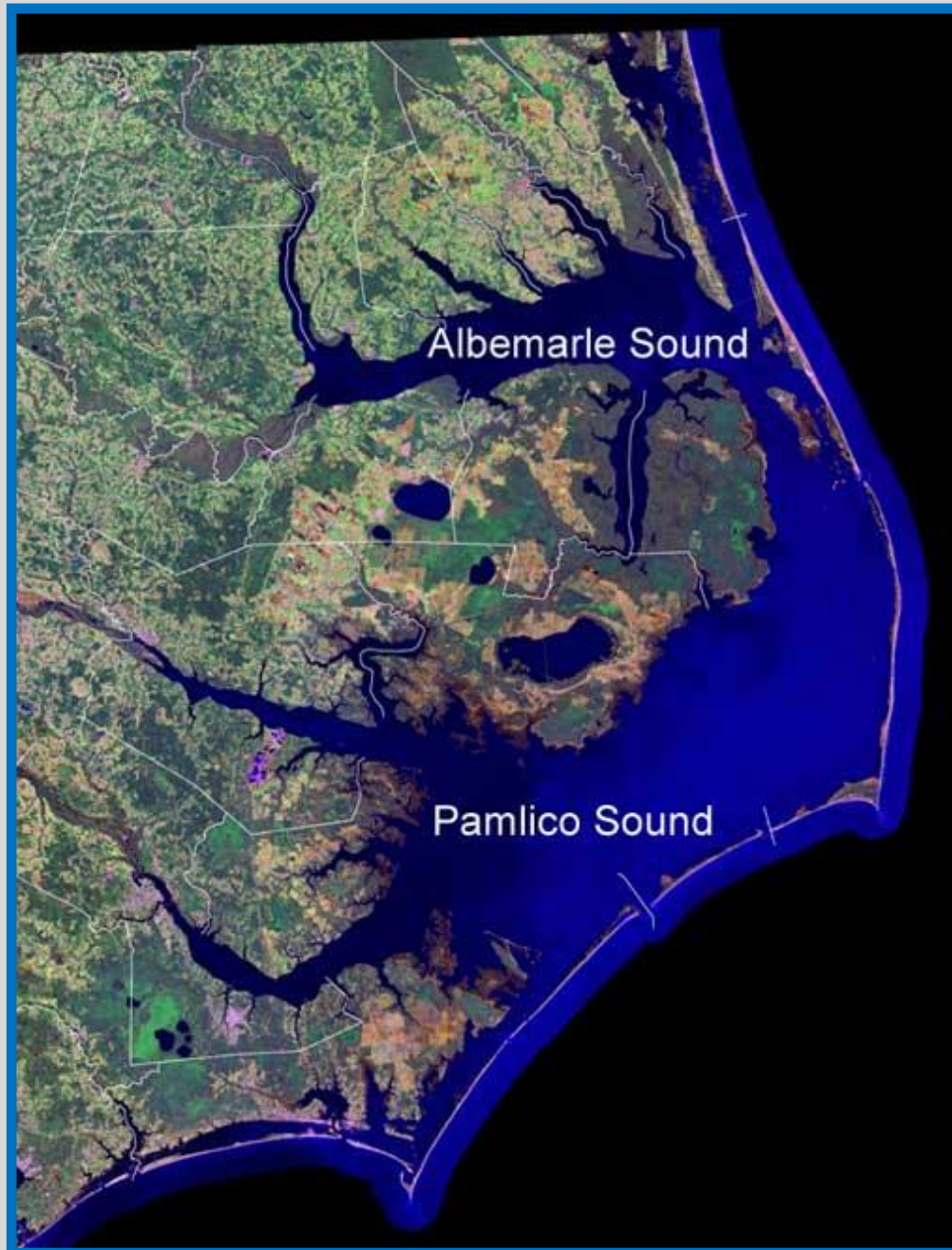


Landscape Conservation and Restoration Pilot Project Phase II Final Report



Southeast Natural Resource Leaders Group

June 2013

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Project Coordinator Contact

Name: Rick Durbrow
US EPA Region 4
Address: 61 Forsyth Street, S.W.
Atlanta, Georgia 30303
Phone: 405-562-8286
Email: Durbrow.Rick@epa.gov

SENRLG Agency and Contributing Organization Contacts

APNEP – Bill Crowell, Bill.Crowell@ncdenr.gov
BOEM – Arie Kaller, Arie.Kaller@boem.gov
DOD – Marshall Williams, Fredrick.M.Williams28.civ@mail.mil
EPA – Linda Rimer, Rimer.Linda@epa.gov
FHWA – Unwanna Dabney, Unwanna.Dabney@dot.gov
FWS – Pete Campbell, Pete_Campbell@fws.gov
NOAA – Richard Bandy, Richard.Bandy@noaa.gov
NPS – Charlotte Gillis, Charlotte_Gillis@nps.gov
SALCC – Rua Mordecai, Rua@southatlanticlcc.org
TVA – Evan Crews, ERCrews@tva.gov
USACE – Vechere Lampley, Vechere.V.Lampley@usace.army.mil
USFS – Mary M. Long, MMLong@fs.fed.us
USGS – Brian Hughes, WBHughes@usgs.gov

Foreword

The Southeast Natural Resource Leaders Group has undertaken the Landscape Conservation and Restoration Pilot Project (LCRPP) to provide Federal leadership in natural resource protection that will accomplish three goals. The first goal is to develop a consistent approach to understanding the shared values of the natural resource agencies. These values are embedded within the funding objectives used to protect important natural, cultural, and social resources in the Southeast. The second goal is to develop shared tools that can assist local communities in protecting important landscapes from climate change and other potential risks. The third goal is to establish a common framework of accountability that provides a foundation for leveraging resources more efficiently.

The LCRPP uses available data to identify essential attributes across the landscape. These attributes support agency funding objectives linked to habitat, recreation, human health and water quality protection. In addition, the attributes provide the basis for working at a regional scale and help identify opportunities to allow ecosystems to respond to environmental risks associated with climate change, urban development and other natural resource threats.

The LCRPP lays out an innovative approach to leverage available resources for conservation and restoration on the landscape. The continued constraints on fiscal spending implore innovative strategies that integrate accountability of existing resources used to protect and sustain a productive landscape for future generations. Its value as an organizing theme for federal, state, tribal and local organizations is strengthened through the use of geospatial tools to: assist efforts to visualize adjacent land attributes; identify potential impacts to the landscape from human and natural environmental risks and evaluate how those risks can be addressed by supporting resiliency across the landscape.

The results of this work provide natural resource agencies with a significant opportunity to enhance their missions through coordinated efforts with on-the-ground partners in resource protection. Through the use of a common language developed in this effort, federal agencies can integrate diverse missions with a set of science based attributes that are essential to a healthy landscape. In addition, the framework enables federal agencies to target resources, engage stakeholders and establish performance measures that support leadership and accountability in the Southeast.

Southeast Natural Resource Leaders Group

Acknowledgments

This effort was financially supported by the South Atlantic Landscape Conservation Cooperative. Their assistance and participation in the process has been very valuable in understanding the Albemarle-Pamlico region as well as the many stakeholders supporting landscape conservation efforts. In addition, the in-kind staff time and technical assistance provided by the Southeast Natural Resource Leaders Group and the State of North Carolina were critical to completing this effort and identifying opportunities for leveraging existing resources on the landscape. The staff time and geospatial services expertise of the National Environmental Modeling and Analysis Center at the University of North Carolina in Asheville played a significant role moving this effort forward. Their facilitation skills and flexibility in dealing with multiple federal agencies and their individual missions were a great benefit to completing Phase II. Thanks also to the federal agency staff for their flexibility and time. It was their consistent participation and involvement which is credited with successfully completing this project and laying a foundation for achieving success with local stakeholders in the Albemarle-Pamlico region. Finally, the leadership and continued drive toward innovation of the SENRLG Principals is greatly appreciated.



Abbreviations

APNEP – Albemarle-Pamlico National Estuary Program
CSU – Climate Solutions University
CRAFT – Comparative Risk Assessment Framework and Tools
DOD – Department of Defense
DOT – Department of Transportation
EA – Essential Attribute
EEP - Ecosystem Enhancement Program
EPA – Environmental Protection Agency
FHWA – Federal Highway Administration
ICCATF – Intergovernmental Climate Change Adaptation Task Force
ICLEI – International Council for Local Environmental Issues
LCRPP – Landscape Conservation and Restoration Pilot Project
NCDOT – North Carolina Department of Transportation
NEMAC – National Environmental Modeling and Analysis Center
NLCD – National Land Cover Database
NOAA – National Oceanic and Atmospheric Administration
NPS – National Park Service
NRCS – Natural Resource Conservation Service
MFPP – Model Forest Policy Program
MODIS - Moderate Resolution Imaging Spectroradiometer
MRLC - Multi-Resolution Land Characteristics Consortium
SALCC – South Atlantic Landscape Conservation Cooperative
SAMBI - South Atlantic Migratory Bird Initiative
SARP - Southeast Aquatic Resources Partnership
SENRLG – Southeast Natural Resource Leaders Group
SLEUTH - Slope, Land cover, Exclusion, Urbanization, Transportation, and Hillshade
TNC – The Nature Conservancy
TRIP – Targeted Resource Implementation Plan
TVA – Tennessee Valley Authority

Abbreviations (continued)

UNC – University of North Carolina

USACE – United States Army Corps of Engineers

USFS – United States Forest Service

USGS – United States Geological Survey

US FWS – United States Fish & Wildlife Service

Table of Contents

Executive Summary	9
Background	12
Phase I	12
Objectives	12
Methods	13
Results	14
Implications	15
Phase II	15
Problem Statement	16
Methods	16
Data Inputs	17
Workshop	18
Priority Areas	19
Funding Resources	22
Results	23
Recommendation	24
Possible Next Steps	24
Stakeholder Involvement	27
Appendix A: Data Maps for Essential Attribute Values	30
Appendix B: Geospatial Story Maps and Data Sources	46
Appendix C: Bayesian Belief Networks and Map Algebra Explained	56
Appendix D: Regional and Local Stakeholders in Albemarle-Pamlico	61
Appendix E: Funding Resource Matrix	64
Appendix F: Model Forest Policy Program	90
Appendix G: Climate Solutions University	92
Web Site References	94

Executive Summary

This is the final report outlining the completion of the Landscape Conservation and Restoration Pilot Project (LCRPP). The report reviews important accomplishments from Phase I that provided the framework for the LCRPP. In addition, the report provides the methodology used during Phase II to prioritize three locations in the Albemarle-Pamlico region of North Carolina that could benefit from direct support of the Southeast Natural Resource Leaders Group (SENRLG) funding and technical assistance resources. Finally, the report outlines an opportunity to utilize the LCRPP tools in support of a local stakeholder process. The stakeholder process would develop an actionable Targeted Resources Implementation Plan (TRIP) for the Roanoke Retreat Corridor.

Throughout the course of the project, the main charge to the LCRPP Team was to identify a landscape scale approach to natural resource protection that worked across existing agency missions, goals and objectives. During Phase I of the LCRPP, a common approach to understanding the key values associated with each agency's mission was established. The approach adopted science based Essential Attributes (EAs), to reflect the key values of natural resource agency missions and program objectives.

The eight EAs used to bridge program objectives included six natural resource based attributes and two human attributes. The natural resource attributes included landscape condition, hydrology/geomorphology, natural disturbance, chemical/physical, biotic condition, and ecological processes. The two human attributes included cultural and social components that underlie many program objectives common to natural resource agency missions.

Geospatial datasets were linked to each of the EAs in order to visualize where the priorities were located in relation to recognized stressors to the landscape from climate change threats. The vulnerability analysis focused on North Carolina, South Carolina, and Georgia to help narrow the locations of identified risks on-the-ground. The three vulnerabilities from climate change included increased precipitation and flooding in the mountain region of Appalachia, drought conditions in the Piedmont region and sea level rise along the Atlantic Coast.

Phase I was completed with the identification and prioritization of eleven locations across the three states. Sea level rise was identified as having the potential to cause the greatest imminent impact to federal priorities and became the focus of the prioritization process. The recommended priority location was a twenty county area identified as the Albemarle-Pamlico region.

Phase II of the LCRPP sought to narrow the project location to three areas that would benefit from direct support of existing agency programs and technical assistance. The priority area identification was driven by a set of spatial story maps developed by the LCRPP Team. The story maps helped visualize the landscape from the perspective of the agency values identified through the EAs. This process provided the LCRPP Team

with a value based perspective for looking across the landscape. Enabling a decision as to which on-the-ground location could benefit from leveraging resources.

The three areas identified (Figure 1) reflect priorities across the agencies. The first area is a conservation corridor in the Onslow Bight area at the southern end of the Albemarle-Pamlico region. The second area focused on the Outer Banks as a front line defense strategy to address vulnerabilities to existing infrastructure, cultural, historical and recreational resources. The final area was identified as the Roanoke retreat corridor for species impacted by sea level rise. Each area supports agency co-benefits by maintaining natural areas, completing habitat corridor connectivity across existing protected lands, increasing recreational opportunities and protecting water quality.

Events such as Irene in 2011 and Sandy in 2012 clearly show the vulnerability that this area has to water level rises. It is important to understand the potential impacts sea level rise will contribute to these risks in the future. Some of the threats to the landscape may be easier to address than others. The recommendation of the LCRPP Team sought to incorporate these concerns and provide an outline of potential next steps that will lead to an implementation approach that builds on the work of the LCRPP. Although the LCRPP did not develop a Targeted Resource Implementation Plan (TRIP) for any of the locations, an approach to work with local partners to create an actionable plan is presented.

The actionable strategic plan would be developed by on-the-ground stakeholders with the ability to make decisions at the municipal, local, and county planning levels and could link directly to regional and state planning efforts. The planning would incorporate the Phase I and Phase II decision support tools created during the LCRPP to help align potential federal resources. One avenue that SENRLG could take to assist the local planning process would be to provide technical support to the Model Forest Policy Program (MFPP) and their Climate Solutions University (CSU) project. This would achieve the objectives of the TRIP for federal resource co-benefits. In addition, measures of accountability could be incorporated into current or new planning documents and support of the State's Land Use Compatibility Plan for working landscapes.

The partnership between local organizations, NC land use planning, and the CSU project coordinators is an opportunity for SENRLG to provide federal leadership through the products developed during the LCRPP effort. Agency staff may need to provide technical assistance in a limited capacity as the strategic plans are developed. The main focus of the support would be to assist local officials in developing performance measures that meet their needs with potential existing funding and technical resources that are available. This would give agencies measurable results in support of the Administration's priorities for more effectively integrating existing federal agency resources and adapting to climate change risks.

Albemarle Pamlico (Analysis Region)

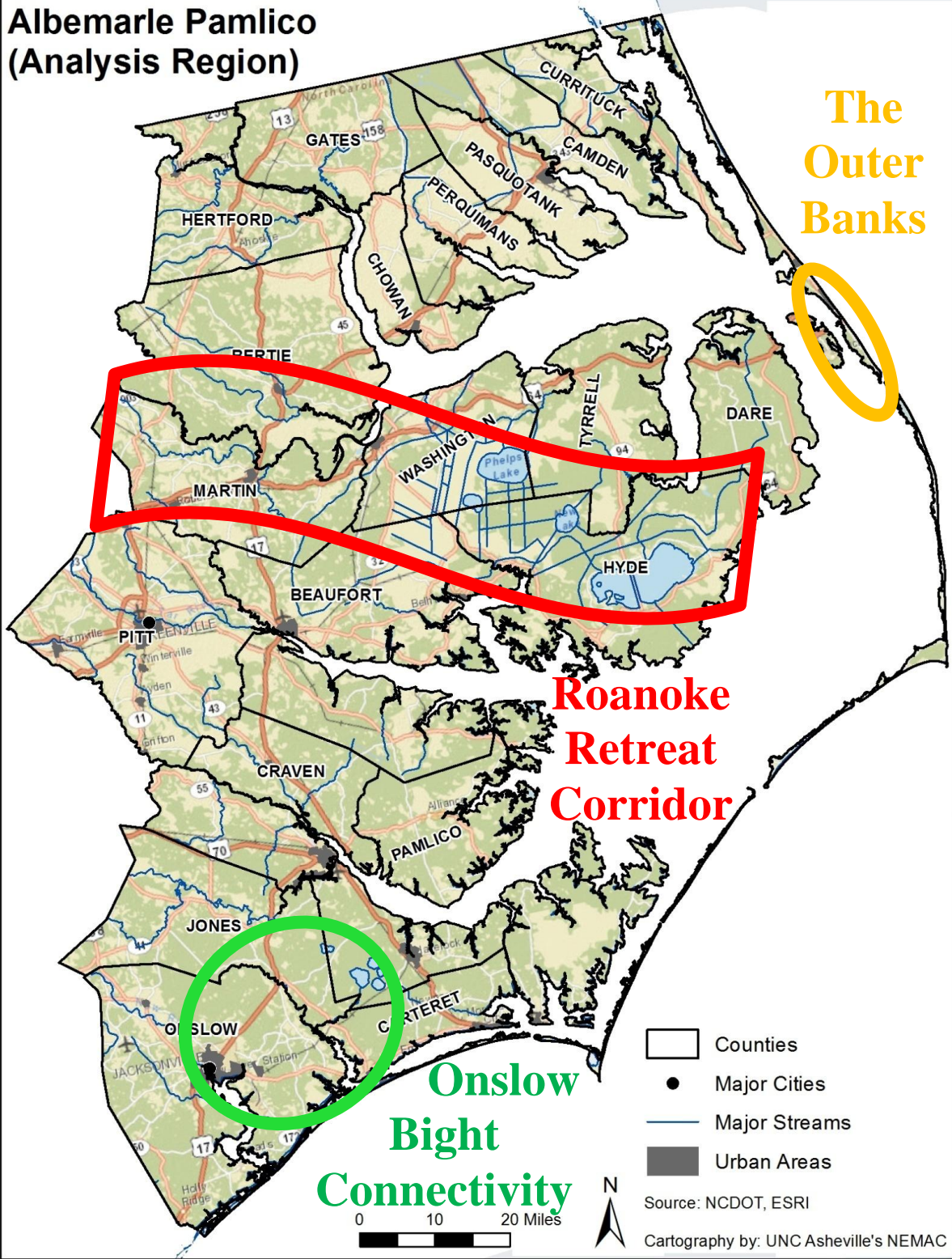


Figure 1: Identified Priority Locations

Background

The Southeast Natural Resource Leaders Group (SENRLG)¹ Principals initiated a Landscape Conservation and Restoration Pilot Project (LCRPP). The purpose of the LCRPP is to illustrate how federal agencies can coordinate and leverage their mission mandates and resources to enhance natural resource management in the Southeast United States. Climate change threats to the landscape were selected as the point of focus for targeting program resources. The overall goal of the work was for SENRLG agencies to identify a location in the Southeast where collaborative, on-the-ground climate change related conservation and restoration work would produce results that exceed those that could be achieved through individual agency efforts.

