary, Center for Conservation Biology (CCB) and Virginia Institute for Marine Sciences (VIMS)*
James Madison University (JMU)
Old Dominion University (ODU)*
University of Virginia (UVA)
Utah State University (USU)
Virginia Commonwealth University (VCU)*
Virginia Tech (VT)*

Industry
Dominion
WestRock
American Electric Power
The Homestead
Contura Energy
Environmental Consulting and Engineering Firms*
Non-Governmental Organizations
Chesapeake Bay Foundation (CBF)*
National Wildlife Federation
Southern Environmental Law Center
Virginia United Land Trusts (VaULT) (and member organizations)
Virginia Conservation Network (VCN) (and partner organizations)

***VARTF partner organizations**

VARTF partner organizations.

American Rivers	New River Land Trust
Bedford County	Northern Neck Land Conservancy
Canaan Valley Institute	Northern Virginia Conservation Trust
Cave Conservancy of the Virginias	Northern Virginia Soil and Water Conservation District
Central Virginia Battlefields Trust	Old Dominion University*
Chesapeake Bay Foundation*	Orange County
Christopher Newport University	Potomac Conservancy
City of Bedford	Private Citizens
City of Charlottesville	Private Landowners
City of Fredericksburg	Rappahannock Phragmites Action Committee
City of Harrisonburg	Rivanna Conservation Alliance
Culpeper County	Shenandoah Valley Battlefields Foundation
Ducks Unlimited	Spotsylvania County
Environmental Consulting and Engineering Firms	Stafford County
Fairfax County	Trust for Public Land
Fauquier County	U.S. Army Corps of Engineers*
Friends of the Rappahannock	U.S. Environmental Protection Agency*
Goochland County	U.S. Fish and Wildlife Service*
Goose Creek Association	Valley Conservation Council
Henrico County	Virginia Commonwealth University*
James City County	Virginia Department of Conservation and Recreation*
James River Association	Virginia Department of Environmental Quality*
Land Protection, Construction, and Management Firms	Virginia Department of Forestry*
Local Government Staff	Virginia Department of Game and Inland Fisheries*
Loudoun County	Virginia Department of Transportation (VDOT)
Middle Peninsula Land Trust	Virginia Institute of Marine Science*
Middle Peninsula Public Access Authority	Virginia Marine Resources Commission*
National Park Service*	Virginia Outdoors Foundation*
Natural Resources Conservation Services*	Virginia Tech*
New River Conservancy	Western Virginia Land Trust

*** Key partners for implementing conservation strategies in Virginia**

Appendix 2. Details on TNC's Conservation by Design Process, Regional Resilient and Connected Systems, and Focal Landscapes

TNC's Conservation Planning Process Applied to VARTF CPF (Element V)

For more than two decades, TNC's work has been guided by a collaborative, science-based conservation framework, called Conservation by Design (CBD). From the beginning, Conservation by Design (based on the Open Standards for the Practice of Conservation[37]) has unified TNC and partner conservation efforts around the world by providing a common language and consistent approach across the diversity of systems, cultures, geographies and communities in which TNC engages. It has guided TNC and partners in identifying what to conserve and where and how to conserve it, and in measuring the effectiveness of strategies. Conservation by Design articulates TNC's conservation vision and marries a collaborative, science-based approach with key analytical methods. Around the world, this strategic framework guides the Conservancy and its partners in conserving the lands and waters on which all life depends. TNC seeks solutions that will meet the needs of people, as well as species and ecosystems. The basic concepts of Conservation by Design are simple: set goals and priorities, develop strategies, take action, and measure results.

Recently, TNC has evolved its approach in the 20th Anniversary Edition of Conservation by Design (CBD 2.0) to meet the challenges of the 21st century, including climate change, a growing human population, and increasing demands for energy, food and other resources. This edition of CBD is centered on four key advances: 1) explicitly considering linkages between people and nature, 2) designing interventions focused on creating systemic change, 3) integrating spatial planning with the development of new conservation strategies, and 4) robustly drawing upon and building the evidence base for conservation (Figure 2). Place-based conservation is TNC's heritage and continues to be a cornerstone of its work. But local protection, restoration and management efforts must be amplified, so that they have an impact beyond each place.

Regional Resilient and Connected Systems

Ecoregional planning is the cornerstone of CBD and has historically guided TNC's identification of conservation priorities, threats, strategies, and goals across ecoregions. Recent CBD framework updates and cutting-edge science on resilience in the face of climate change have added a new lens to build on and refine these previously identified ecoregional priorities. Elements IV, V, and VI in this Compensation Planning Framework have utilized the CBD planning process to identify priorities for VARTF. Recent resiliency science and the identification of the Resilient and Connected Network for terrestrial systems and highly resilient coastal and freshwater systems (Figures 1 and 2) has enabled the update of previous ecoregional priorities based on the best available science to assess the "viability" of places in the face of climate change. New resiliency science and the resulting spatial priorities (in addition to ecoregional

[37] *https://cmp-openstandards.org/*

prioritizations) are described in the section below, and details on ecoregional planning processes can be found in Appendix A of the previous VARTF Compensation Planning Framework.[38]

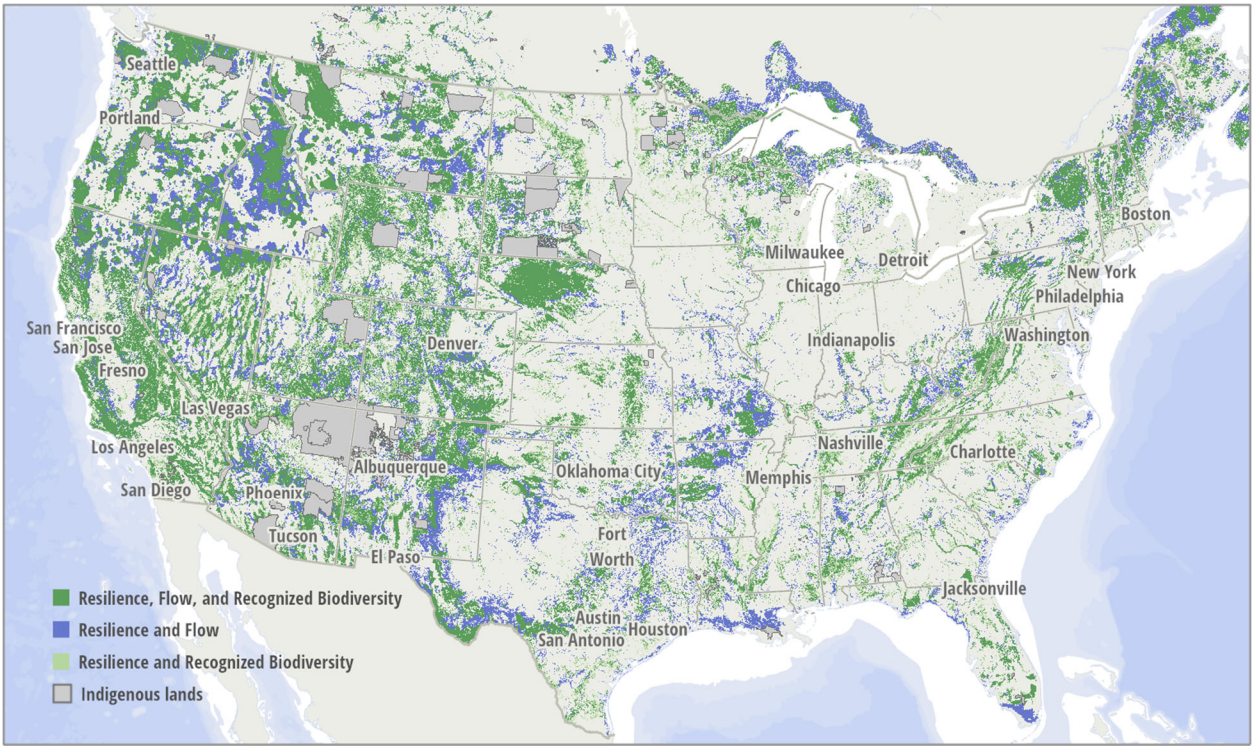


FIGURE 1. RESILIENT AND CONNECTED NETWORK (TERRESTRIAL AND COASTAL)

[38] *The Nature Conservancy's Watershed Approach to Compensation Planning for the Virginia Aquatic Resources Trust Fund. 2009* https://www.conservationgateway.org/Documents/Exhibit_A_ComprehensivePlanningFrameworkFinal.pdf

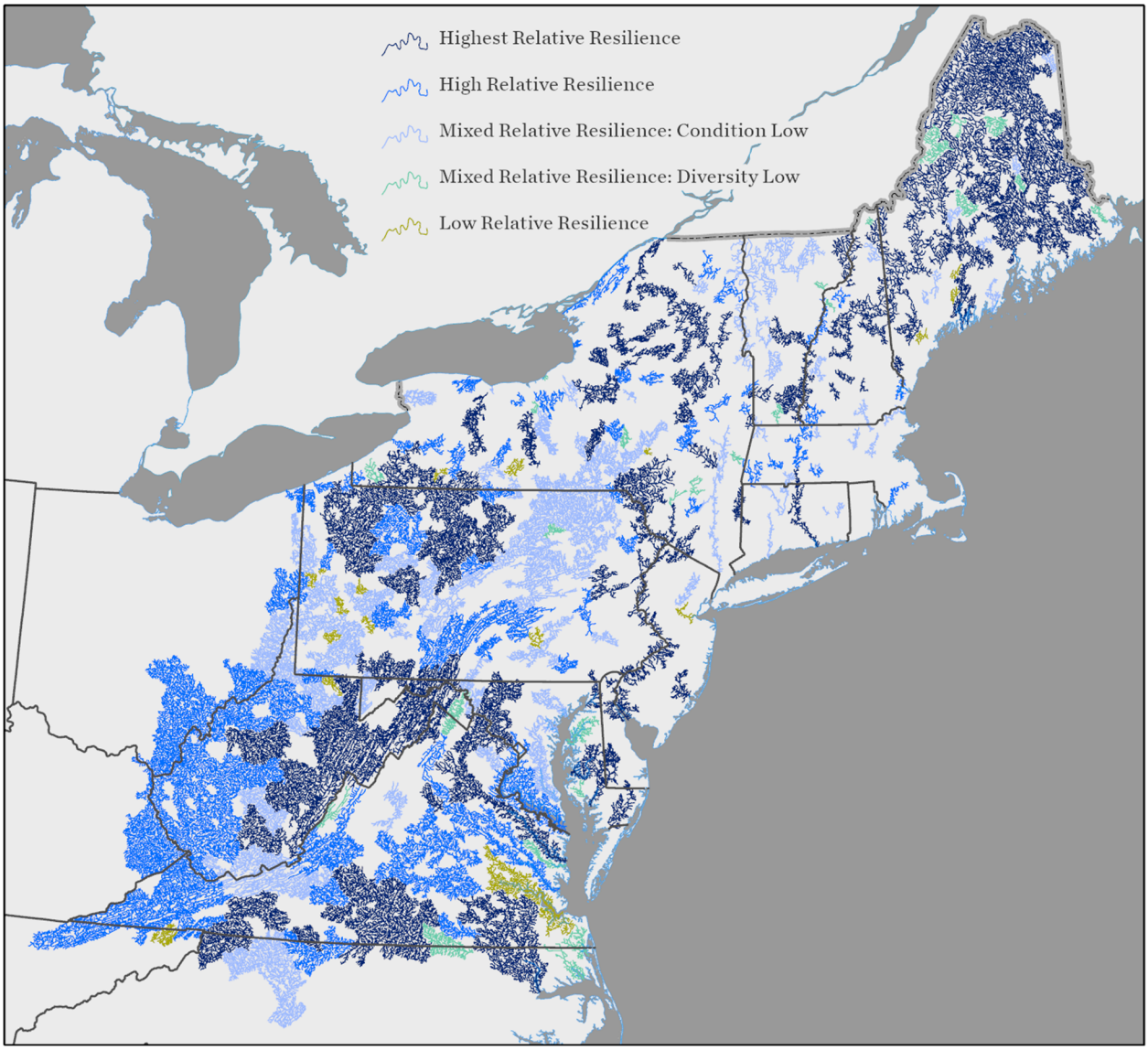


FIGURE 2. RESILIENT FRESHWATER SYSTEMS

A resilient system is an area with sufficient geophysical options to maintain species diversity and ecological function by allowing species/communities to adapt or transform in the face of climate stresses. Thus, at a landscape scale, these analyses identify spatially defined resilient and connected land and waters in freshwater, coastal and terrestrial systems as a blueprint for conservation that represents all habitats, while allowing nature to adapt and change. This blueprint is a tool that can guide TNC and its partners to set strategic priorities for conservation investment.

Resilient Terrestrial and Coastal Systems include climate-resilient sites, confirmed biodiversity locations, and species movement areas (zones and corridors), stratified by ecoregion, to prioritize a conservation portfolio that naturally aligns these features into a network of resilient terrestrial sites and species movement zones, integrated with identified resilient coastal sites (tidal complex areas with the greatest ability to accommodate sea level rise and resulting habitat migration). More than 10 years of work by more than 100 TNC scientists in collaboration with external partners has gone into developing the Resilient and Connected Landscapes analysis and blueprint for regional conservation. Seven internally-reviewed reports and 11 peer-reviewed journal articles have been written on this approach, including a

special section in the premier science journal "Conservation Biology" that includes overview articles by 33 authors from around the world. The central idea behind this analysis is the need to 'conserve nature's stage' – in other words, to conserve and connect the geophysical "stages" that support diversity at local and regional scales and that will continue to support botanical diversity and iconic wildlife as the climate changes. This network of "stages" will support a changing cast of "actors" sure to be on the move under a changing climate. Individually, each site (or "stage") must be resilient to climate change, as measured by the presence of many microclimates and intact natural cover which together buffer species from climate impacts and allow communities of species to rearrange within resilient areas. Collectively, the network of sites must represent the full spectrum of the region's soils, bedrocks, elevation and latitudinal zones, and be spatially configured to allow species to move from stage to stage.[39]