The initial pilot project used a structured decision support process known as Comparative Risk Assessment Framework and Tools (CRAFT)² to facilitate the discussion across multiple agency goals and objectives. The geographic area of focus identified through the CRAFT process during Phase I was the North Carolina coastal area of the Albemarle-Pamlico region.

The effects of climate change and more specifically sea level rise within the Albemarle-Pamlico region of North Carolina are of concern to a number of organizations. Trying to understand the adaptive capacity of the natural landscape has also gained increased research attention during the past decade. The SENRLG, in an effort to pilot an approach to leveraging existing technical and financial resources, identified the Albemarle-Pamlico region as an area that could benefit from their concentrated assistance.

This document is prepared as a final report of activities conducted during Phase II of the LCRPP. The information is being provided to the SENRLG Principals and their delegated representatives as the foundation for any future actions in the priority focus areas. In addition, the report provides potential stakeholders with a basic understanding of the work to help them leverage resources and technical assistance more effectively. This will be critical for implementing activities on-the-ground and reporting success.

Phase I

Phase I of the LCRPP effort was to identify a common approach to linking agency values across a broad landscape. This was accomplished by the development of a set of common attributes that identified ecological and human goals which federal agencies could use to coordinate their mission perspectives across the landscape. In order to visualize these attributes on the landscape, datasets were identified that provided a geospatial view of each of the attributes associated with agency program objectives.

Phase I: Objectives

The LCRPP goal was to establish an innovative framework which could integrate existing federal resources for natural resource protection. The framework is structured

around decision tools that: provide agencies with the ability to integrate funding resources based on co-benefits to program objectives; identify important landscape issues and priorities; and support a strategic planning process that can be utilized by stakeholders across the Southeast.

The framework had to identify locations that could benefit from agency programs and provide co-benefits consistent with the SENRLG mission. The LCRPP Team (Team) identified six objectives to create the framework.

- 1) Identify natural resources impacted by climate change.**
- 2) Identify existing agency programmatic resources.**
- 3) Coordinate science and services across agencies.**
- 4) Prioritize areas and issues impacted by climate change.**
- 5) Identify a location where SENRLG resources can be coordinated to enhance ecosystem resiliency through conservation and restoration.**
- 6) Do a project.**

These objectives were used to create a geospatial framework to target existing resources and support an integrated approach to ecosystem protection in light of climate change adaptation challenges. The first five objectives were completed through a series of meetings and a workshop designed to identify a location where all agencies felt there was an opportunity to demonstrate success. The final objective of the project was supported through the Phase II work of the LCRPP, but will require stakeholder leadership to develop the Targeted Resource Implementation Plan (TRIP) that meets local community needs and the broader landscape conservation and restoration goals.

Phase I: Methods

The CRAFT process was used to facilitate meetings and provide a starting point for discussing agency priorities across program objectives. The process provided an important breakthrough in cross agency communications. By breaking the policy values into science based attributes, the Team was able to link program objectives across agency missions. This enabled the primary objectives of agency programs to be highlighted from a science based perspective, rather than a policy perspective. For instance, clean water is a policy value shared by all of the natural resource agencies, and yet clean water means very different things (habitat, flooding, fishing, drinking water, etc.) depending on the agency mission. Agreeing to use Essential Attributes (EAs) as a common language to reflect characteristics of the ecological and human program objectives of clean water provided a basis for linking program objectives. In essence, the EAs provided agencies with the ability to communicate across agency objectives and established a basis for linking objectives with geospatial data.

The use of EAs provided a common science based language essential for understanding agency program values (Figure 2) that support ecological and human objectives. Six attributes focused on the ecological objectives and include: biotic condition, landscape condition, natural disturbance, hydrology & geomorphology, chemical & physical, and ecological processes which were adopted from a report by the Environmental Protection Agency's Science Advisory Board (SAB): A Framework for Reporting and Assessing Ecological Condition³. A number of other similar reports were identified, but the SAB report met the needs of the group. The human objective focused on cultural and societal attributes that support or underlie many natural resource management programs.

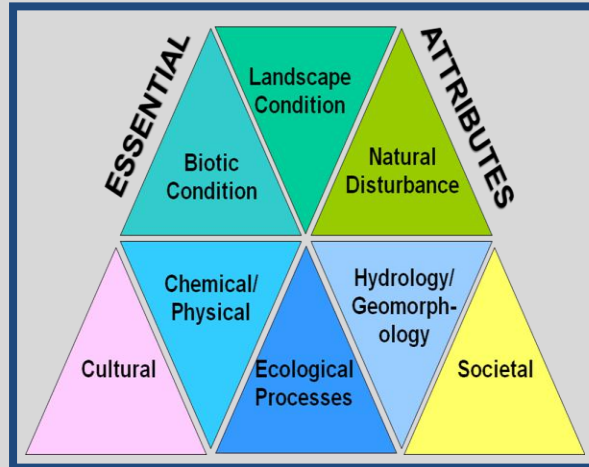


Figure 2: Essential Attributes Reflecting Agency Values

Phase I: Results

The Phase I LCRPP illustrates how federal agencies can coordinate and leverage their mission mandates and resources to enhance natural resource management in the Southeast. The National Environmental Modeling and Analysis Center (NEMAC)⁴, in conjunction with SENRLG agency staff, developed an approach to linking agency objectives. The approach was successful. The Team could link geospatial data across agency programs that supported important attributes on the landscape and the natural resource mission of all the SENRLG agencies. Linking the data with EAs provided the foundation for a geospatial decision tool. Giving agencies and stakeholders a tool to target existing resources and define co-benefits for ecosystem protection.

The initial assessment across the southeast was narrowed down to three states: Georgia, North Carolina and South Carolina. Data linking agency programs is also available for Mississippi, Tennessee, Kentucky, Alabama, and Florida. Climate change risks identified as the most recognizable stressors to landscape resilience included increased rainfall events and flooding in the mountain region, drought conditions along the piedmont, and sea level rise on the coast. Through a group prioritization exercise that addressed the likelihood of occurrence and the possible impacts from climate change, the Team selected the North Carolina coastal area of the Albemarle-Pamlico region. This was based on the cumulative priorities of the federal agencies and the vulnerability to the landscape associated with sea level rise.

Phase I: Implications

The project is beneficial to the Administration's goal of providing federal leadership as noted in the White House Council on Environmental Quality's Interagency Climate Change Adaptation Task Force⁵ recommended action to "Align federal efforts to respond to climate impacts that cut across jurisdictions and missions." The project supports all of the other actions identified in the report recommendations as well. The LCRPP effort also supports America's Great Outdoors⁶ (AGO) Initiative. Their report states that "the goals of the AGO Initiative can be better achieved by strategically aligning existing federal resources, authorities, and funding" which is assisted under the work completed in Phase I.

Phase I of the LCRPP provides the foundation for SENRLG agencies to view federal program objectives across the Southeast in light of other identified natural resource risks. In addition, internal and external partnerships could use the visualization tools to identify essential program objectives across the landscape and potential risks to the landscape.

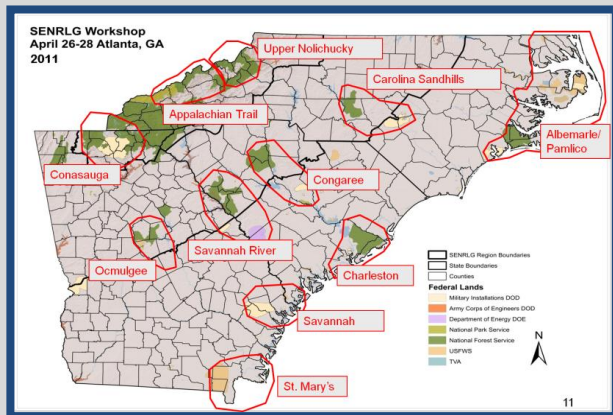


Figure 3: Potential Project Areas from Phase I

Phase II

The Albemarle-Pamlico region identified during Phase I covered 20 counties. Phase II was designed to identify three locations within that broad area that could benefit from a coordinated effort by the SENRLG agencies. The Team sought to answer the following questions to support coordination.

- **Where can SENRLG agencies collaborate and leverage resources that support resilience of the landscape to adapt to climate change risks within the Albemarle-Pamlico region?**
- **How can SENRLG agencies collaborate with external stakeholders to obtain co-benefits through targeted funding of restoration and conservation projects across a landscape?**
- **What performance measures can help evaluate SENRLG agency program coordination accomplishments for on-the-ground work?**

These questions ensure that each agency can work within their specific mission, technical assistance, and funding resources in order to target federal actions with local stakeholders. The answers provide insight to the best places to invest federal resources and build resilience into the landscape in order to address potential risks associated with sea level rise. To answer these questions, the Team followed a process and methodology based in Geographical Information System (GIS) technology and

Bayesian statistics. The process started with an analysis of existing sea level rise research, and then an assessment across EA values to determine where to invest potential resources to support resiliency within the selected landscape.

Phase II: Problem Statement

The second phase began with several meetings with the LCRPP Team to determine the scope and plan of the collaboration in the Albemarle-Pamlico region. This began with the development of a problem statement, which is outlined as follows:

- **Brief description** – Sea level rise and other climate change-related issues continue to impact natural and cultural resources in the Southeast. Federal, state, and local agencies, non-governmental organizations and private sector partners want to leverage existing funding resources and programs to help develop and potentially implement adaptation strategies that will support the resilience of social, cultural and natural resources across the region.
- **Relevant benefits and consequences** – If the project is successful, the Southeast will obtain a consistent set of strategies and tools that can build resiliency to climate change. These strategies can be designed across the landscape to address extreme events associated with heat waves from temperature increases, increased inundation of the land from storm surges and sea level rise, and flooding from increased rain fall events. Additionally, federal agencies will be able to identify priority locations where they can best work with stakeholders to implement landscape strategies that support resiliency through specific actions on-the-ground.
- **If no action is taken** – Federal dollars will potentially be applied to individual agency interests that may not have a larger landscape perspective. The ability of local implementers to interface with and strategically coordinate activities of multiple agencies will be hindered. Local adaptation efforts may not seamlessly interface with an overall strategy; resulting in counteractive or negative consequences and impeding regional benefits.

The next step was to create a methodology for selecting areas that could benefit from federal investments. The methodology was based in GIS probabilistic map algebra and on the application of Bayesian statistics. These tools were used during the Phase II workshop on August 2 and 3, 2012 in Atlanta, Georgia to support the Team decision making process.

Phase II: Methods

Using software that connected geospatial data with Bayesian statistics, the NEMAC facilitators led the Team through a series of exercises that combined different datasets associated with the essential attribute values. Combinations of datasets were integrated in real time discussions using a statistical and visual tool called a Bayesian Belief Network (BBN). This allowed the Team to visualize priorities across the Albemarle-

Pamlico based on different combinations of EAs proposed by the Team. The approach helped the Team to reach consensus on the EAs most critical in examining the landscape impacted by sea level rise.

Phase II: Data Inputs

The EAs identified by the Team represented common objectives across the agencies and connected data proxies to existing program resources. The datasets chosen focused on conservation corridors, recreation and tourism, natural areas, and water quality. Figure 4 is a roadmap that conceptually associates the identified EAs with the contributing factors, threats and adaptive activities to address sea level rise.

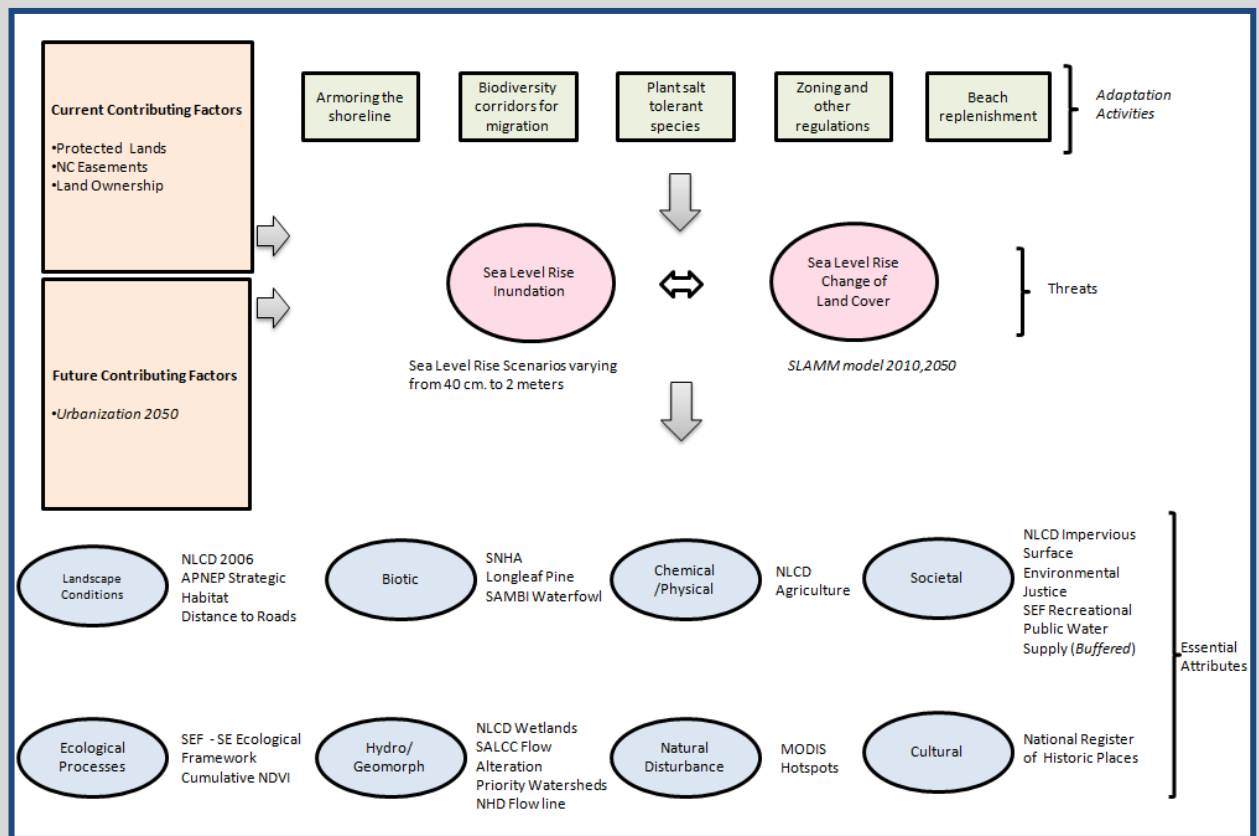


Figure 4: SENRLG Project Roadmap Associations

In the roadmap, a contributing factor is defined as something beyond immediate control. Threat refers to the hazardous condition under consideration, primarily sea level rise in this case. Adaptation activities are considered actions that have the ability to change conditions. Identification of datasets for the roadmap was identified prior to the workshop during a series of virtual and face-to-face meetings. The placement of datasets within the EAs was driven by the SAB report table shown in Figure 5.

During the meetings leading up to a two day workshop, it was stressed that the purpose of selecting data that represented the values of each agency was to support a geospatial approach in the decision making process. This provided a visual perspective of the landscape that linked directly to the EAs. Datasets were selected to represent only one EA category, although many categories contained several datasets, reflecting the diversity of program values

(see Appendix A).

<p>Landscape Condition</p> <ul style="list-style-type: none"> • Extent of Ecological System/Habitat Types • Landscape Composition • Landscape Pattern and Structure <p>Biotic Condition</p> <ul style="list-style-type: none"> • Ecosystems and Communities <ul style="list-style-type: none"> - Community Extent - Community Composition - Trophic Structure - Community Dynamics - Physical Structure • Species and Populations <ul style="list-style-type: none"> - Population Size - Genetic Diversity - Population Structure - Population Dynamics - Habitat Suitability • Organism Condition <ul style="list-style-type: none"> - Physiological Status - Symptoms of Disease or Trauma - Signs of Disease <p>Chemical and Physical Characteristics (Water, Air, Soil, and Sediment)</p> <ul style="list-style-type: none"> • Nutrient Concentrations <ul style="list-style-type: none"> - Nitrogen - Phosphorus - Other Nutrients • Trace Inorganic and Organic Chemicals <ul style="list-style-type: none"> - Metals - Other Trace Elements - Organic Compounds • Other Chemical Parameters <ul style="list-style-type: none"> - pH - Dissolved Oxygen - Salinity - Organic Matter - Other • Physical Parameters 	<p>Ecological Processes</p> <ul style="list-style-type: none"> • Energy Flow <ul style="list-style-type: none"> - Primary Production - Net Ecosystem Production - Growth Efficiency • Material Flow <ul style="list-style-type: none"> - Organic Carbon Cycling - Nitrogen and Phosphorus Cycling - Other Nutrient Cycling <p>Hydrology and Geomorphology</p> <ul style="list-style-type: none"> • Surface and Groundwater Flows <ul style="list-style-type: none"> - Pattern of Surface Flows - Hydrodynamics - Pattern of Groundwater Flows - Salinity Patterns - Water Storage • Dynamic Structural Characteristics <ul style="list-style-type: none"> - Channel/Shoreline Morphology, Complexity - Distribution/Extent of Connected Floodplain - Aquatic Physical Habitat Complexity • Sediment and Material Transport <ul style="list-style-type: none"> - Sediment Supply/Movement - Particle Size Distribution Patterns - Other Material Flux <p>Natural Disturbance Regimes</p> <ul style="list-style-type: none"> • Frequency • Intensity • Extent • Duration
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Figure 5: EPA Science Advisory Board Data Categorization Table

Phase II: Workshop

During the workshop, the Team was charged with addressing the issue of climate change impacts and resource vulnerabilities in the Albemarle-Pamlico region, a 20-county area in North Carolina (see Figure 6). The Team sought to identify project areas that supported individual missions and provided the opportunity to leverage co-benefits for potential activities implemented on-the-ground. To support facilitation, NEMAC prepared some initial GIS story maps to begin discussing links across the essential attribute datasets. The Team decided to collaboratively enhance the story maps based on each agency's perspective in order to support the group decision making. The story map compilations selected by the Team fit into four identified themes (see Appendix B): natural areas, connectivity corridors, water protection, and recreation/tourism. The datasets for these themes relate directly back to the EAs. Focusing in on results via a thematic story mapping approach proved useful in helping to locate areas that met all of the value conditions set by the Team. Further, the method of story mapping fit well with the exploratory approach of BBN. Using the story maps allowed the group to focus on

specific themes across the BBN. See Appendix C for a more thorough explanation of the BBN and map algebra approach used to assess the landscape and target federal priorities. The use of the BBN and map algebra also enabled the facilitation of additional data overlays to the story maps. This provided additional flexibility in the identification of funding resources that could be used to assist on-the-ground conservation and restoration efforts.

Priority Areas

In prioritizing areas, the Team used the belief maps from each of the selected stories. This assisted in a spatial analysis approach to decision making. This also provided the Team with the ability to explore additional datasets and spatial relationships across the specific stories identified. Because of the complexity of layered geographic data (23 in this case), certain visual filtering methods were necessary and useful. An important function of spatial analysis is the ability to represent the values across the landscape. It was within the context of the landscape view that the Team was able to prioritize agency values and decision making. The process was guided by the story maps and BBNs in a defined workflow shown in Figure 7.

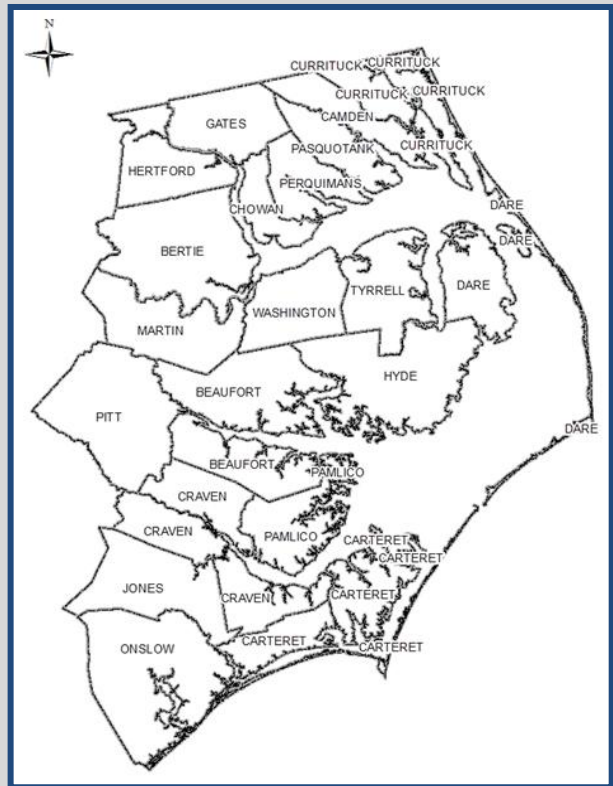


Figure 6: Albemarle-Pamlico Pilot Project Area

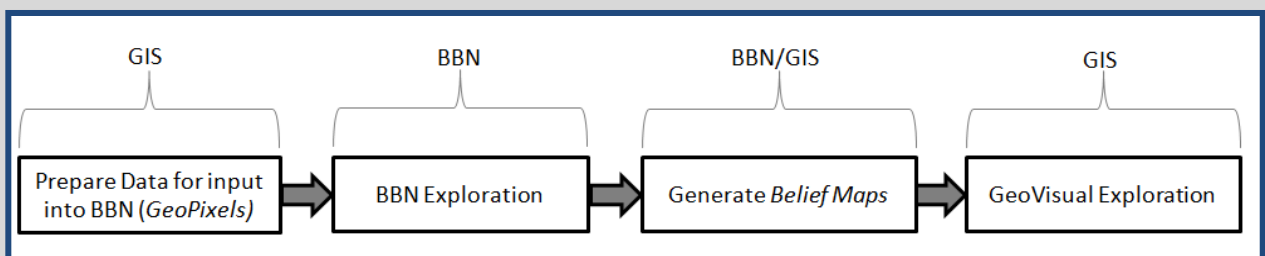


Figure 7: SENRLG Decision-Making Defined Workflow

During the Phase II workshop it became evident that being able to visually explore the thematic story results, as they related spatially to some of the previously identified datasets, helped re-enforce the contextual knowledge of the Albemarle-Pamlico region. For instance, while considering different areas as they related to the story maps, knowledge of specifically owned places by local non-profit organizations (e.g., North Carolina Coastal Land Trust) was useful. The Director from the Albemarle-Pamlico

National Estuary Program (APNEP)⁷ provided valuable contextual knowledge during the visual exploration of the area. Indeed, it is worth noting that APNEP’s participation and knowledge of local resources, existing easements, related projects, important natural features, and potential partners in the region was important in putting the region in context with existing activities on-the-ground. See Appendix D for a list of potential stakeholders for each of the priority areas identified during the workshop.

Priority focus areas were selected based on the overlay of each of the story maps. During this process, the Team first overlaid sea level rise data (40 cm) to help determine which areas may be vulnerable to sea level rise and which areas may be adjacent to sea level rise.

In order to determine areas suitable for future projects, areas were nominated based on the proximity of groupings of geopixels in the story map. Geopixels are the spatial representation of the landscape in a given pixel size. In this work the pixel size was 231 meters, which resulted in about one million pixels across the Albemarle-Pamlico region. Using a consistent pixel size allowed the Team to view the same location across each of the EA data layers.

By focusing on areas with obvious gaps or corridors between these groupings, the Team could identify potential opportunities for collaboration. As an example of this process, consider the gap in the conservation corridor story map along the lower Roanoke River (Figure 8a). If the wetlands dataset is overlaid onto one of the story maps in this area, it is revealed as a potential connecting layer (Figure 8b). What follows is the ability to then link the wetlands to funding sources specific to different federal agency values. This can easily be done within the map interface, or in a separate query exercise.

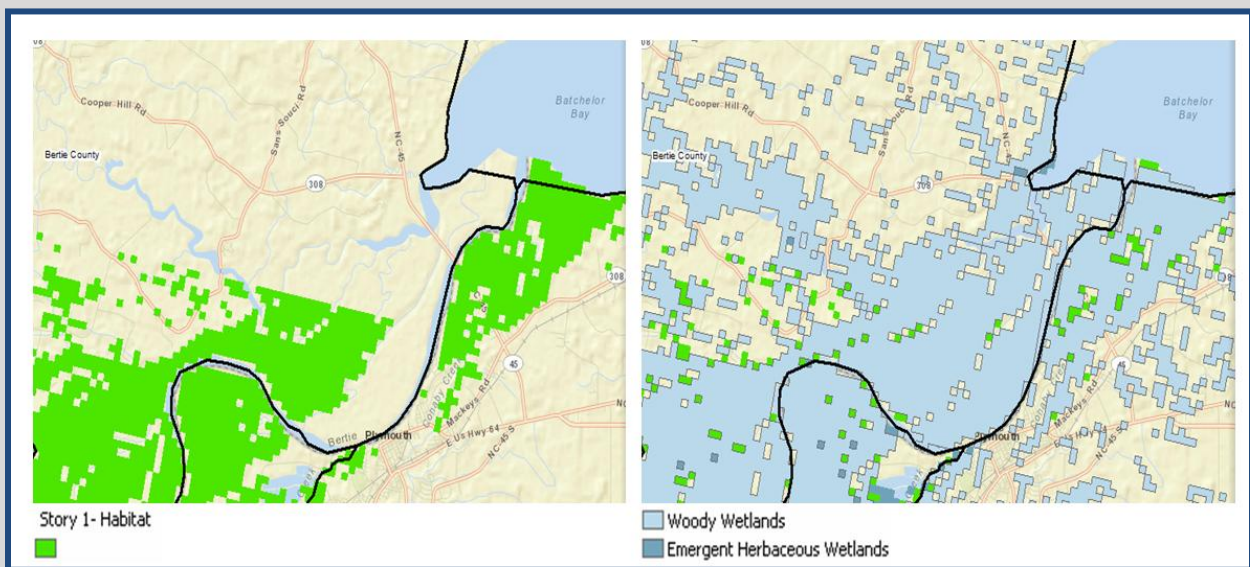


Figure 8a: Corridor Connectivity Story Map

Figure 8b – Wetland Overlay

Finally, the threat condition of sea level rise developed by the Renaissance Computing Institute⁹ at East Carolina University was used to assess landscape EAs in relation to the corridor areas where SENRLG may want to recommend investing time and resources in order to increase adaptive capacity. For instance, in Figure 9 an overlay shows this area to be susceptible to inundation at 0.4 meters of sea level rise. Knowledge of this vulnerability can help guide the SENRLG Principals and staff in prioritizing resources.

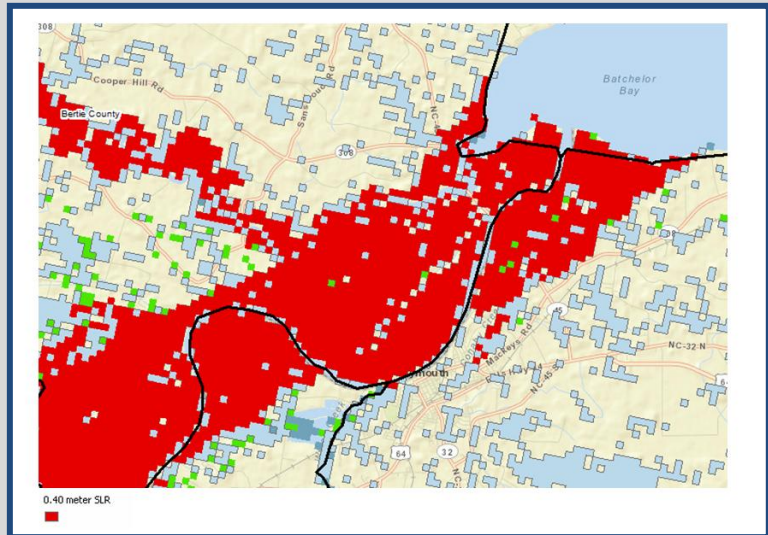


Figure 9: Story Map, Wetlands, and Sea Level Rise

The final selection of the three priority areas resulted from discussions using the dataset maps representing agency values. A total of nine locations were identified during the workshop analysis. Figure 10 identifies all of the locations that were nominated during the discussion. Each area received additional discussion from Team members to highlight known agency priorities in support of a more detailed analysis during the workshop. The analysis discussion resulted in combining areas noted as 1 and 2 to form the Onslow Bight Connectivity, areas noted as 4, 5, and 6 formed the Roanoke Retreat Corridor, and areas 7, 8 and 9 were considered as best represented by The Outer Banks.

To determine the best area for the implementation of a project by SENRLG, several factors need to be considered. These include potential cost, project feasibility and leadership, timing of implementation, landscape resilience, co-benefits to agencies, and potential stakeholders. The Roanoke Retreat Corridor may most closely meet those needs.

The Outer Banks location may likely be very difficult to implement because of the associated costs with beach front adaptation projects. The Outer Banks vulnerability to sea level rise is very real. However, determining areas of greatest vulnerability was only one aspect of consideration in this project. The primary intention is to determine where SENRLG partners can best invest resources to help support resiliency across a multi-agency mission perspective.

The Onslow Bight Connectivity could be a good location to work in as well. The area would provide direct benefits to the Croatan National Forest and a nearby state forest. This partnership could help expand protected buffers and create conservation corridors for species migration and genetic flow. The landscape impacts may not be as broad

given the urban nature of the area and existing transportation routes. These urban elements may increase the potential costs of any conservation and restoration efforts as well.

The priority areas and associated counties are:

1. **Roanoke Retreat Corridor (Hyde, Tyrrell, Beaufort, and Martin Counties)**
2. **The Outer Banks and Sound Front Line (Dare County)**
3. **Onslow Bight Connectivity (Onslow and Jones Counties)**

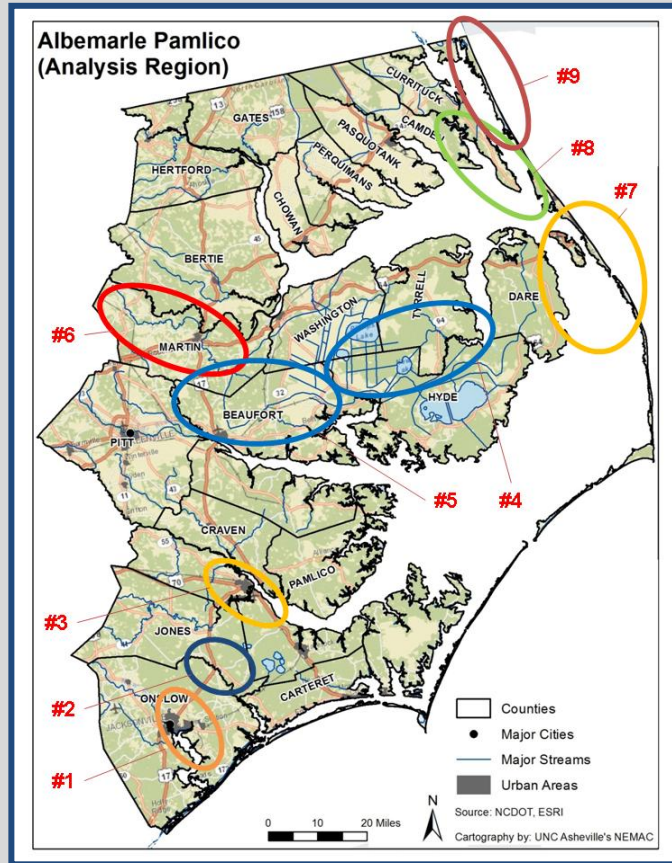


Figure 10: Nine Nominated Areas Identified

A final goal for the SENRLG project was to identify existing funding resources for the three locations. The priority being, good locations for federal investments that enhance the adaptive capacity of the landscape to sea level rise. Starting with data available from the Catalogue of Federal Domestic Assistance (CFDA)⁸, a matrix was developed that linked the program objectives with each of the related EAs.

Figure 11 is a partial list of USGS resources and is shown as an example of the potential funding available.

The complete matrix is in Appendix E and was used to highlight potential funding sources and performance measures that can be associated with the EA

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
USGS	Cooperative Water Program	X	X	X	X	X	X		
USGS	Assistance to State Water Resources Research Institutes				X	X	X		
USGS	Earthquake Hazards Reduction Program			X				X	
USGS	National Spatial Data Infrastructure Cooperative Agreements Program	X	X	X	X	X	X	X	X
USGS	National Cooperative Geologic Mapping Program	X			X			X	
USGS	Gap Analysis Program	X	X						
USGS	Cooperative Research Units Program		X				X		
USGS	Cooperative Research Units Training Program		X					X	
USGS	National Land Remote Sensing Education Outreach and Research	X						X	
USGS	Minerals Resources External Research Program	X			X	X			
USGS	National Geospatial Program: Building the National map	X	X	X	X	X	X	X	X
USGS	Energy Cooperatives to Support the National Coal Resources Data System	X			X	X		X	

Figure 11: Example List of CFDA Programs

data in the GIS decision support tool. Within the SENRLG tool, a users can employ the identify feature to locate program resources. The spatial analysis for decision making is enhanced with the ability to link the essential attribute data layers (e.g., wetlands) spatially to the story maps. Following on the lower Roanoke River connectivity and the wetlands corridor example, the user can select a data layer, in this case wetlands, using the identify function in the decision tool. This will return the user with a list of the Fiscal Year 2012 agency funded programs linked to that dataset by way of the essential attribute (Figure 12). The information can be changed or updated as the FY 2013 programs are finalized.