Resilient Freshwater Systems are those that continue to support biodiversity and ecological services as they adapt to climatic change. These waterways have extensive longitudinal connectivity linking tributaries of many sizes, gradients and temperatures, good lateral connectivity linking them to their floodplain, and relatively unaltered natural flows within a permeable watershed. A team of 13 TNC scientists developed a method to estimate the relative resilience of freshwater systems based on four physical and three condition characteristics that can be accurately mapped at the regional (Northeast and Mid-Atlantic) scale. These characteristics ensure that a stream network contains a diversity of environments, allows aquatic species to migrate and find suitable habitat, has clean water delivered to the channel, and has the capacity to store water, nutrients and sediment on the floodplain. Based on scores for physical properties and condition characteristics, stream networks were categorized as having the highest relative resilience (scores far above average), high relative resilience (scores above average), mixed relative resilience (above average for condition but not physical properties (diversity) or vice versa), or low relative resilience (scores below average).[40]

Virginia's Focal Landscapes

The Virginia Chapter of TNC utilized the Conservation by Design planning approach to evaluate conservation goals, set priority strategies, and establish programs within 3 broad, system-level Focal Landscapes within Virginia, (1) the Central Appalachians, including identified nested systems of (a) Matrix Forests (b) Caves and Karst, and (c) Freshwater, and containing TNC's programmatic offices in the Clinch Valley (CVP) and Allegheny Highlands (AHP), (2) the Virginia Pinelands (VPP), and (3) the Volgenau Virginia Coast Reserve (VVCR) (Figure 3). Primary interests for each Focal Landscape system are described below. TNC's programmatic offices (CVP, AHP, VPP, and VVCR) have developed Conservation Plans with more detailed spatial data within program boundaries. These plans and the evidence cited within them should be consulted where additional data refinement could be beneficial in assessing mitigation project potential.[41]

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[39] *Terrestrial and Coastal Resilience Data and Reports on Conservation Gateway and Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA: Anderson, M.G. and Barnett, A. 2017. Resilient Coastal Sites for Conservation in the Northeast and Mid-Atlantic US. The Nature Conservancy, Eastern Conservation Science.*

[40] *Freshwater Resilience Data and Reports on Conservation Gateway and Anderson, M.G., A. Olivero Sheldon, C. Apse, A. Bowden, A. Barnett, B. Beaty, C. Burns, D. Crabtree, D Bechtel, J. Higgins, J. Dunscomb, and P. Marangelo. 2013. Assessing Freshwater Ecosystems for Their Resilience to Climate Change. The Nature Conservancy, Eastern Conservation Science.*

[41] *Clinch Valley, Allegheny Highlands, Virginia Pinelands, and Volgenau Virginia Coast Reserve Program Conservation Plans. 2018. TNC VA. Unpublished.*

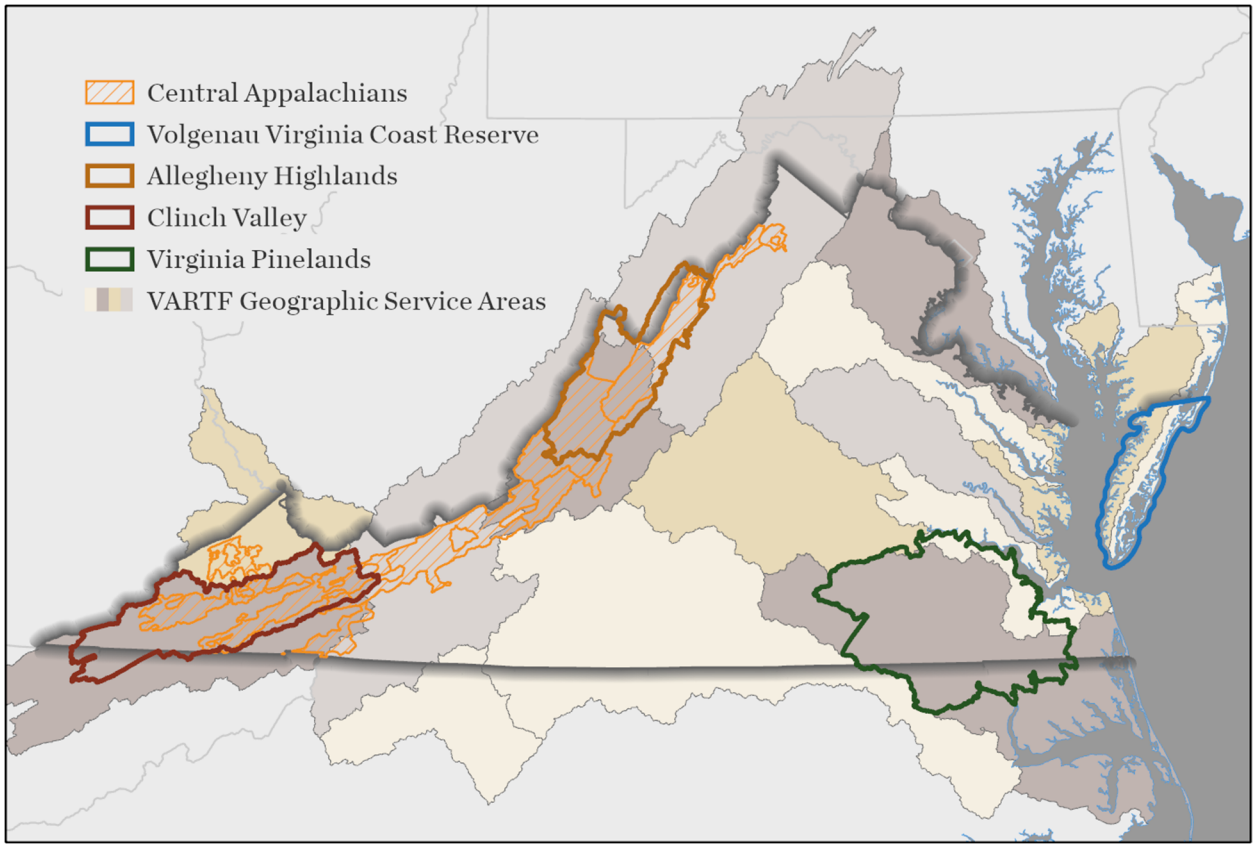

FIGURE 3. FOCAL LANDSCAPES.

CENTRAL APPALACHIANS

Matrix Forests

Central Appalachian Matrix Forests are identified as nested primary interests within the overall Central Appalachians Focal Area. This target refers to a select number of forested tracts across western Virginia that are unbroken by major roads, representative of landscape heterogeneity, and large enough to be resilient to natural disturbances, while maintaining healthy breeding populations of associated forest fauna. These matrix forests also provide critical connections and corridors for species movements and climate resiliency across the Appalachians. In general, the temperate broadleaf forests of the Central Appalachians are composed of a range of different natural community types and successional stages, with dominant hardwoods and minor softwood components, (i.e., largely deciduous oak, hickory and maple, with hemlock in cove areas and mixed pine on dry ridges). Uncharacteristic vegetation in these forests has resulted from fire suppression for the last 100 years and intensive timbering through the 1980's. Forest structure, diversity, and species composition are departed from the natural range of variation. Fire-adapted forest communities (Dry Mesic Oak-Hickory, Shortleaf-Pine, Oak-Pine-Heath, and High Elevation Red Oak systems) are most significantly departed. In general, early successional habitats and open canopy "woodlands" forests are underrepresented, and there is an overabundance of mid-late seral, closed canopy forests on the landscape. Compounding factors are likely to pose additional risks to these forests (forest pests and pathogens, invasive species, fragmentation from energy and development corridors, etc.)

Within the matrix forest target are nested conservation targets, including rare patch forest communities and forest-dependent wildlife. Rare patch communities refer to a number of rare, endemic communities,

as well as other areas designated "High Value Conservation Forests" (FSC designation) embedded in and contributing to the diversity of the larger matrix forest. Identified target rare patch communities include spruce-fir and northern hardwood and conifer forests, Southern Ridge and Valley/Cumberland dry calcareous and alkaline glades, acidic barrens and glades, limestone and dolomite barrens, and forested river cliffs. Due to rare and unique ecological attributes, these small patch communities often face additional threats, are more susceptible to degradation, and support a disproportionately large number of rare species compared to their extent on the landscape. Major threats to rare patch communities are invasions by nonindigenous species, development, hydrological alteration, fire suppression, recreation, grazing, agricultural conversion, and fragmentation.

Three types of wildlife of special conservation concern are also a nested target within the matrix forest focal area. These include forest interior birds, golden-winged warblers, and rare bats. Target forest interior bird species include black-and-white Warbler (*Mniotilta varia*), Eastern Towhee (*Pipilo erythrophthalmus*), Eastern Wood Pewee (*Contopus virens*), Hooded warbler (*Setophaga citrina*), Ovenbird (*Seiurus aurocapilla*), Scarlet Tanager (*Piranga olivacea*), Worm-eating warbler (*Helmitheros vermivorum*), and Cerulean warbler (*Setophaga cerulea*). Population declines are noted among 25-30% of forest interior neotropical migratory bird species that breed in the Appalachians. This region ranked extremely high by Partners In Flight (PIF), in terms of immediate conservation concern, based on high concentrations of high-priority and declining species. The lack of forest structural and age class diversity is the primary overall threat to these birds. Golden-winged warblers (*Vermivora chrysopterais*) are included as a separate nested target because they require a unique high-elevation early successional habitat with clumped shrubs, sparse trees, and an herbaceous understory adjacent to mature deciduous forest, and because this species is rated as a high-priority species by Appalachian Mountain Joint Venture, Bird Conservation Regions and U.S. Fish and Wildlife Service partners. Steep declines are known for Golden-winged Warbler populations, especially in the Appalachians – with 97.8% population loss from 1966 to 2010 and 61.7% loss over the last decade (VA: -8%/year). This decline is attributed to loss of breeding habitat and land use change. Seven globally-rare focal bat species are also included as nested conservation targets within the matrix forest, including Little brown bat (*Myotis lucifugus*), Big brown bat (*Eptesicus fuscus*), Eastern small-footed bat (*M. leibii*), Tri-colored bat (*Perimyotis subflavus*), Northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), and Virginia big-eared bat (*Corynorhinus townsendii virginianus*). In the AHP, there are 32 known element occurrences of 4 state rare bat species using caves, 3 of which are federally-listed. Significant (>80%) declines have been noted among target species in 4 known AHP hibernacula, due to white-nose syndrome. Other threats to bat populations and habitat include cave recreation, ecologically-incompatible agricultural practices, residential or infrastructure development, and illegal dumping in key recharge areas.

Caves and Karst Systems

The Central Appalachians also includes karst landscapes (sinkholes, sinking streams, springs and caves) which support particularly high levels of biodiversity and endemism. These systems support aquatic and terrestrial cave-obligate invertebrate species (including at least 40 globally-rare species that are known to occur in only one or two cave systems) and provide essential habitat for some of the largest concentrations of common and rare bat species in the region (including three federally-endangered bats, Indiana bat, gray bat, and Virginia big-eared bat). Each year, these systems reveal invertebrate species entirely unknown to science. The vast groundwater that percolates through these systems is also essential to rare aquatic species and to the base flow and quality of our surface waters. Karst concentration areas in the CVP are in the top two places in the Central Appalachians recognized for subterranean biodiversity and endemism, and contain over 50% of all Virginia caves (> 160 designated as biologically-significant), and five of the seven significant karst areas identified by the Virginia Department of Conservation (DCR), Division of Natural Heritage. In the AHP, this conservation target refers to Siluro-Devonian limestone solution caves, sinkholes, epikarst, springs, intermittent streams and groundwater aquifers, concentrated in five DCR conservation areas. There are 60 known state-designated biologically-significant caves in the

AHP, located in 35 mapped DCR conservation sites. Ten caves are known to be associated with federal or state listed bat species. Most biologically-significant caves have controlled access so that accidental pathogen or invasive species introduction risk is minimal and physical habitat disturbance is prevented. Karst areas are considered to be intact and functioning, though more monitoring needs to be conducted to determine impacts of grazing and agriculture on water quality. Land use changes and habitat fragmentation in karst recharge zones can stress karst systems by altering temperature, nutrient, or hydrologic regimes, and by causing sedimentation. The land use surrounding many recharge zones and openings remains open agricultural land, altering the natural hydrologic and allochthonous inputs that karst communities depend on. Climate change can amplify these stressors.

Rare cave invertebrates are a nested target within the Central Appalachian cave and karst system. Obligate cave aquatic organisms (or "stygobites") include isopods and amphipods and obligate cave terrestrial organisms (or "troglobites") include springtails, centipedes, psuedoscorpions, mites, spiders, and beetles. Rare, endemic species include: Crossroads cave beetle (*Pseudanophthalmus intersectus*, G1), Burnsville Cove cave amphipod (*Stygobromus conradi*, G2), Morrison's cave amphipod (*S. morrisoni*, G2), Bath County cave amphipod (*S. mundus*, G2), and Virginia spring snail (*Fontigens morrisoni*, G1). There are 27 terrestrial and 12 aquatic cave-limited invertebrate species documented in AHP. Fifty-five occurrences of rare cave invertebrates are tracked by DCR. It is assumed that cave invertebrates are viable, due to the good condition of their habitat. However, the condition cannot be confidently stated without a current and comprehensive biological inventory.

Freshwater Systems

Freshwater system focal areas have been identified in both the AHP and the CVP. In the AHP, freshwater system targets include priority large rivers, headwaters and tributaries, and montane non-alluvial wetlands. The CVP has identified mussel and fish fauna as key globally-rare targets that indicate health and viability of the priority large rivers and headwater streams in the CVP landscape.