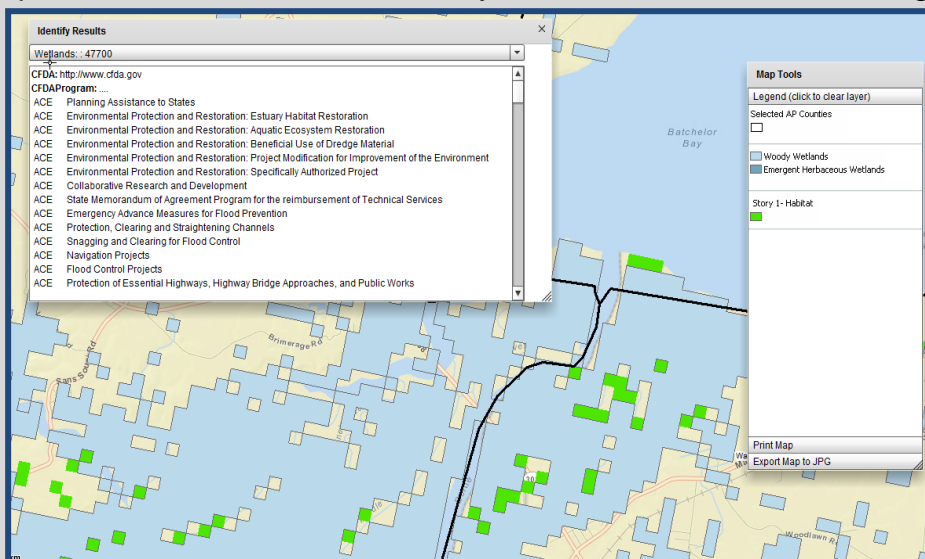


Figure 12: Partial Listing for Catalog of Federal Domestic Assistance Programs for Wetland Essential Attribute Funding

Results

The project identifies an approach to landscape conservation that allows organizations to analyse relationships among a wide range of natural resources. In addition, potential threats such as sea level rise can be assessed while dealing with a range of defined uncertainty. The result enables stakeholders to articulate their viewpoints on different values (or essential attributes) and identify alternative courses of action to an identified threat. The methodology is not meant to be a static model or a single result, but rather to provide a venue to discuss relationships between data and trade-offs when certain choices are made.

Phase II produced some key maps that highlighted priority areas for potential collaboration. The essential attribute datasets were associated across the landscape and tied to federal funding and technical assistance resources. This provided the Team with the opportunity to address specific attributes important to agency goals and increase landscape resiliency using existing federal resources and services. In the end, the Team identified three priority locations in the Albemarle-Pamlico region. Each area addressed a different group of essential attributes and looked to maximize the capacity for resiliency within the landscape.

The methodology used in the Landscape Conservation and Restoration Pilot Project encompasses many hours of research, study, and discussion between designated representatives of the SENRLG federal agencies. The work accomplished by the team and described in the report provides a strong foundation for decision making.

The usefulness of this work cannot be understated. While it has been an extended and sometimes arduous process, the ground work is laid for a usable and replicable approach to integrating federal resources. The current work is useful at the project level as a foundation for decision making.

Recommendation

The SENRLG Principals must now determine if any of the three priority areas should be targeted for agency involvement through technical or funding support, outreach to stakeholders in the priority area, and dedication of internal resources to achieve defined results. The decision for implementation of a given project will be driven by agency program specific values, Fiscal Year 2013 resource constraints, and the identification of likely stakeholders to support achieving agency co-benefits. Some of the threats to the landscape may be easier to address than others. The recommendation of the Team sought to incorporate these concerns and provide an outline of potential next steps that will lead to an implementation approach that builds on the work of the LCRPP. Based on these factors, it is likely that the Roanoke Retreat Corridor may most closely meet the criteria.

Although the LCRPP did not develop a specific TRIP for any of the locations, an approach to work with local partners to create that plan is presented. The effort could be led with foundation funding from the Model Forest Policy Program (MFPP)¹⁰. See Appendix F for a proposal to assist a locally organized, intense ten month stakeholder driven assessment and implementation plan development process through their Climate Solutions University (Appendix G). The actionable strategic plan would be developed by on-the-ground stakeholders with the ability to make decisions at the local, municipal, regional and county planning level. The plan would incorporate the Phase I and Phase II decision support tools created during the LCRPP.

The partnership is an opportunity for SENRLG to provide federal leadership through the products developed during the LCRPP effort. SENRLG staff may be needed from time to time in a limited capacity. The main focus would be to assist local officials in developing performance measures associated with different funding and technical resources available. Agencies would be able to achieve measurable results in natural resource protection at a landscape scale and continue to support Administration priorities.

Possible Next Steps

During the workshop, the Team discussed issues that crossed agency boundaries and value drivers. A key stakeholder in the Albemarle-Pamlico region is Bill Crowell, the APNEP Director. His attendance at the workshop and participation in Phase II meetings provided indispensable insight about the area. In addition, his contacts with local on-the-ground decision makers can serve as a conduit for any next steps. Linda Rimer, EPA Region 4's liaison to NC, can also serve as a champion in the state. Both can connect the SENRLG LCRPP effort with key people at the state and local level.

The tools developed during the LCRPP provide an initial scope of activities, resources, and technical assistance that agencies could potentially use to support local efforts on the ground. For instance, the National Park Service (NPS) could support efforts through the Land and Water Conservation Fund (LWCF) which provides funds to states for outdoor recreation and can be used to acquire, protect or enhance lands, including lands vulnerable to sea level rise, which meets the NC State-wide Comprehensive Outdoor Recreation Plan. Another opportunity could be with the Cultural Resource Management Technical Assistance program. This program can be provided by the NPS to assess and evaluate cultural and historical resources that may be impacted or vulnerable to sea level rise. Finally, the Rivers Trails and Conservation Assistance Program Technical Assistance (RTCA) can collaborate with local partners and stakeholders to facilitate a process to identify future planning and implementation of open space strategies that consider sea level rise for the Roanoke River Corridor. Partners to support these efforts include the State of North Carolina, NC State and Historic Preservation Office, and local cities and counties adjacent to Roanoke River.

The U.S. Fish and Wildlife Service (FWS) is currently focused on developing climate change adaptation strategies for its lands in Eastern NC, particularly on the Albemarle-Pamlico Peninsula which corresponds to the Retreat Corridor. These include pilot projects to reduce or buffer the effects of sea level rise and ensuing salt water intrusion that is adversely affecting freshwater wetland communities on Alligator River National Wildlife Refuge (ARNWR). Additional hydrologic restoration projects are underway on Pocosin Lakes and ARNWR to rehydrate peat soil wetland communities to improve carbon sequestration and reduce the likelihood of catastrophic wild fires.

In addition, funding and staff time from many FWS programs is currently allocated to support these objectives and to collaborate with numerous partners within this area. For instance, the FWS Coastal Program in North Carolina and Partners for Fish and Wildlife Program can be used to enhance habitat management on private lands, as well as public lands, within these connectivity corridors to meet objectives for priority species and habitats. The Environmental Quality Program is a large player in the development of carbon sequestration research and priorities for adaptation to climate change and sea level rise. The FWS Migratory Bird Program has identified numerous focal areas and biological objectives for migratory birds, waterfowl, and shorebirds. The Endangered Species Programs are focused on recovery and candidate conservation objectives for several species within this proposed area, and the Fisheries Program and Conservation Planning and Assistance programs are focusing on fish passage and fish restoration priorities within these basins as well as resource responsible energy development. All of the FWS Programs' efforts and resources focused on the delivery of sustainable ecological conservation objectives will enhance the objectives of this SENRLG priority area.

Finally, the FWS, together with state and Nongovernmental Organization (NGO) partners, have developed a landscape scale land protection plan. This plan will connect core public areas (refuges, state game lands and military lands) in the Albemarle-Pamlico and up through the Roanoke River to enable the migration of natural communities and species in response to climate change. Land protection will be in the

form of fee simple acquisition or obtaining donated or purchased conservation easements within established refuge acquisition boundaries using Land and Water Conservation Funds. FWS will work with partners to permanently protect other key lands outside FWS refuge acquisition boundaries lying within important connectivity corridors between refuges and other publicly owned lands.

The United States Army Corps of Engineers (USACE) will continue to collaborate with partners and stakeholders in future planning and possible implementation of aquatic ecosystem restoration and other water resource needs, if identified. USACE projects and studies require Congressional authorization and project specific funding. Projects under Continuing Authorities Program have existing authorities, but compete for funding nationwide from small appropriated amounts. Further, most studies/projects are cost shared by a sponsor or sponsors.

The Department of Defense (DOD) is an active participant in the Albemarle-Pamlico region. Some existing state programs that receive support from federal agencies could play a significant role in helping to coordinate activities on the ground. For instance, the State of North Carolina (NC) has formed a Governor's Land Compatibility Task Force which is charged with developing a 'multiple benefits' framework to serve as a basis for development of a comprehensive state-wide Land Use Sustainability prioritization process and incentives program. The program will simultaneously provide for economic sustainability and development, maintain conditions that can support needed levels of military operations and training, and protect the lands, ecosystems and other natural resources that are important for North Carolina's future.

One specific organization which is comprised of state, local and department of defense conservation professionals is the NC Working Lands Group (WLG). The NC WLG, along with other organizations, seeks to build upon existing programs developed to protect working lands and to conserve natural resources and ecosystems. The ability of the LCRPP to build on previous successes in the region and work with the Task Force and WLG in future endeavors will ensure that both the ecological and economic interests of the State and local organizations are fully considered.

In contrast, the United States Geological Survey (USGS) perspective on the LCRPP is somewhat different from other federal agencies in that USGS does not own or manage any property. The main goal of USGS is to provide high-quality science to support the management decisions that are made by other public agencies and private entities. As such, the exact location for the LCRPP is not critical to USGS goals as an agency, although some places may be better than others due to the existence of historical data, ongoing data-collection or research activities. The USGS role in this project has been and will be to locate and provide existing data that may be beneficial to developing the planning or management activity, once those details are worked out. Depending on data availability, USGS may be able to provide insight into the long-term risks associated with climate change and the possible effects of management activities to ameliorate the results of climate change.

The most likely resources USGS could use to support work for the LCRPP would come from the Cooperative Water Program (Coop Program). Each state receives an allocation of funds for the Coop Program on an annual basis that can be used to match state and local agency funds. Funds may be fully committed to ongoing projects in any given year and decisions on which projects to fund are made by the state Water Science Center Director. Coop Program funds are used to support USGS staff for data collection and analysis and are not available as a grant to outside agencies.

The USGS Southeast Climate Science Center (SECSC) may provide another funding opportunity for the LCRPP. The SECSC puts out an annual request for proposals on research topics related to climate change. Levels of funding and research topics vary from year-to-year and may or may not coincide with the needs of the LCRPP. Science directions for the SECSC are guided by the Stakeholder Advisory Council, a group of leaders selected from Southeast Federal Agencies, and funding recommendations are made by a Science Implementation Panel.

The tools are transferable as well. For instance, the Bureau of Ocean and Energy Management (BOEM) has identified opportunities to utilize the tools developed in support of Gulf Coast landscape conservation and restoration efforts. There are many databases for the Gulf of Mexico that have mapped areas in an effort to better understand land loss especially with the recent increase in sea level rise. Different federal entities have interest in and funding for restoration projects on the Gulf of Mexico coastline. Research has been based on ecology of the wetlands, physical aspects of sea level rise, and the socio-economic impacts of the land loss resulting from sea level rise in the Gulf of Mexico. With these data the SENRLG Principals would have a better understanding of where a possible restoration research and monitoring project would be most beneficial and cost effective. The process discussed in the SENRLG pilot project is based not only on open inter-agency discussions and sharing of information and resources, but also on engaging the local stakeholders. Ensuring financial resources are not spread over a large range area with multiple small projects, but focused on a robust research and restoration effort.

There is also an opportunity to use as many agency and stakeholder databases as possible to narrow down locations in the Gulf of Mexico that not only have the largest risks of disturbance (land loss) from an increase in sea level rise but also have the greatest chance for resiliency after a restoration effort. These locations would need to best support natural (ecological function), cultural, and socio-economical priorities as well as be an area vulnerable to elevated sea level rise as predicted with climate change. This could also provide BOEM with the opportunity to use the SENRLG developed process to identify areas where sand and gravel resources would be best used in a restoration effort.

Stakeholder Involvement

The LCRPP effort has developed a number of tools that can be used to develop a Targeted Resource Implementation Plan (TRIP). However, conducting outreach efforts in preparation for creating performance measures that could be implemented on the

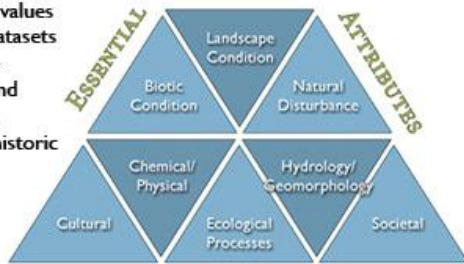
ground was not pursued. While this was the planned focus of the second workshop, the Team felt regional discussions with local organizations prior to the consent of the Principals would be inappropriate, possibly provide incorrect information and produce unrealized future expectations. Also, the project and specific location have not been approved. In addition, developing a specific action plan for each of the three locations would not be a productive use of limited time and resources. Once a specific project is identified, a course of action to meet with stakeholders will be appropriate,

The Team felt that the Roanoke Retreat Corridor location provides the broadest participation and opportunity for collaboration among the SENRLG agencies. If the Principals decide to pursue an investment in the Retreat Corridor, the Model Forest Policy Program (MFPP) could provide a means to develop an effective strategy for leveraging resources that meet local and federal objectives. Although other methods could be developed or explored, the MFPP's Climate Solutions University (CSU) is an existing national program with a history of educating communities and developing actionable implementation plans. Through strengthened local leadership and enhanced public engagement to protect forests, streams, human and ecological health, the program provides an option that focuses on preserving natural resource based economies. The Team believes that the CSU could efficiently and effectively develop the TRIP through broad public support by breaking a complicated and often overwhelming process into manageable components that will integrate federal and local community goals.

The Team recommends SENRLG commit to providing technical assistance in support of a locally driven stakeholder process. In addition, the Team recommends that the tools developed during the LCRPP be made available to communities to assist with developing a TRIP. This will provide the community with insight into potential federal program funding and agency technical resources available to support their issues and concerns. Federal agencies will gain the opportunity to provide input into an actionable plan for landscape conservation and restoration efforts at the local level. This will provide co-benefits for agencies by leveraging defined results based on the foundation of the Landscape Conservation and Restoration Pilot Project process (see Figure 13).

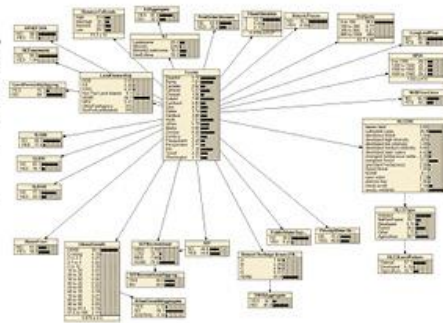
Essential Attributes and Data

Data were collected from each essential attribute to represent the values of each SENRLG agency. Datasets selected for the Albemarle-Pamlico region included Land cover, habitat, longleaf pine, environmental justice and historic places, to name a few.



Belief Network

SENRLG used a belief network to apply probabilistic map algebra to the essential attribute data. Each node of the network represented criteria, which were queried then used to determine areas in the Albemarle-Pamlico region that fit that criteria. These criteria were used to create "stories."



Stories

The SENRLG "stories" described different themes and indicated which areas in the AP met the criteria.

Criteria for Natural Story

Distance to Roads: HIGH
Ownership: NON-FEDERAL
NLCD: NATURAL
NDVI: HIGH



+

Criteria for Drinking Water Story

Environmental Justice: YES
First Order Streams: YES
Priority Watersheds: YES
SEF: YES
Public Water Supply: YES



+

Criteria for Biotic Habitat Story

Waterfowl: YES
SN Heritage Areas: YES
SEF: YES
NLCD: NATURAL



+

Criteria for Tourism Story

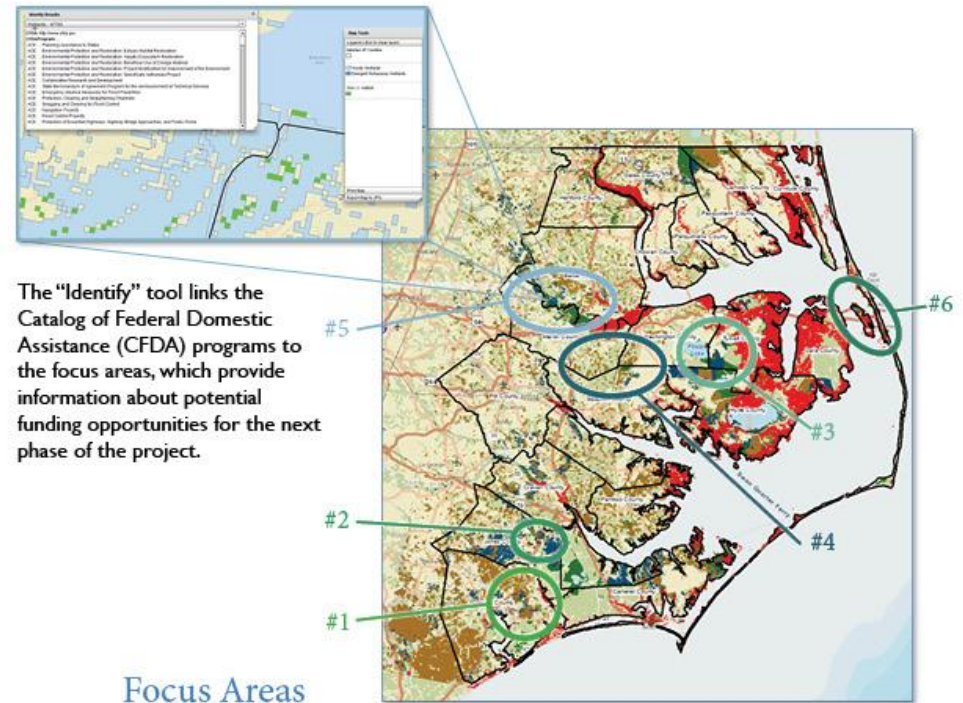
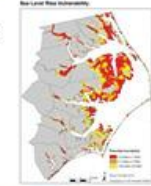
SEF Recreation: YES
National Register of Historic Places: YES