Priority large rivers in the AHP occur in the Upper James and Potomac River drainages, and include the Cowpasture, Jackson, Calfpasture and South Branch Potomac rivers. Fish fauna is a typical Ridge and Valley warmwater assemblage with some species less tolerant of alkaline conditions. The Cowpasture River is the best remaining example of a small central Appalachian river in the James River Drainage, and is one of the most pristine rivers in the state, with high water quality and healthy, diverse aquatic fauna. Aquatic species of special conservation concern include viable populations of James River endemic fishes (e.g., Roughhead shiner [*Notropis semperasper*], G2), 1 fish endemic to the Potomac and James rivers, 5 tributary fish species, 2 mussel species (James River Spinymussel [*Pleurobema collina*], G1; Virginia pigtoe [*Lexingtonia subplana*], G1) and 1 aquatic snail. The Jackson River has been historically impaired below the WestRock paper mill in Covington, due to point source legacy impact that is slowly improving. Aquatic life impairments exist on a few segments, and identified sources of impairment include channelization, sanitary sewer overflows/discharge, and agricultural runoff. Lake Moomaw, formed by Gathright Dam of the Jackson River is the most significant impoundment. A 17-mile portion of the Jackson River tailwater, below Gathright Dam, is a major recreational fishery. Although most of the river drainages for the north and south forks of the South Branch Potomac River are outside of the state of Virginia, the headwaters of both of these rivers are nested within the Central Appalachian Forest Matrix focal area, and they both rank as at or above the regional mean in both diversity and condition.

The headwater streams target includes lower order streams and tributaries of moderate to high gradient that flow off moderate/high elevation sandstone/shales ridges. Low gradient channels occur in moderate elevation shales. Colder water tributaries provide excellent habitat for Brook Trout, though are potentially imperiled by the threat of acid deposition. Outstanding water quality and lack of hydrological impediments contribute to sustaining the health of aquatic fauna. Flow is augmented by good connection to karst groundwater. Many tributaries are subterranean and surface flow is highly intermittent.

The montane non-alluvial wetlands target consists of primarily groundwater-controlled, non-alluvial wetlands including seeps, bogs, fens, and ponds. Appalachian Bogs and High-Elevation Seepage Swamps contain saturated, coniferous or mixed forests of gently sloping stream headwaters, large spring seeps, and ravine bottoms at elevations above 3,000 feet. Montane Depression Wetlands include saturated, seasonally flooded, and semi-permanently flooded vegetation situated on broad ridge crests, landslide benches and mountain-foot alluvial fans. These wetlands provide important breeding grounds for odonates and amphibians (Fleming et al. 2001). These are uncommon to rare communities with ~24 element occurrences in the AHP. Appalachian Bogs and High-Elevation Seepage Swamps are clustered primarily along Laurel Fork. Scattered, isolated Montane Depression Wetlands occur at 7 sites. One well known, significant Calcareous Fen (Hotchkiss Meadow) is on private land and at risk of development or alteration.

The endemic Cumberlandian Mussel Assemblage target is the suite of 46+ freshwater mussel species native to the Upper Tennessee River Basin, including 21 federally-endangered species. This assemblage is the greatest concentration of imperiled mussel species in the world. Five assemblage strongholds in the Clinch and Powell rivers have been identified as strategic focal areas. This mussel assemblage is characterized by a mixed pattern of health. Populations in the lower Clinch, middle Clinch (centered around Artrip), and upper North Fork Holston are generally robust and rich, while the remainder of Clinch, Powell, and North Fork Holston river reaches exhibit depauperate mussel assemblages with lower-than-expected species richness, reduced recruitment, and depressed population densities. Water quality issues (specific conductance, some metals, and Polyaromatic Hydrocarbons) help explain the mixed pattern of mussel population viability. Mussel culture and augmentation has become a viable tool for the recovery of mussel assemblages at the scale of individual shoals, and is needed for population recovery at the river system scale, in the face of expected continued legacy impacts. Culturing and augmentation capacity is required to implement planned recovery efforts, which prioritize expansion of mussel populations in river sections that have the best chance for near-term recovery (due to enabling water quality and habitat conditions). Certain reaches of these rivers exhibit stressed or degraded mussel assemblages in need of restoration and protection.

The Upper Tennessee River Fish Assemblage target refers to the community of 118 fish species native to the Clinch, Powell and North Fork Holston rivers, with a focus on 23 globally-rare species. These rivers support approximately ½ of the globally-significant Tennessee River Basin fish fauna, including the federally-endangered duskytail darter (*Etheostoma percnurum)* and pygmy madtom (*Noturus stanauli*), and the federally-threatened slender chub (*Erimystax cahni*), blackside dace (*Chrosomus cumberlandensis*), and yellowfin madtom (*N. flavipinnis*). While most agency sampling (Tennessee Valley Authority & Virginia Department of Wildlife Resources) indicates that species richness, distribution, and fish biological integrity is Good to Very Good throughout the Clinch & Powell rivers, little is known about population densities compared to historic conditions or carrying capacity. No known extinctions have occurred, but a few species are exceedingly rare now, including the slender chub and duskytail darter. Land use conditions in the watershed may be causing stress on fish populations, as both the Powell and Clinch river mainstems have mining extents that exceed impact thresholds, natural landcover in the riparian area is below optimal, and agricultural land use in the riparian area is predominately over 25% throughout the mainstem valleys. Few tools other than riparian restoration and habitat protection/restoration are available to biologists and managers to improve conditions for native fish populations.

VIRGINIA PINELANDS

The Virginia Pinelands Focal Landscape includes long-leaf pine (*Pinus palustris*) savanna, which supports the federally-endangered red-cockaded woodpecker (*Dryobates borealis*), Nottoway River and tributary streams below the fall-line, and Albemarle Sound forests and marshes. Southern pine savannas and open woodlands once dominated the southeastern Coastal Plain of the United States. These communities are comprised of relatively sparse pine canopies, open understories and a ground cover consisting of grasses, forbs, shrubs and small trees. Longleaf pine is thought to have been the dominant canopy pine across much of the Coastal Plain at the time of European settlement. Other pines include loblolly (*P. taeda*), pond (*P. serotina*), shortleaf (*P. echinata*) and slash (*P. elliottii*). Longleaf pine ecosystems, of primary importance to red-cockaded woodpeckers, are now among the most endangered ecosystems on Earth. In addition, the Nottoway River and its tributary streams below the fall-line have been identified as a priority corridor system linking longleaf pine conservation areas. Forest and marsh protection in the Albemarle Sound portion of Virginia Beach and Chesapeake is also a priority to preserve the flood risk reduction services these natural systems provide. Threats to the Virginia Pinelands include lack of land base in pine savanna management, maintenance of a diverse, healthy forest products industry that includes longleaf pine, lack of fire, lack of red-cockaded woodpecker breeding habitat, incompatible timber harvest in riparian areas, lack of riparian forest hardwood and bald cypress regeneration, and lack of awareness of asset value of protected natural lands.

VOLGENAU VIRGINIA COAST RESERVE

The Volgenau Virginia Coast Reserve (VVCR) Focal Landscape is located on Virginia's Eastern Shore, on the lower Delmarva Peninsula separating the Chesapeake Bay from the Atlantic Ocean. Virginia's Eastern Shore consists of a lagoonal system located between the mainland and barrier islands. This system is made up of extensive salt marshes, mud flats, tidal inlets, marsh islands, and shallow bays. The Shore is hemispherically renowned for the significant populations of migratory and breeding shorebirds, colonial waterbirds, landbirds, and raptors. The 65-mile long barrier island chain is one of the best examples of naturally functioning barrier island systems and it is one of the nation's last remaining expanses of Atlantic Coastal Wilderness. For the past 40 years, the Conservancy has worked on Virginia's Eastern Shore to protect land and water; manage and monitor the resources of the barrier islands, coastal bays, marshes and inlets, breeding and migratory colonial waterbirds, shorebirds, and waterfowl; and restore marine habitats such as eelgrass meadows and oyster reefs. VCR comprises the barrier islands and mainland holdings owned by the Conservancy and public and private partners. VCR's ecological value is recognized through its designation as a United Nations International Man and the Biosphere Reserve, a U.S. Department of the Interior National Natural Landmark, a National Science Foundation Long Term Ecological Research Site, and a Western Hemisphere International Shorebird Reserve Network Site. The specific targets within the VCR focal area are described further below, and include migratory land birds, tidal creeks, mainland marshes, bay coastal species, barrier islands and back barrier/lagoonal marshes, shorebirds and waterbirds, and forest and scrub shrub habitats.

Accelerated sea-level rise, changing frequency and intensity of storms, altered patterns of precipitation, warming air and water temperature, and ocean acidification could dramatically affect the location and distribution of physical habitats and species distributions at VCR, and fundamentally alter the processes that maintain them. Virginia's Eastern Shore lies within one of the United States' most vulnerable coastal regions. The U.S. Mid-Atlantic (New Jersey through Virginia) is experiencing higher rates of relative sea level rise, as compared to global mean sea level rise, in the amount of 0.12 to 0.2 in/yr due to glacial isostatic adjustment and subsidence amongst other factors. According to the most current projections adjusted for local factors, by 2100 Virginia's Eastern Shore will experience a 5.07 ft sea level increase under an intermediate scenario, and an 8.35 ft sea level increase under a high scenario. In addition to sea level rise, this region frequently experiences disturbances such as nor'easters and other storms that are

responsible for storm surge, coastal flooding, and erosion. These events will keep occurring in the future, and new sea level conditions will likely exacerbate the effects, such as coastal flooding and erosion.

Each fall millions of migratory landbirds (representing nearly 200 species) and raptors funnel through the southern Delmarva Peninsula, making the mainland one of the most important stopover and staging areas along the Atlantic flyway and in the eastern United States. Migratory landbirds stopover and forage in upland mixed hardwood forest and riparian and bottomland forest habitat before flying south en route to wintering grounds. The majority of neotropical migrants utilizing the peninsula mainland are young of the year, likely funneled to the Eastern Shore by cold fronts and prevailing winds. Due to insufficient soft-mast producing and broad-leaved forest and scrub-shrub habitats, forage for fall migration of landbirds is limited, preventing birds from replenishing their fat reserves, leading to a 70% mortality rate in young of the year migrants. Therefore, migrating landbirds are not meeting their collective metabolic demand for their southward journey when they stop on the lower Virginia's Eastern Shore. Restoration efforts over the past 15 years have focused on creating forests that maximize the energetic benefits for migrating landbirds during fall months, while expanding the net amount of forest cover on the mainland. However, there is no evidence that suggests habitat restoration efforts are improving the population viability of the migrating landbirds, and how much additional work needs to be done to ensure adequate forage requirements are met for migrating populations.

Slow-moving, shallow, tidally-influenced creeks and headwater streams connect directly to the Chesapeake Bay or Atlantic coastal bays/lagoons. The water flow and level in these streams fluctuates with the tides creating a subtidal habitat, which is permanently flooded, and an intertidal habitat, exposed at low tide. Salinity typically ranges between 30 and 0.5 ppt and grades into a freshwater system in the upper portions of many of these reaches. Most tidal streams have moderately firm, sandy channel bottoms and vertical banks that are regularly eroded and slump into the creek bottom. Many have a very sinuous pattern as they wind through large salt marshes along the coast. Others have smaller associated brackish or salt marshes along their length and/or intertidal sand and mud flats in their lower portions. These streams and their associated estuaries support a rich diversity of plant and animals and serve as the primary nursery area for many marine fishes. The ecological importance of small tidal streams has historically been undervalued, but recent research is showing that their collective influence on estuarine ecosystem function may equal or exceed that of larger tidal rivers. According to the Virginia Department of Environmental Quality, 33.9 stream miles or 4% of the total stream miles on Virginia's Eastern Shore are considered impaired. Virginia category 5d the Water Quality Standard is not attained where Total Maximum Daily Loads (TMDL) for a pollutant(s) have been developed but one or more pollutants are still causing impairment requiring additional TMDL development. The 5D category includes 82 water bodies on the Accomack Bayside and six on the Seaside. In Northampton County, there are 41 Bayside water bodies included and two Seaside water bodies.

Tidal saltmarshes are intertidal wetlands typically located fringing the backside of barrier islands, in the coastal lagoon as marsh islands, and along the mainland. Two primary communities occur in the coastal bays: *Spartina patens* and *Distichlis spicata* at higher elevations along the mainland interface, referred to as high marsh; and *S. alterniflora* and *D. spicata*, the more extensive type found at lower elevations, referred to as low marsh. Salt marshes provide numerous critical ecological functions, including shoreline stabilization, fish and wildlife habitat, nutrient and sediment cycling, carbon sequestration, and serving as the basis of primary production within the lagoon system. According to our most recent GIS analysis, mainland or fringing marshes cover over 41,155 acres. Recent studies have indicated that most of the Atlantic marshes are building at rates similar to or greater than the current rates of sea-level rise. The study also shows that mainland marshes can generally survive 10 to 50 millimeters of sea-level rise per year; this is mainly due to accretion rates increasing non-linearly as sea-level rise rates accelerate. This means that mainland marshes are either accreting, due to more sediment available due to longer inundation periods, or transgressing upland, where topography allows and obstacles are not present;

however, lagoonal marsh islands are experiencing net losses. Ultimately, some mainland marshes may erode as a result of the "coastal squeeze," meaning a continuously shrinking area will be available for this habitat. Marshes may be keeping pace with sea level rise, but are becoming more fragmented.

Reefs created by living eastern oysters (*Crassostrea virginica*) are integral to the diversity and function of the barrier island lagoon system. Oyster reefs are "ecosystem engineers" providing several ecological services: they provide critical fish and invertebrate habitat, filter water, buffer shorelines from erosion, and are a food source for migratory birds like oystercatchers. Due to disease, overharvest, and environmental degradation, by the 1990s oysters were termed "commercially extinct" in the Virginia coastal bays and lagoons. Since then, oysters appear to have developed immunity to the disease dermo, which, in combination with restoration efforts, has led to healthy recruitment and growth of oyster reefs in the lagoons. According to the most recent, comprehensive quantitative assessment of oyster population in the coastal bays of Virginia's Eastern Shore, the estimate is of about 3.2 billion oysters. TNC's own data indicate that there are about 955 acres of oyster reefs in seaside coastal lagoons, with 43.5 acres within TNC/Virginia Marine Resources Commission sanctuaries, and that there is a lack of reef substrate and three-dimensional structure in the lower intertidal zone, and limited space for restoration in non-private, unleased bottom areas.