+

Sea Level Rise

40cm



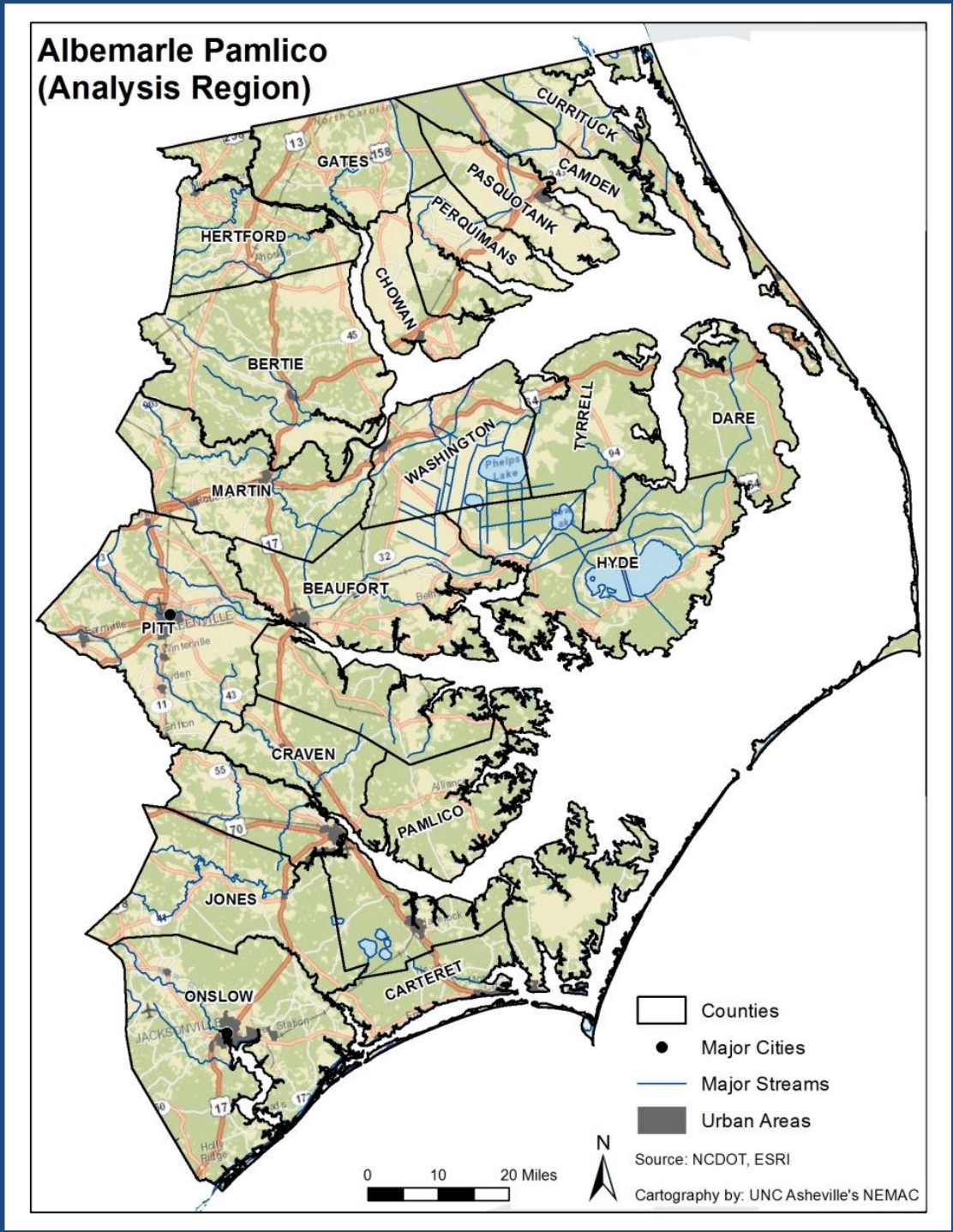
The "Identify" tool links the Catalog of Federal Domestic Assistance (CFDA) programs to the focus areas, which provide information about potential funding opportunities for the next phase of the project.

Focus Areas

The final focus areas were selected based on criteria for the SENRLG "stories." These three regions are located in Onslow and Jones County (1,2), along the Roanoke River (3,4,5), and in Dare County (6).

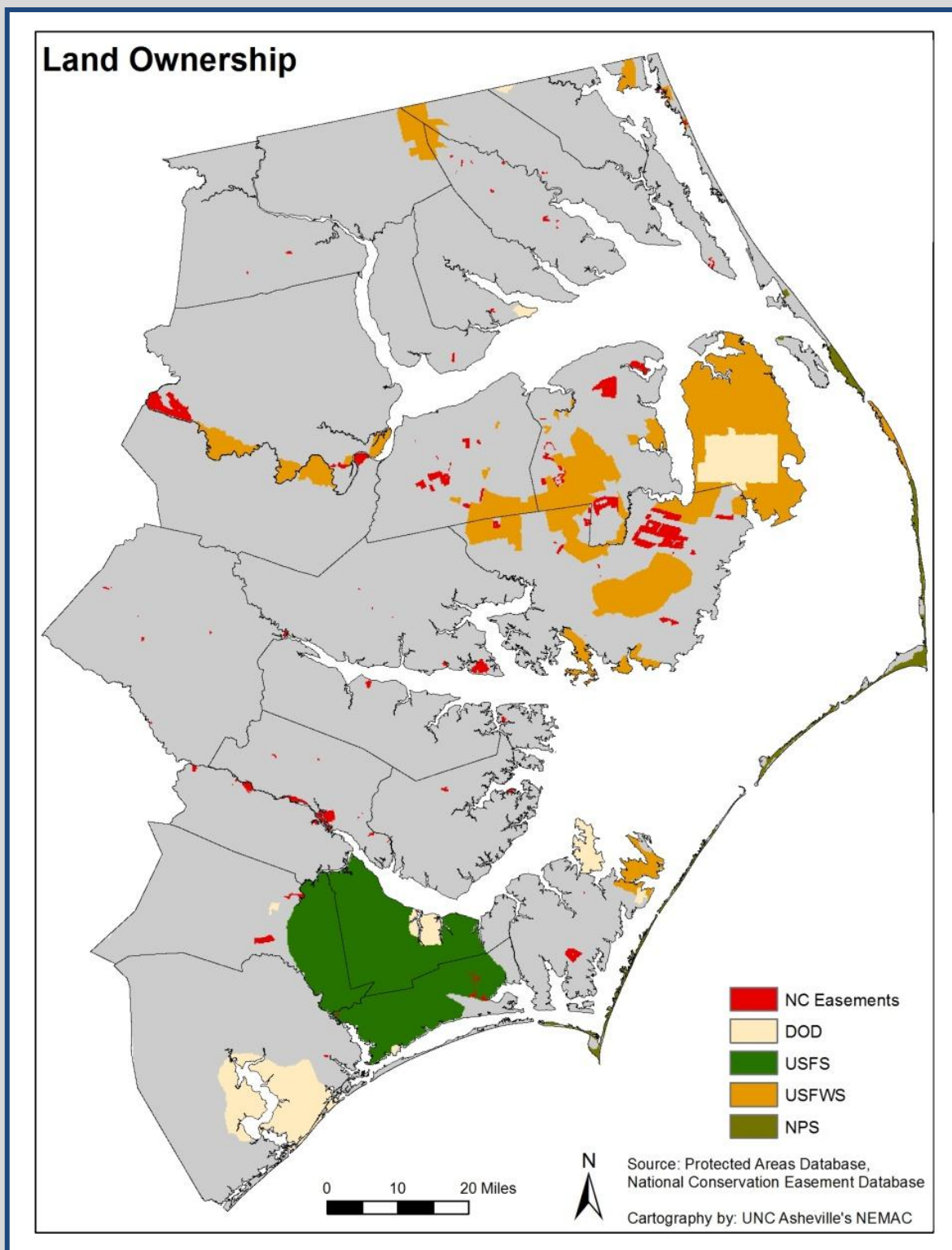
Figure 13: The SENRLG Landscape Conservation and Restoration Pilot Project Process

Appendix A: Dataset Maps and Sources for Essential Attributes



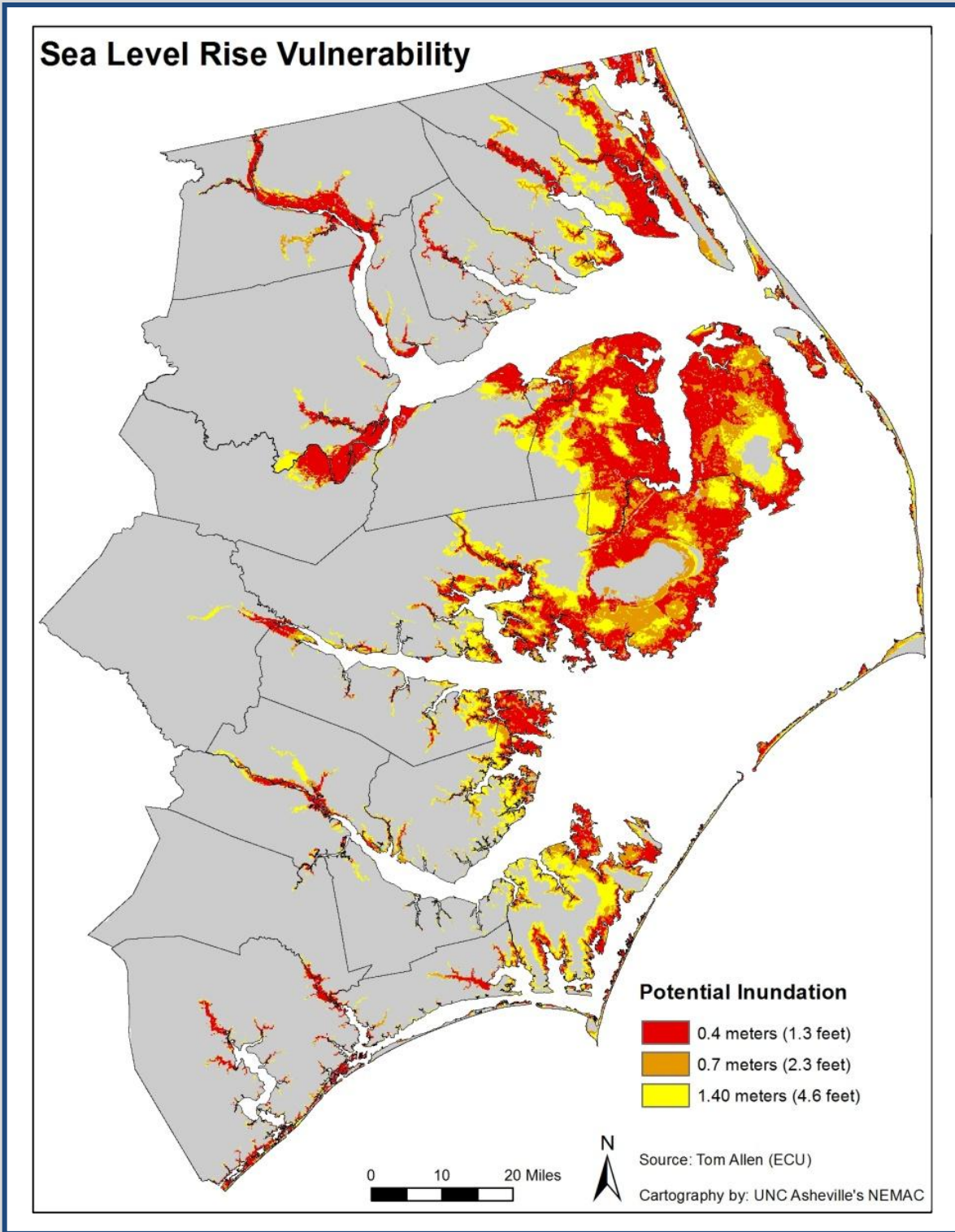
Data Map 1: Albemarle-Pamlico Region

Appendix A: (continued)



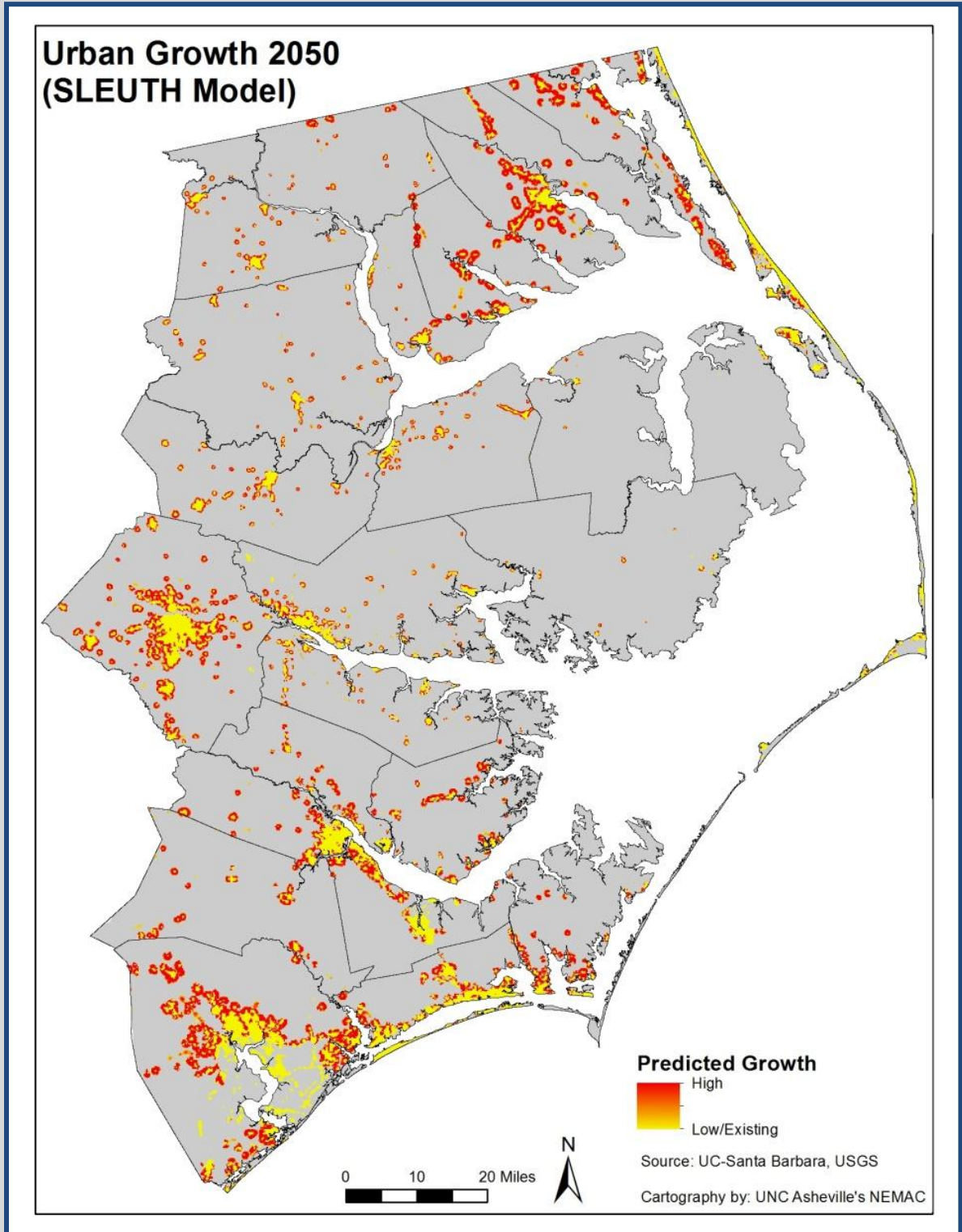
Data Map 2: Land Ownership in the Albemarle-Pamlico Region

Appendix A: (continued)



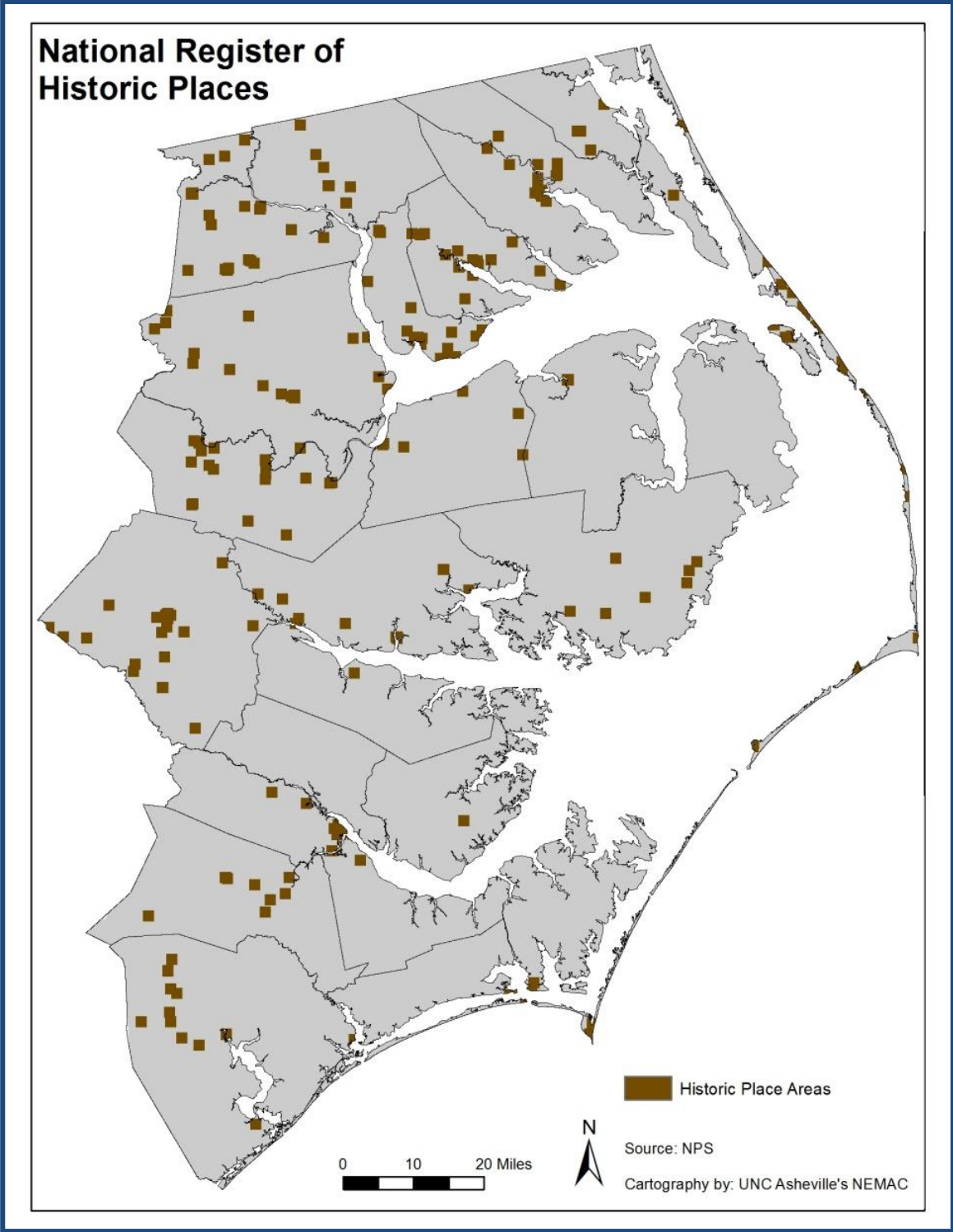
Data Map 3: Sea Level Rise Inundation in the Albemarle-Pamlico Region

Appendix A: (continued)



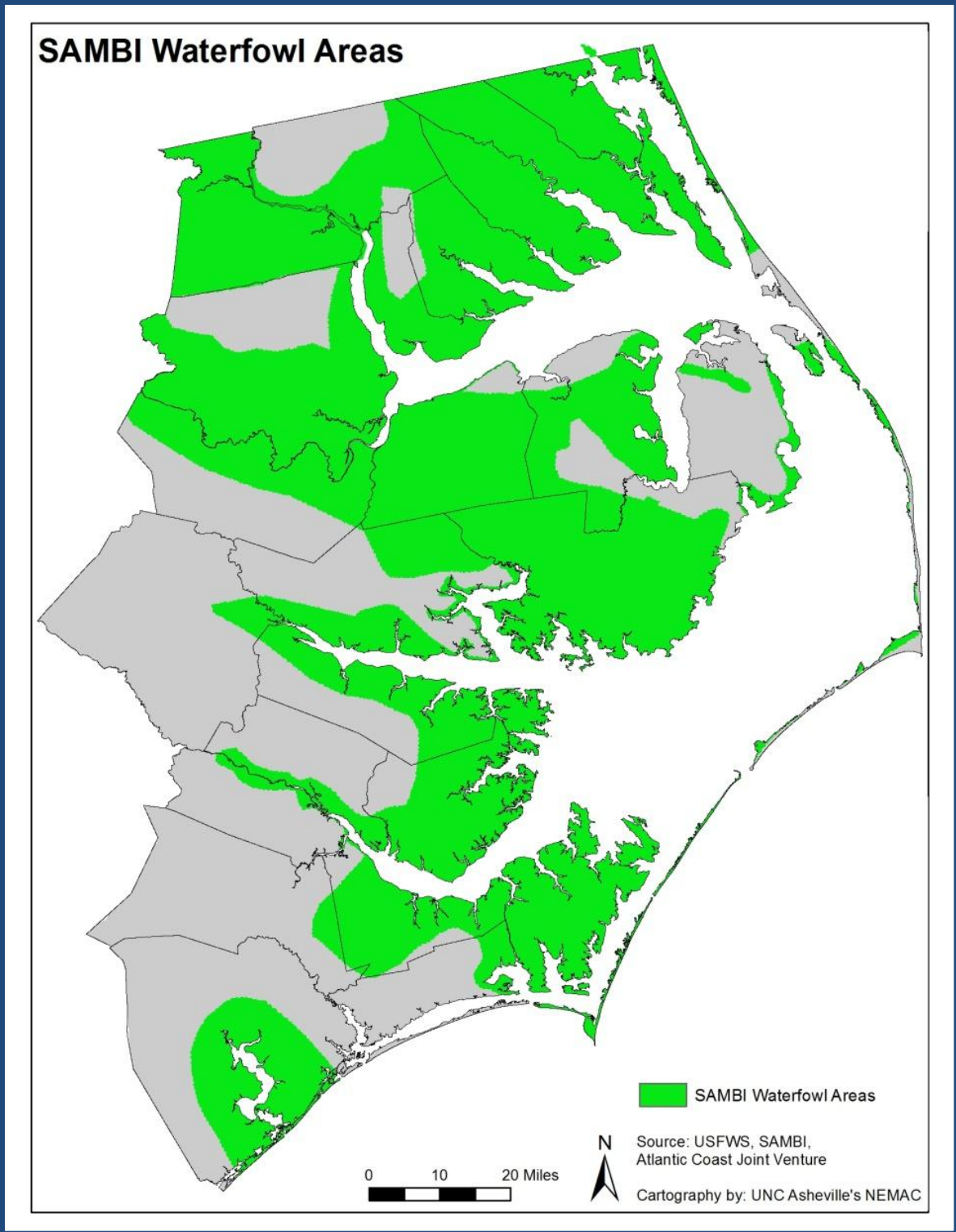
Data Map 4: Urban Growth Model Projection for 2050

Appendix A: (continued)



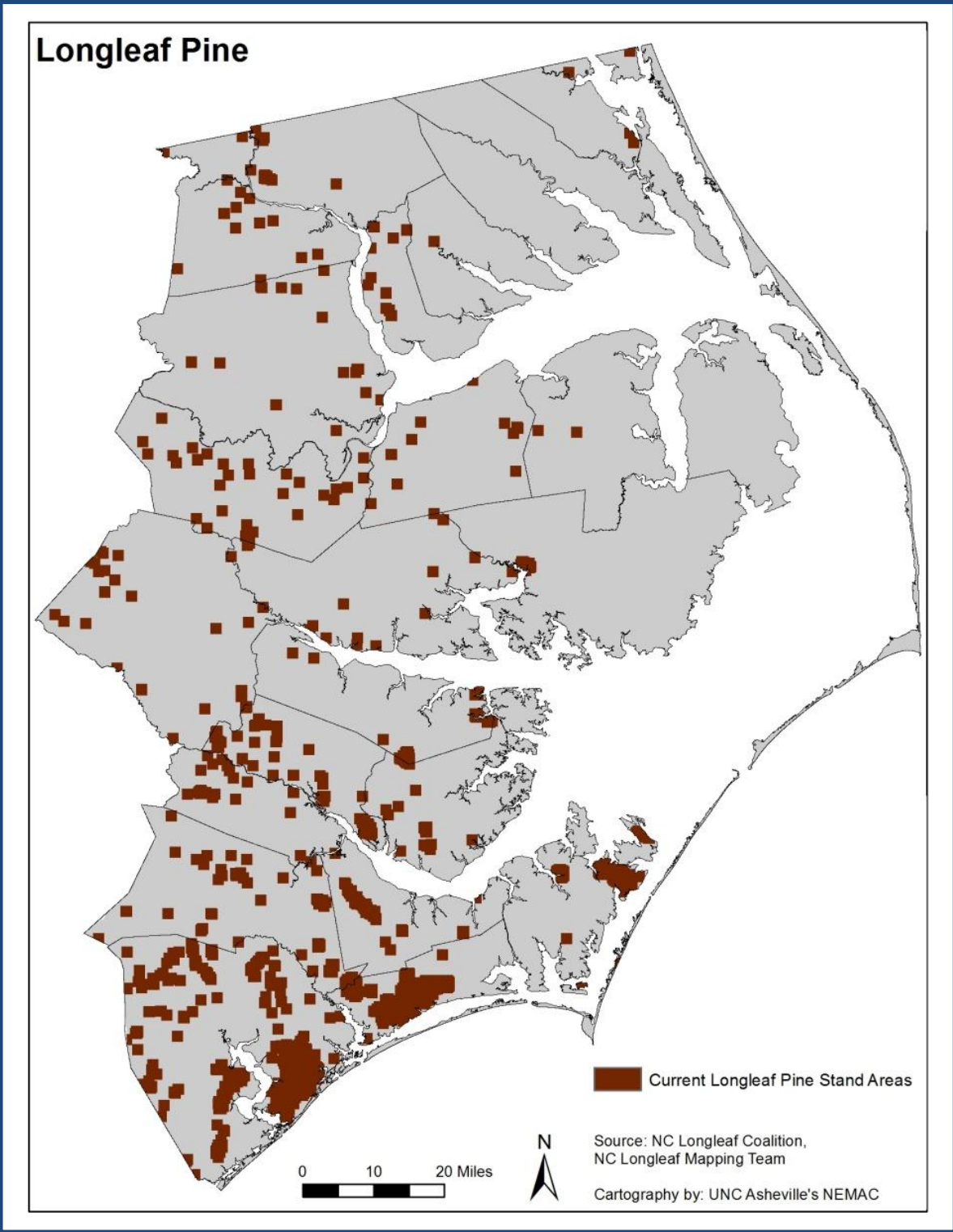
Data Map 5: Buffered National Register of Historic Places

Appendix A: (continued)



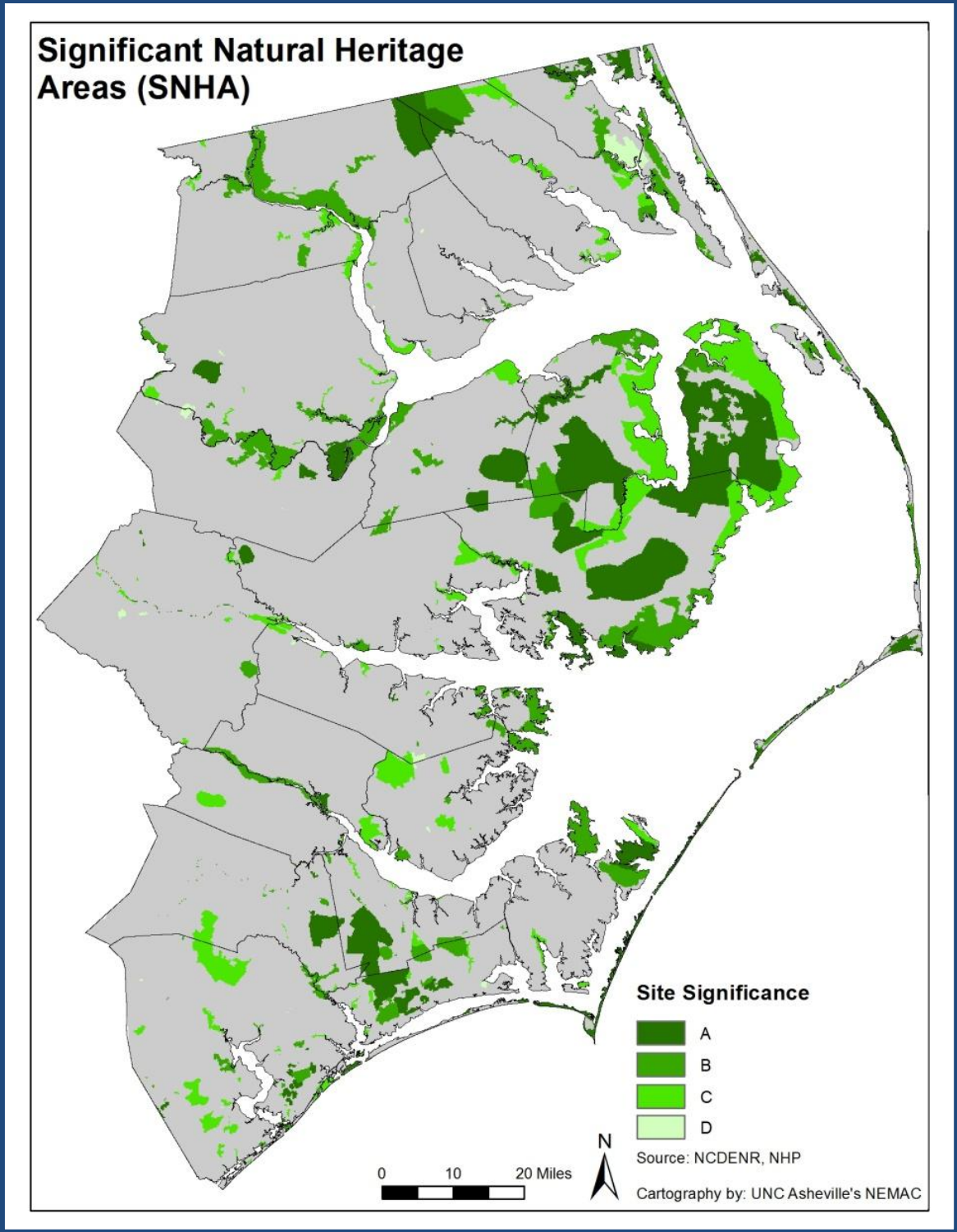
Data Map 6: South Atlantic Migratory Bird Initiative Waterfowl Areas

Appendix A: (continued)



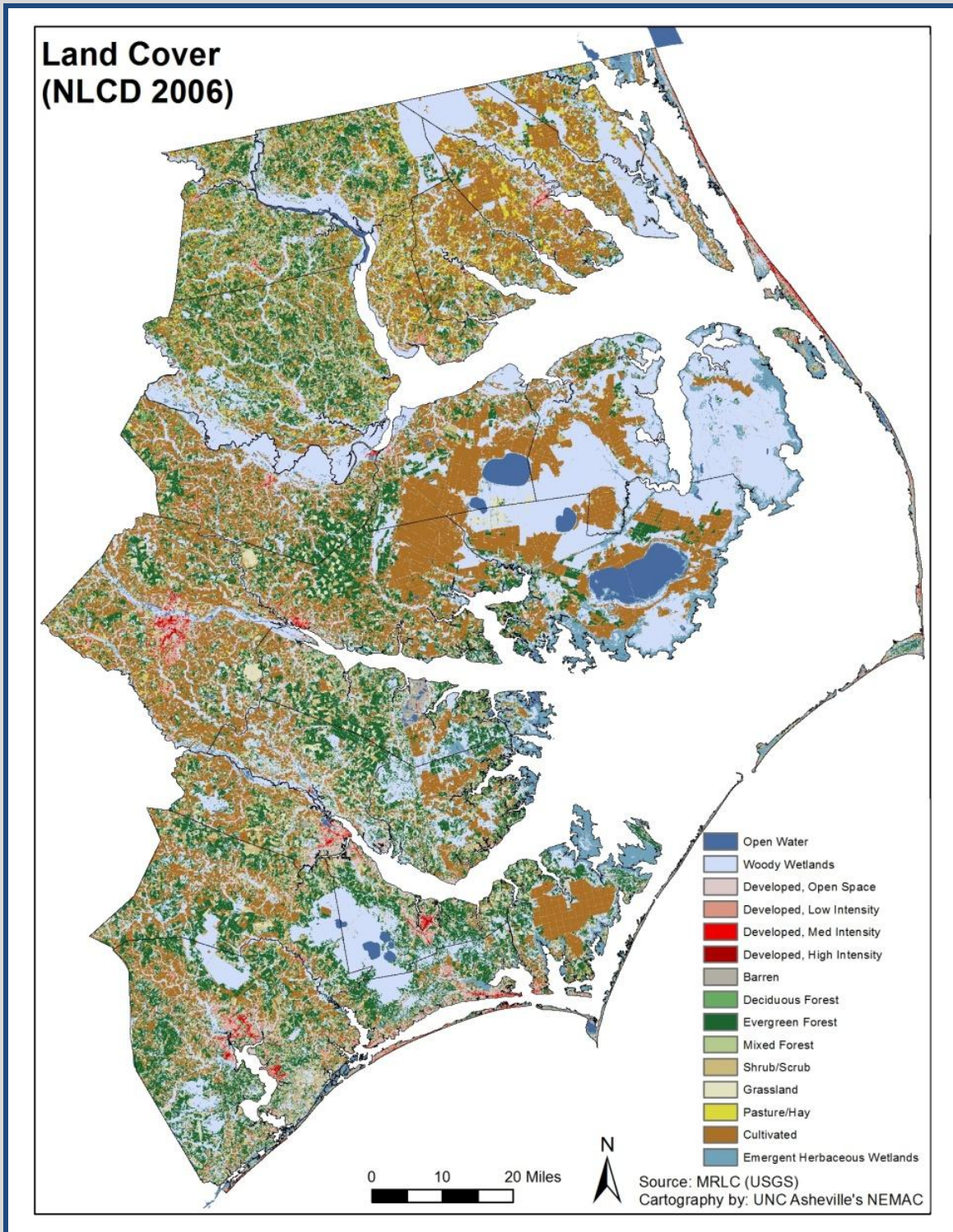
Data Map 7: Buffered Longleaf Pine Stands

Appendix A: (continued)