The barrier island system extends for nearly 60 miles along the seaward margin of the Lower Virginia Eastern Shore and comprises 12 barrier islands, their associated tidal inlets and sandbars, six back barrier islands, and thousands of acres of fringing salt marshes. Except for Wallop's Island, the islands are free to respond naturally to the processes that have shaped and nourished them since the Pleistocene. Virginia's barrier islands are eroding or migrating landward at 3 to 18 feet per year. It is estimated that landward migration consumes at least 60 acres of back-barrier saltmarsh annually, and has buried almost 8,000 acres of these saltmarshes since 1870 – nearly 10% of Virginia's historical acreage of back-barrier saltmarsh habitat. Historically, given lower rates of sea level rise, sediments were available in the system and were supplied to marshes in an amount sufficient to accrete vertically and not be submerged. The TNC Virginia Eastern Shore Coastal Resilience Tool Coastline Change app (http://maps.coastalresilience.org/virginia/) shows that the barrier islands have had a complex history since the mid 1800's: some show seaward movement and others landward movement; some show clockwise rotation, others anti-clockwise rotation; short-term trends may differ from long-term trends. Currently, there are about 58,780 acres of lagoonal marshes or marsh islands on Virginia's Eastern Shore. The TNC Virginia Eastern Shore Coastal Resilience Tool Future Habitat app shows a higher rate of change for higher sea level projections and longer time frame due probably to the fact that marshes cannot accrete fast enough to keep pace with accelerated sea-level rise. Within the lagoonal marshes at VCR are two nested targets: bay scallops and eelgrass meadows. Bay scallops were sufficiently abundant in the coastal lagoons to briefly support a commercial fishery until the loss of eelgrass, their preferred habitat, around 1933. Successful restoration of eelgrass now allows for potential restoration of scallops in these lagoons. The most recent TNC-Virginia Institute of Marine Science (VIMS) bay scallop population assessment indicates density in eelgrass of 0.007 individuals/m^2. This density is still too low for a self-sustaining population and, because of their short life span (of about 2 years), varies greatly from year to year. Eelgrass (*Zostera marina*) is a marine flowering plant that grows in subtidal regions of the coastal bays and is the major seagrass in the Virginia coastal bays. Similar to the shellfish reefs, eelgrass meadows provide numerous ecological services, including food, nursery and spawning habitat, and refuge for blue crab, bay scallops, and numerous other invertebrates and fish species. In addition, the complex networks of leaves, roots, and rhizomes serve to trap and utilize nutrients and sediments, and attenuate wave action. As a restoration effort, for the past 10 years TNC has broadcast more than 71 million seeds into 535 acres to help accelerate the natural spread of eelgrass, which now covers almost 6,200 acres in South, Spider Crab, Hog Island and Cobb Island bays. The successful restoration of eelgrass in Virginia's Eastern Shore seaside bays is primarily due to good environmental conditions, such as light attenuation and water quality.

The Virginia barrier islands also provide critical habitat for an extraordinary number and diversity of breeding colonial waterbirds, shorebirds, raptors, passerines, and waterfowl including the piping plover (*Charadrius melodus*), Wilson's plover (*C. wilsonia*), American oystercatcher (*Haematopus palliatus*), black skimmer (*Rynchops niger*), least tern (Sterna *antillarum*), and gull-billed tern (*S. nilotica*). Colonial waterbird and shorebird breeding habitat includes high-energy upper beach and overwash fans, dune grasslands, scrub/shrub, and topographical highs (wrack, shell rakes) in the salt marshes. High-energy beaches and peat banks formed along ocean beaches by island migration over backside marshes host a great density of beach specific migratory shorebirds including red knots (*Calidris canutus*), sanderlings (*Calidris alba*), and semi-palmated plovers (*Charadrius semipalmatus*). Inter-tidal mudflats and extensive *S. alterniflora* marshes support significant populations of several shorebird species including whimbrel (*Numenius phaeopus*) and marbled godwit (*Limosa fedoa*). Annual productivity rates for American oystercatcher and piping plover, as measured for at least 50% and 75% of the barrier island breeding population respectively, exceed values needed to maintain stable population (0.42 and 0.93, respectively). Breeding pairs are estimated to be 460 for American oystercatcher (2015) and 291 for piping plover; in addition, 1,600 pairs of breeding beach-nesting colonial waterbirds were estimated in 2015.

On Virginia's Eastern Shore, upland mixed hardwood forest habitat is highly patchy and fragmented. Based on 1-meter land cover data from the Virginia Geographic Information Network, much of the landscape has been converted for agricultural uses; thus, forests occupy less than half of the upland terrestrial system. This habitat is highly fragmented and consists mostly of immature stands dominated by pines with little horizontal structure and a lack of soft mast producing hardwood species. Non-tidal freshwater wetlands include sea level fens and acidic seepage swamps (both groundwater fed) and seasonal depression wetlands like non-riverine wet hardwood forests. On Virginia's Eastern Shore, forest consists of 125,083 acres or roughly 30% while scrub-shrub covers 3,600 acres or 1%. Overall, forest cover is inadequate in riparian zones, groundwater recharge areas, swamps and floodplains. There is a general lack of age class structure diversity and successional stages. Additionally, sea-level rise and upland marsh migration are causing canopy die-off at the marsh-forest interface, creating ghost forests. This causes a lack of connectivity between uplands and floodplain/marsh along an elevation gradient.

Table 1. Stresses and Sources of Stress on VA's Aquatic Resources that can be Mitigated by VARTF

Stresses on Aquatic Resources		Impacts of Climate Change or other Biophysical Factors	Sources of Stress (direct threats)	How Mitigation Can Offset/ Address Stresses
ALTERED WATER QUALITY	Point source pollution (sediment, nutrients, and other contaminants)	Droughts increase concentration of pollutants	Household sewage (straight piping/failing septic)	• Removal of livestock access to streams and wetlands eliminates the direct deposition of livestock effluent, and eliminates trampling of streambanks which causes streambank and bed erosion and can lead to unstable channel shape and size • Restoration of streams stabilizes eroding streambanks and beds, restores stable stream channel shape and size, ensures natural dissipation of flow energy through connection of streams to their floodplains, restores a stream's ability to transport water and sediment in a stable manner without eroding or building up excess sediment, and establishes healthy streambank vegetation to reduce bank erosion • Restoration of buffers establishes healthy vegetation in the riparian area which filters pollutants from upland sources, prevents erosion in floodplains, and reduces high flow energy in stream channels, helping to reduce stream bank and bed erosion • Preservation of stream buffers protects healthy vegetated riparian areas from development, agriculture, mining, and other uses, preserving the buffer's ability to filter pollutants from upland sources, prevent erosion in floodplains and reduce high flow energy in stream channels, helping to reduce stream bank and bed erosion • Preservation of streams protects healthy stream systems that transport water and sediment in a stable manner without eroding or building up excess sediment • Wetlands often contain dumpsites. Through restoration or preservation of wetland sites, trash piles are removed.
			Urban wastewater	
			Industrial effluent (point source pollution i.e. mining, paper mills, coal ash ponds)	
			Dumping	
	Non-point source pollution (sediment, nutrients, and other contaminants)	Droughts increase concentration of pollutants; Amplified by higher frequency/severity of flood events (more run-off and sedimentation in flash floods); More amplified in high gradient systems)	Residential and industrial development- runoff from new construction, stormwater from impervious surfaces & removal of natural riparian vegetation	
			Agriculture (crops and livestock)- removal of natural riparian vegetation	
			Timber extraction (current and historical) -removal of riparian forest	
			Unpaved roads-especially on steep slopes	
			Contaminants from mineral and energy extraction	
			Agriculture (fertilizer, pesticides, & animal manure) increasing nutrient inputs	
			Acid deposition from automobiles and power plants (changing pH)	