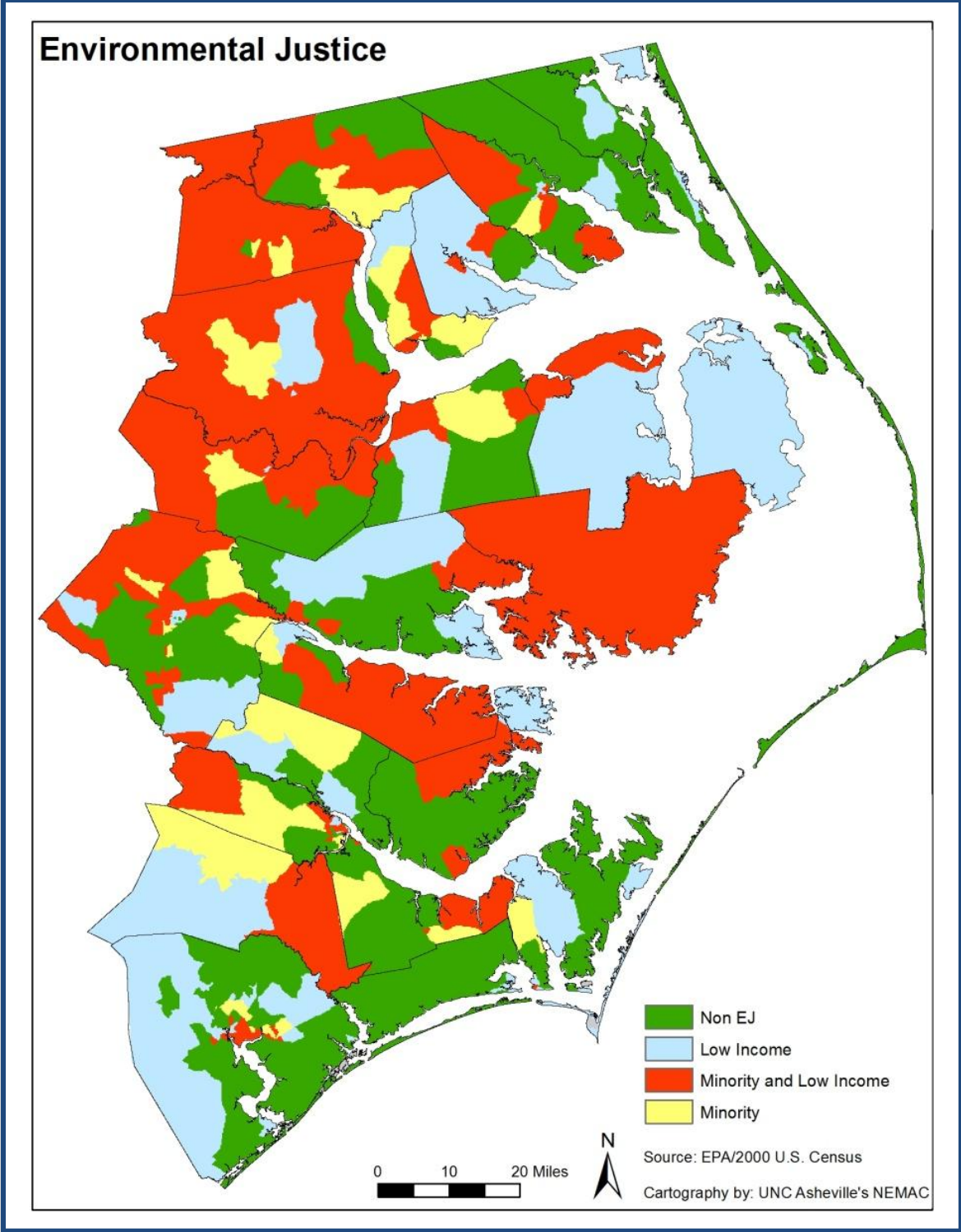
Data Map 8: Significant Natural Heritage Areas

Appendix A: (continued)



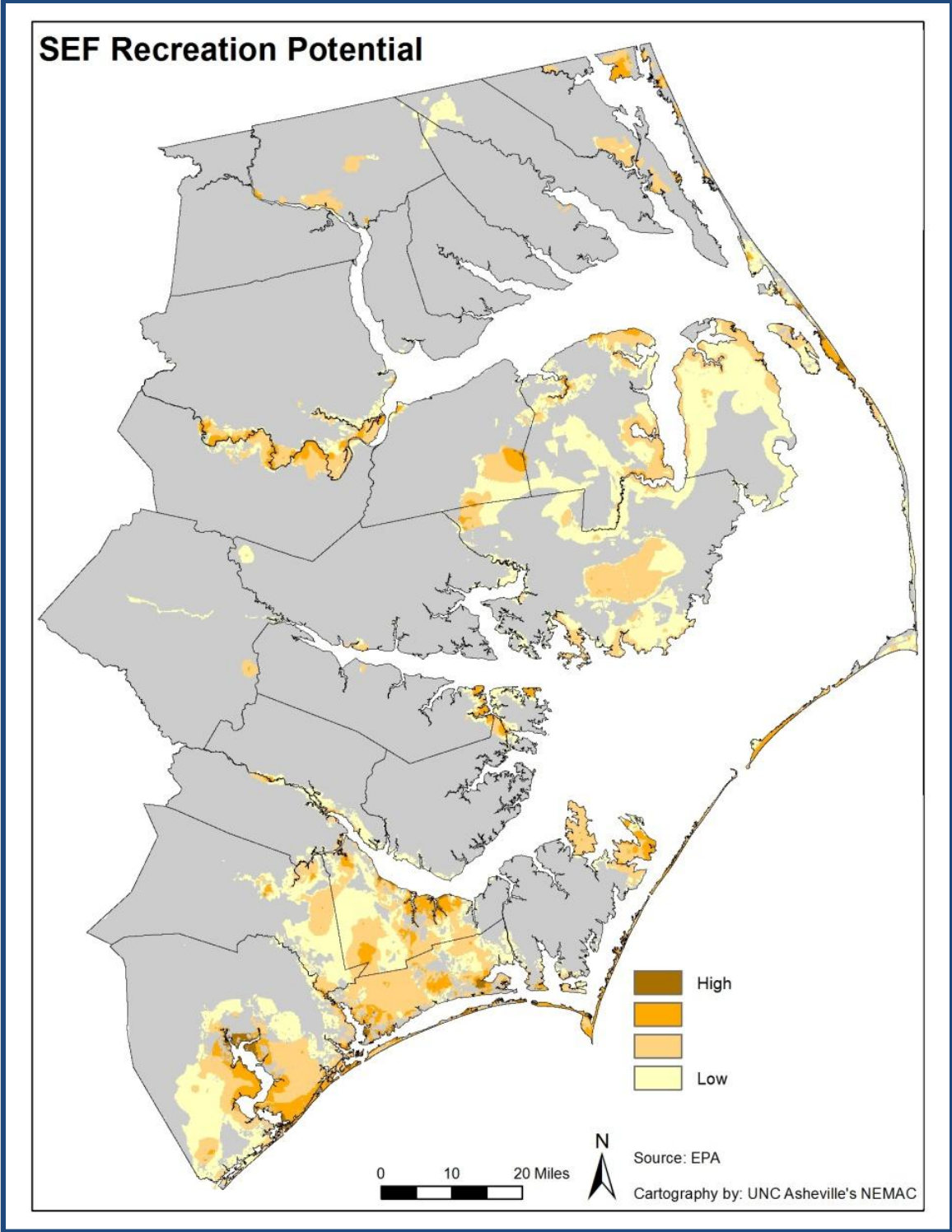
Data Map 9: National Land Cover Data

Appendix A: (continued)



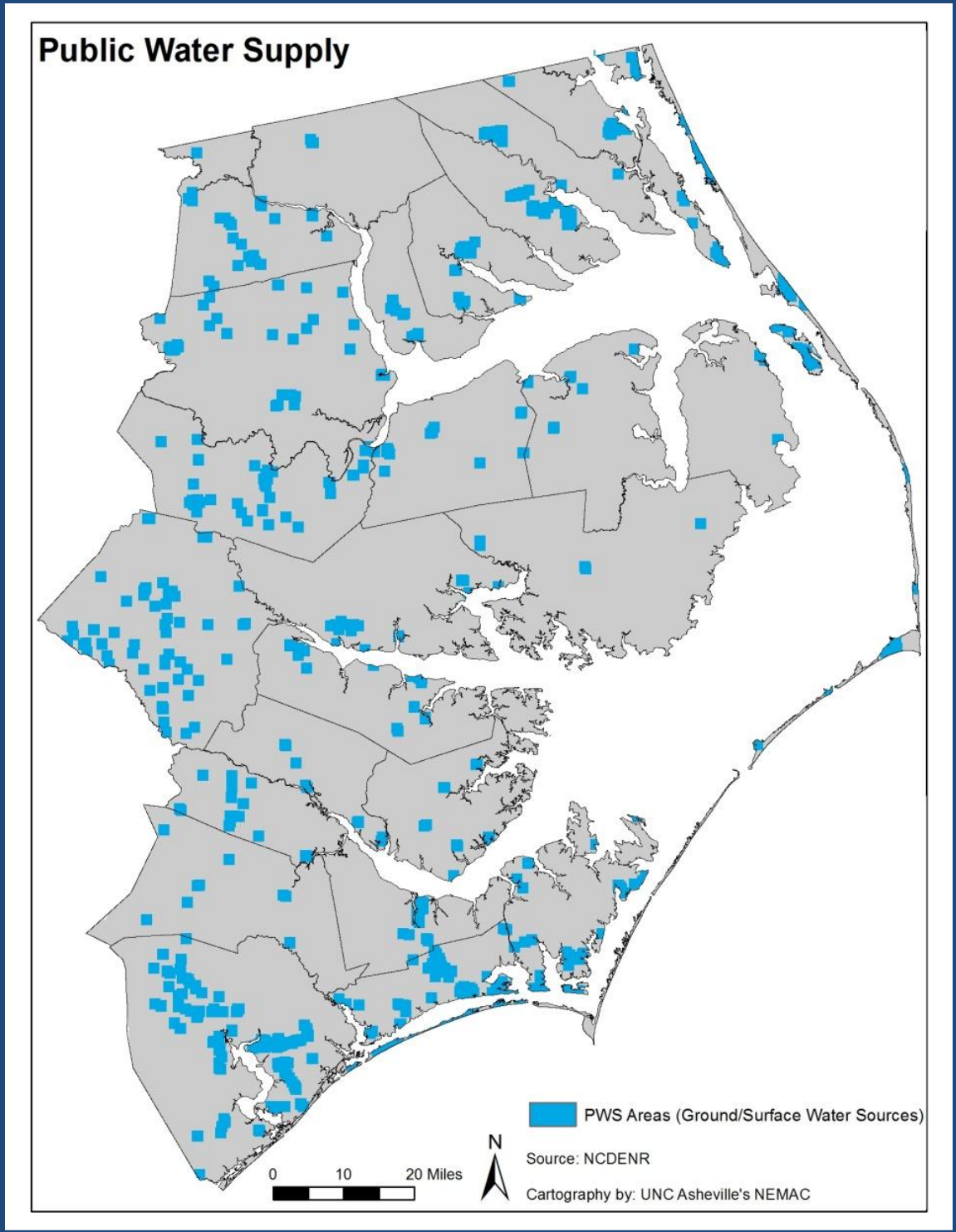
Data Map 10: EPA Defined Environmental Justice Communities

Appendix A: (continued)



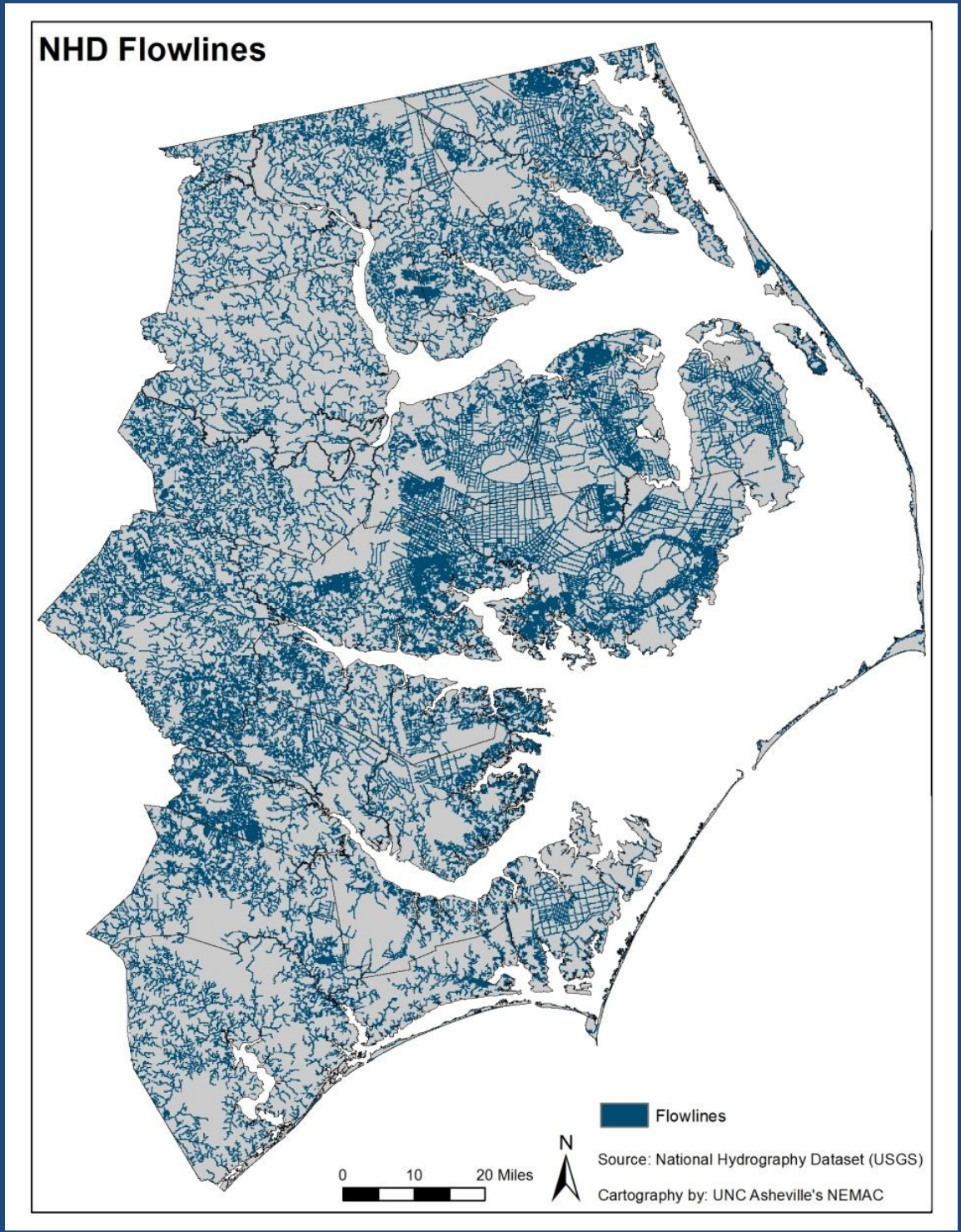
Data Map 11: Southeastern Ecological Framework Recreation Potential

Appendix A: (continued)



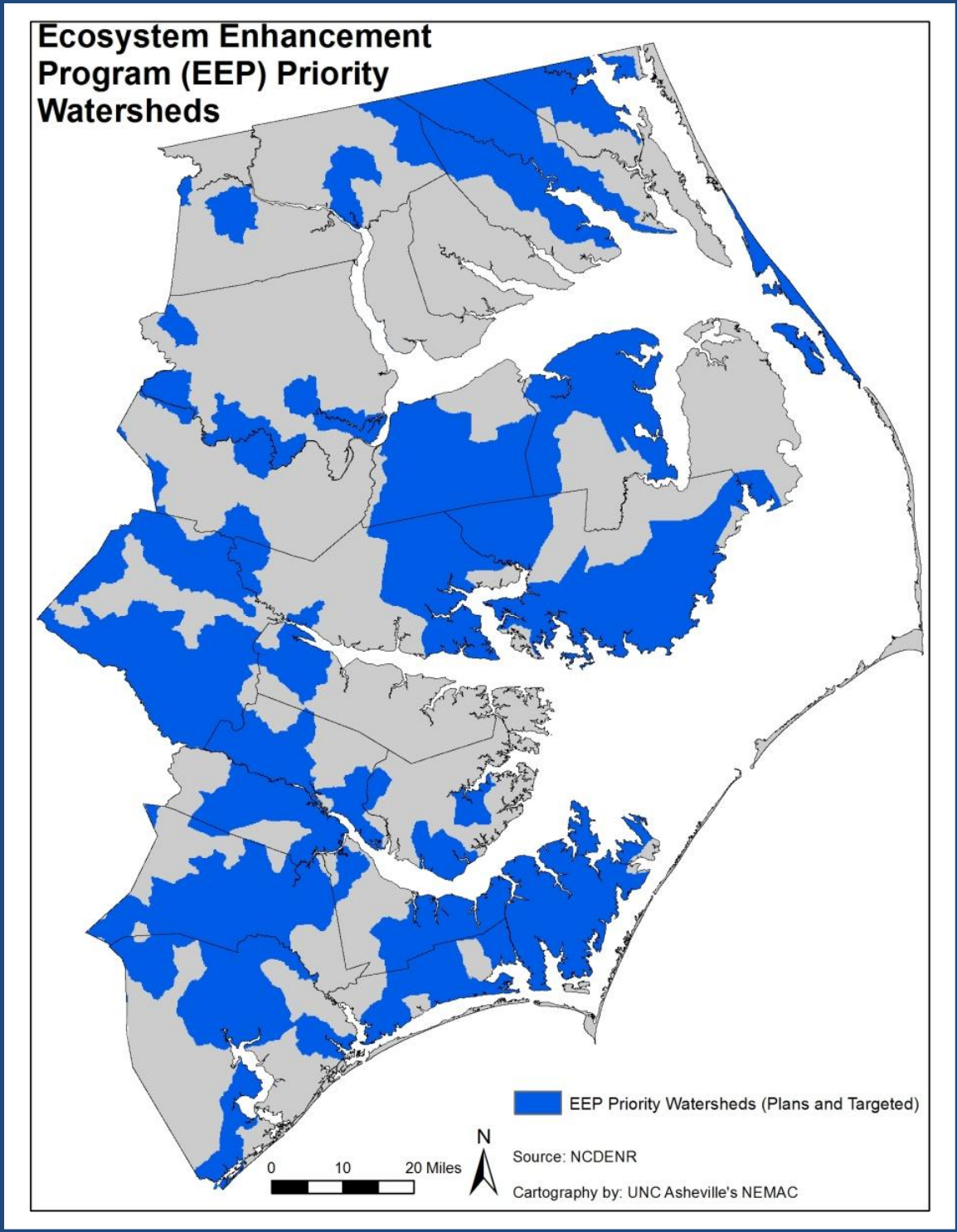
Data Map 12: Public Water Supply

Appendix A: (continued)