Stresses on Aquatic Resources		Impacts of Climate Change or other Biophysical Factors	Sources of Stress (direct threats)	How Mitigation Can Offset/ Address Stresses
ALTERED WATER QUALITY	Non-point source pollution (sediment, nutrients, and other contaminants)	Droughts increase concentration of pollutants; Amplified by higher frequency/severity of flood events (more run-off and sedimentation in flash floods); More amplified in high gradient systems)	Streambank erosion	• Forestry, agricultural, and sand mining practices contribute large amounts of sediment, contaminants, and excess nutrients into the waterways and bays. Restoration or creation of wetlands act as a buffer against this contamination by sequestering and filtering this runoff. Properly designed, managed and healthy wetland restoration sites can handle the influx and storage of contaminants into their systems. • Restoration and preservation of wetlands capture excess water runoff and associated contaminants from roads and other impervious surfaces. • Land protection prevents conversion of natural lands to other uses which could contribute point or non-point source pollution.

Stresses on Aquatic Resources		Impacts of Climate Change or other Biophysical Factors	Sources of Stress (direct threats)	How Mitigation Can Offset/ Address Stresses
ALTERED HYDROLOGIC REGIME	Reduced water quantity	Amplified by more frequent and/or more severe droughts	Withdrawals for agriculture, municipal, industrial use	• Removal of stream barriers removes dam storage, restores hydrologic connectivity and natural stream flows, and restores wetland, stream, and riparian functions. • Restoration of streams that have eroded stream beds often involves raising the elevation of the streambed, thus raising groundwater levels in the vicinity of the project • Restoration of streams restores a stream's ability to transport water and sediment in a stable manner without eroding or building up excess sediment, and ensures natural dissipation of flow energy through connection of streams to their floodplains • Preservation of streams protects healthy stream systems that transport water and sediment in a stable manner without eroding or building up excess sediment • Preservation of stream buffers protects healthy vegetated riparian areas from land conversion, preserving the buffer's ability to reduce high flow energy in stream channels • Restoration of wetlands and buffers establishes native healthy vegetation which reduces runoff during rain events, thereby reducing high flow energy in stream channels, and can reduce excess freshwater from entering downstream tidal rivers and bays which can damage sensitive saltwater and brackish habitats. • Wetlands act as groundwater recharge zones, and therefore restoration or creation of wetlands contributes to the replenishment of the groundwater table. • In response to shoreline and bank hardening, restoration of wetlands in the coastal/riparian interface between the aquatic and terrestrial environment improves and protects not only that particular restored area, but also areas on either side of the coastal shoreline or riparian areas downstream by absorbing the energy rather than deflecting it.
	Lowered ground water	Hotter, dryer climate will drive increase in human water usage	Withdrawals for agriculture, municipal, industrial use	
			Residential wells	
	Dam storage	Hotter, dryer climate will drive increase in human energy needs	Large hydropower or flood control dams and impoundments	
	Changes in flow dynamics	Climate change will drive changes in frequency and intensity	Large hydropower dams and impoundments	

Stresses on Aquatic Resources		Impacts of Climate Change or other Biophysical Factors	Sources of Stress (direct threats)	How Mitigation Can Offset/ Address Stresses
ALTERED HYDROLOGIC REGIME	Reduced water quantity	Amplified by more frequent and/or more severe droughts	Withdrawals for agriculture, municipal, industrial use	• Wetland restoration improves or restores flood water storage and flood energy abatement; therefore, surrounding habitats and human activities have increased protection from floods. • Land protection prevents conversion of natural lands to other uses which could cause reduced water quantity, lowered groundwater levels, dam storage, or flow dynamics. • lowered groundwater levels, dam storage, or flow dynamics.
			Many small dams and impoundments	
			Land conversion -- increased run-off from impervious surfaces or removal of riparian vegetation leads to chronic erosion & incised streams	
	Loss of wetland function	Climate change may increase frequency and intensity of storm events, thereby further damaging degraded wetlands, and in turn the surrounding areas that wetlands buffer and protect.	Filling, draining, or damming wetlands for agriculture, residential, industrial, or recreational development	

Stresses on Aquatic Resources		Impacts of Climate Change or other Biophysical Factors	Sources of Stress (direct threats)	How Mitigation Can Offset/ Address Stresses
ALTERED AQUATIC COMMUNITY COMPOSITION	Introduction of invasive species	Warmer climate may increase invasive species	Recreational fishing/fishery management (i.e. introduction of trout, release of bait buckets)	• Removal of stream barriers restores natural stream flows needed by species, enables migration of aquatic species, reduces water temperatures, removes excess sediment upstream of the dam which buries organisms and habitats, and restores natural transport of sediments, nutrients, and vegetative debris needed by aquatic species to downstream systems • Restoration of streams reduces excess sediment and associated nutrients in the water, thus improving the ability of aquatic species to find food, ensuring submerged aquatic vegetation receives sufficient sunlight, preventing clogging of fish gills with sediment, preventing the burial of bottom-dwelling species which serve as a food source for many other aquatic species, reducing water temperatures, and reducing algal blooms and associated decreases in dissolved oxygen. • Livestock exclusion reduces excess sediment, nutrients, and bacteria in the water which benefits aquatic community composition through improved water quality and habitat • Restoration of stream buffers reduces excess sediment, nutrients, and other contaminants in the water, improving water quality and habitat, and increases vegetative cover which reduces water temperatures and provides vegetative debris needed by aquatic species • Preservation of stream buffers protects healthy vegetated riparian areas from land conversion, preserving the buffer's ability to protect water quality, decrease water temperatures, and provide vegetative debris for aquatic species • Preservation of streams protects healthy stream systems that maintain natural aquatic community composition • Wetland restoration and preservation projects reduces or discourages the spread of invasive aquatic vegetation by managing types of public access and treating certain invasive species when found.
			Recreational boating (spread of invasive aquatic plants & animals)	
	Loss of characteristic/ endemic aquatic species	Temperature changes will alter habitat availability for aquatic species	Land use impacts on water quality, water quantity, connectivity, temperature	

Stresses on Aquatic Resources		Impacts of Climate Change or other Biophysical Factors	Sources of Stress (direct threats)	How Mitigation Can Offset/ Address Stresses
				• Eradication and treatment of aquatic and semi-aquatic invasive vegetation in restored wetlands allows for native aquatic vegetation to thrive, thereby supporting an increased amount of native animal species in the ecosystem. • As invasive aquatic vegetation tends to form thick monocultures and reduces animal species diversity (such as *Phragmites*), the possibility of complete habitat failure in the face of a single threat (i.e. disease, pest, abiotic alteration) increases substantially. Management of invasive species in restored wetland sites reduces this risk and increases biological diversity and resilience.