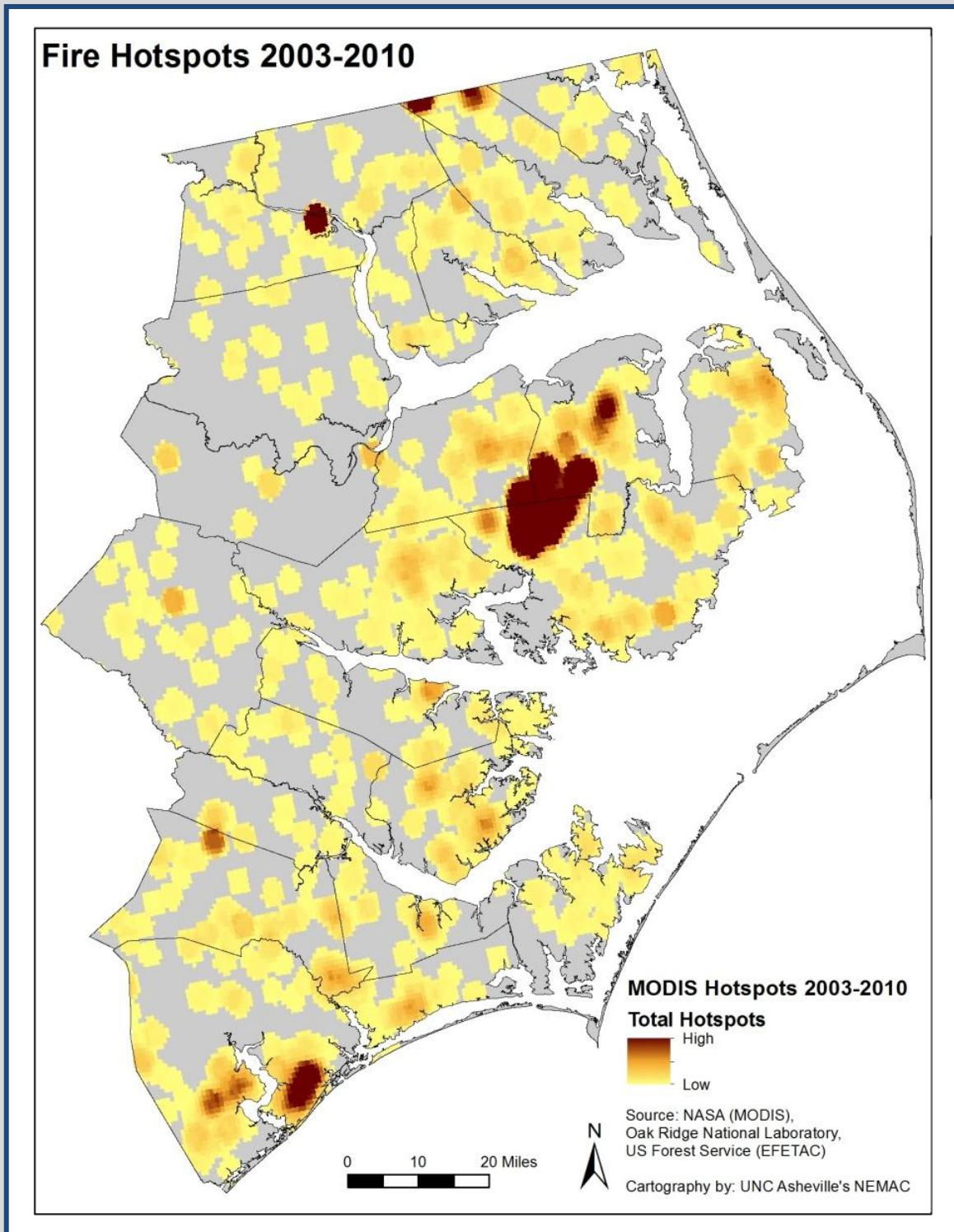
Data Map 13: National Hydrologic Data Flow Lines

Appendix A: (continued)



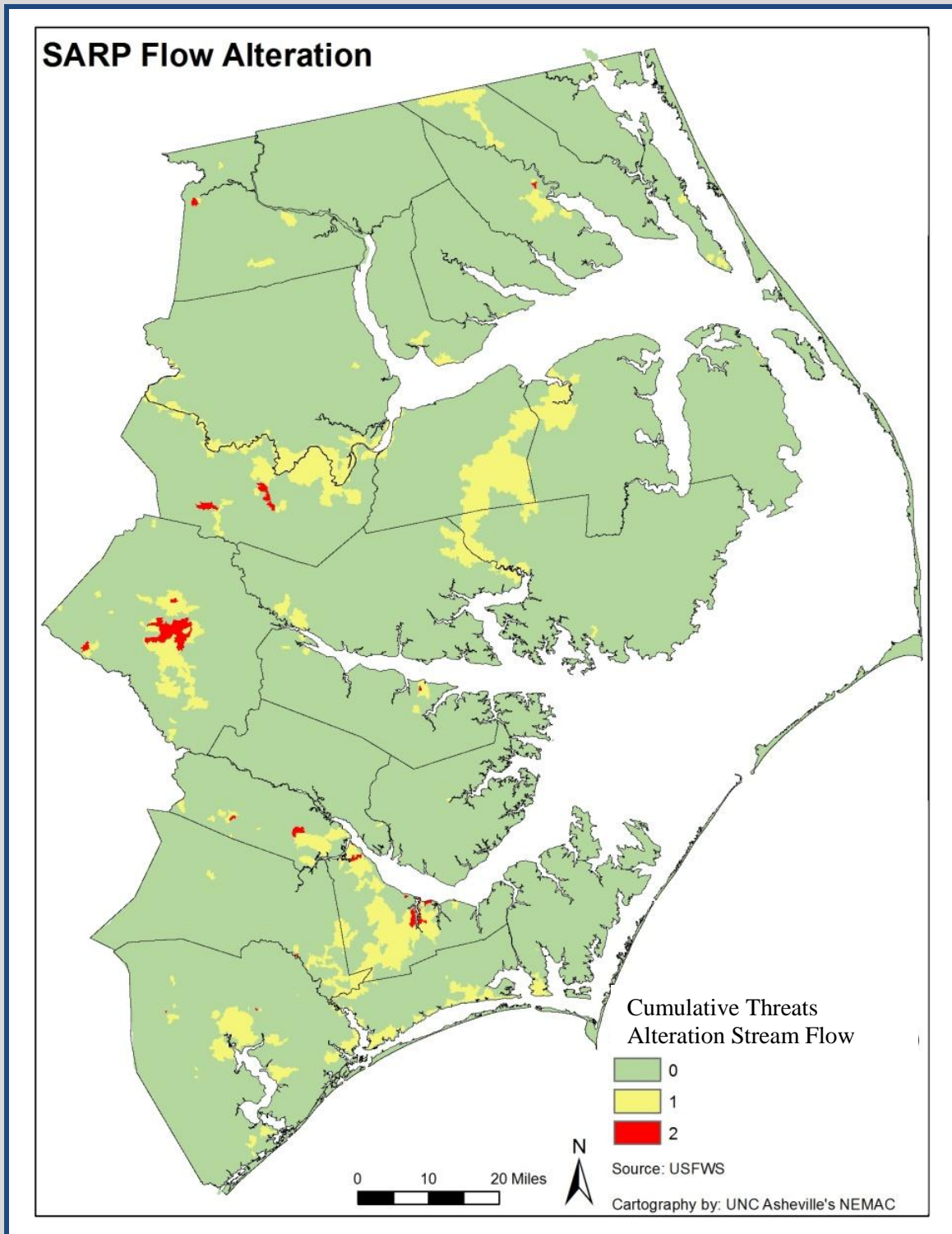
Data Map 14: Ecosystem Enhancement Program Priority Watersheds

Appendix A: (continued)



Data Map 15: Moderate-resolution Imaging Spectroradiometer Fire Hotspots

Appendix A: (continued)



Data Map 16: South Aquatic Resources Partnership Flow Alteration

Appendix B: Geospatial Story Maps and Data Sources

Natural Areas Story

This story had a focus on those areas that were identified as having natural characteristics and where the ability to take action is potentially possible. The first story included evidence entered for the following datasets:

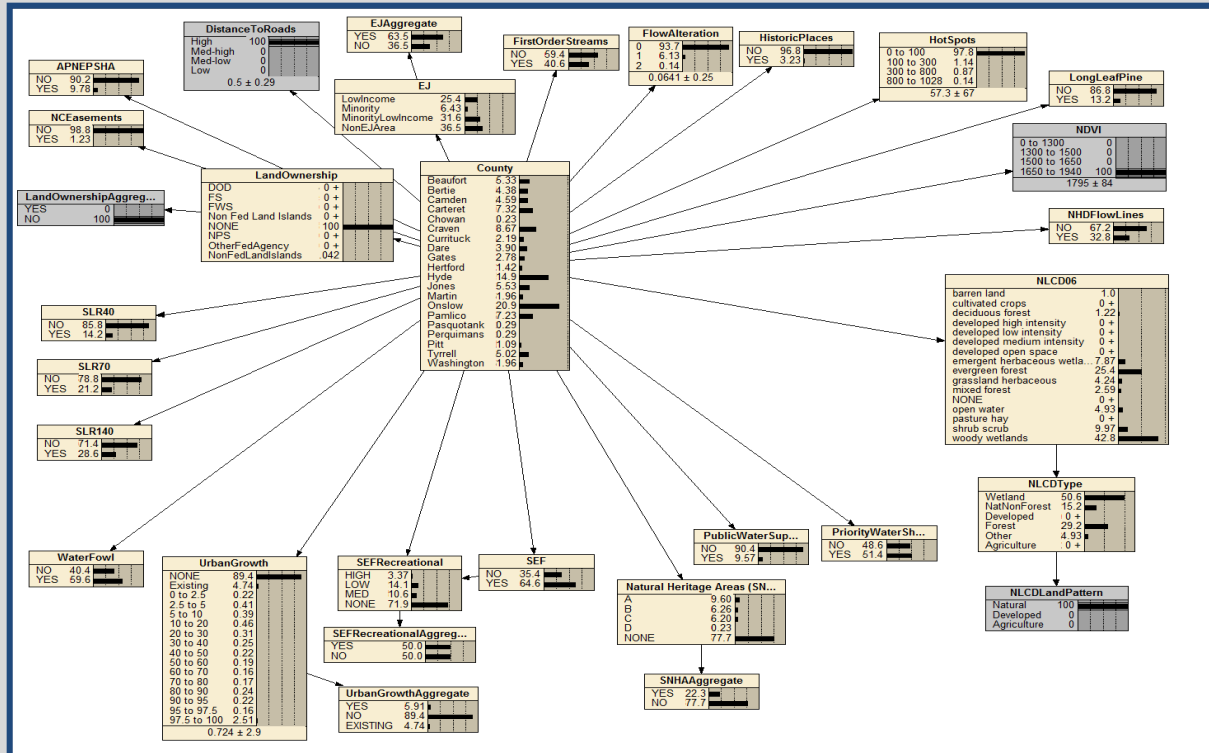
- *Distance to Roads*: A societal essential attribute that represents distance to roads
 - Source: Oak Ridge National Laboratory (2008)
- *Land Ownership*: A contributing factor that represents protected areas based on ownership of land
 - Source: Protected Areas Database of the United States (2011)
- *National Land Cover Database (NLCD)*: A landscape condition essential attribute that provides generalized land cover characteristics of the land surface, such as thematic class (for example, urban, agriculture, and forest), percent impervious surface, and percent tree canopy cover
 - Source: Multi-Resolution Land Characterization Consortium (2011)
- *Normalized Difference Vegetation Index (NDVI)*: MODIS satellite data that correlated with biomass and a standard measure of “greenness”
 - Source: National Aeronautics and Space Administration and Oak Ridge National Laboratory Distributed Active Archive Center

Three of the datasets used in this story [distance to roads, land ownership, and Normalized Difference Vegetation Index (NDVI)] correspond to the goal of locating natural areas. The NDVI is the accumulated average annual value over a decade: 2000–2010. NDVI is a measure of “greenness” which is not necessarily a measure of natural condition, but more of a plant growth measure. Irrigated lands, including golf courses and agricultural land have high NDVI values. Wetter areas will have higher NDVI values than drier areas, thus skewing results toward wetlands and away from mesic areas such as dry upland forests.

The Team didn’t look at a comparison of the individual maps side by side, but drilling through each data layer and obtaining a positive presence of the essential attributes provides a good indication of a more natural landscape.

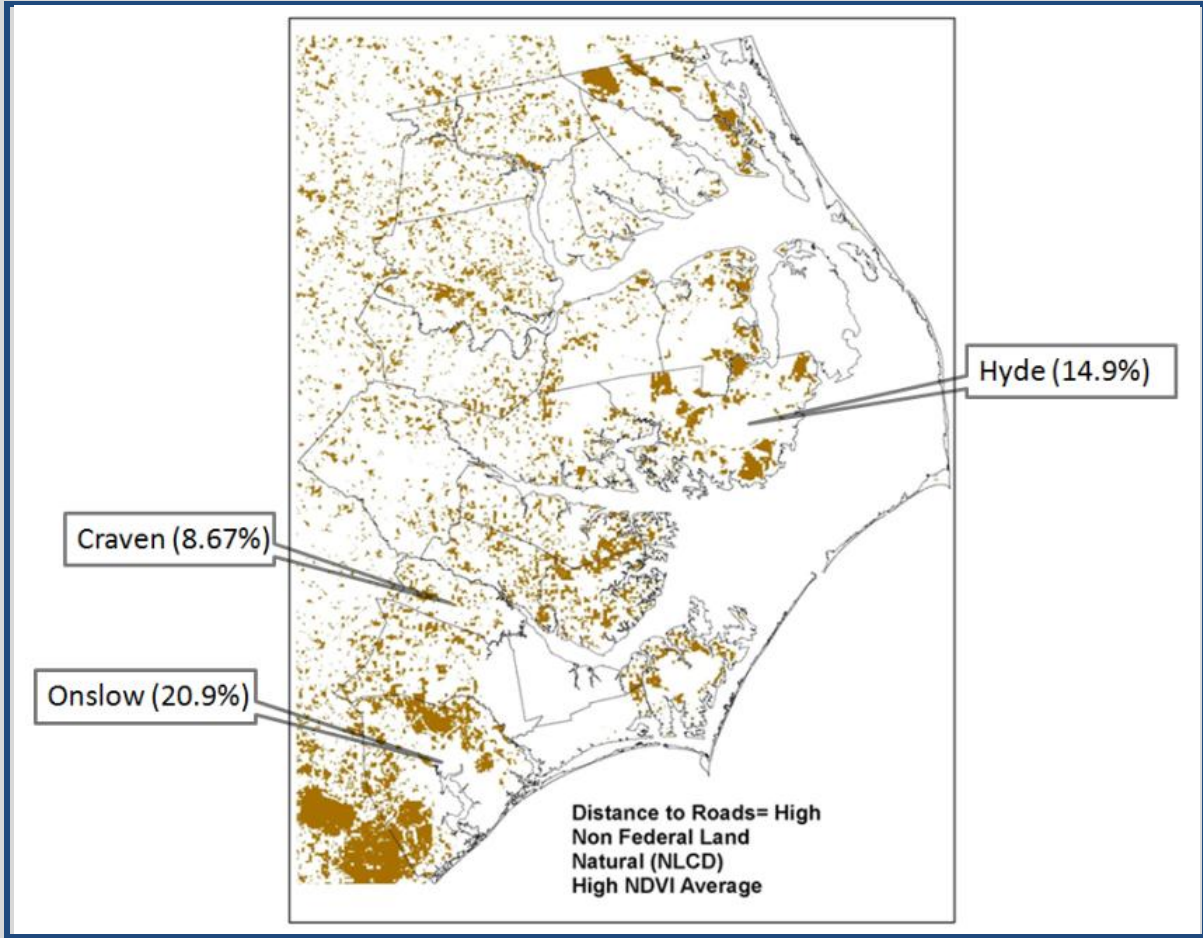
Land ownership, for its part, restricts us to areas that are non-federal. By selecting non-federal in the land ownership node, this story attempts to locate areas that could be good investments for local landholders. The SENRLG workgroup’s goal here was to explicitly take consideration of localized expertise in deciding where to invest in increasing ecosystem resiliency. The county-wide Bayesian Belief Network (BBN) for the natural areas story is presented in Appendix B Figure (ABF) 1 below.

The BBN below is difficult to read, but the concept is fairly easy to understand. For the Natural Areas story, the darker boxes represent the data layers that are turned on in the analysis. These are the noted data sets above and drive the County level percentage distribution noted in the middle of the box. In this case one can see that the BBN inputs (dark boxes) are driving the analysis identified in the central box (County) to help understand where on the landscape these four criteria are in concert with one another. For instance, Onslow County (20.9%), followed somewhat closely by Hyde (14.9%), and then further by Craven (8.67%), are the three counties that share these attributes and meet the conditions of the story.



Appendix B Figure 1: Natural Areas Story BBN

The resulting belief map can be interpreted as being positive for having geopixels that meet the intersecting condition of the story (ABF 2). This can be further interpreted as showing the most likely natural areas that are not federally owned and have a high level of biomass production. These results are driven by the case data provided. It is important to remember that these percentages are distributed across the underlying number of geopixels that meet all four conditions of the story.



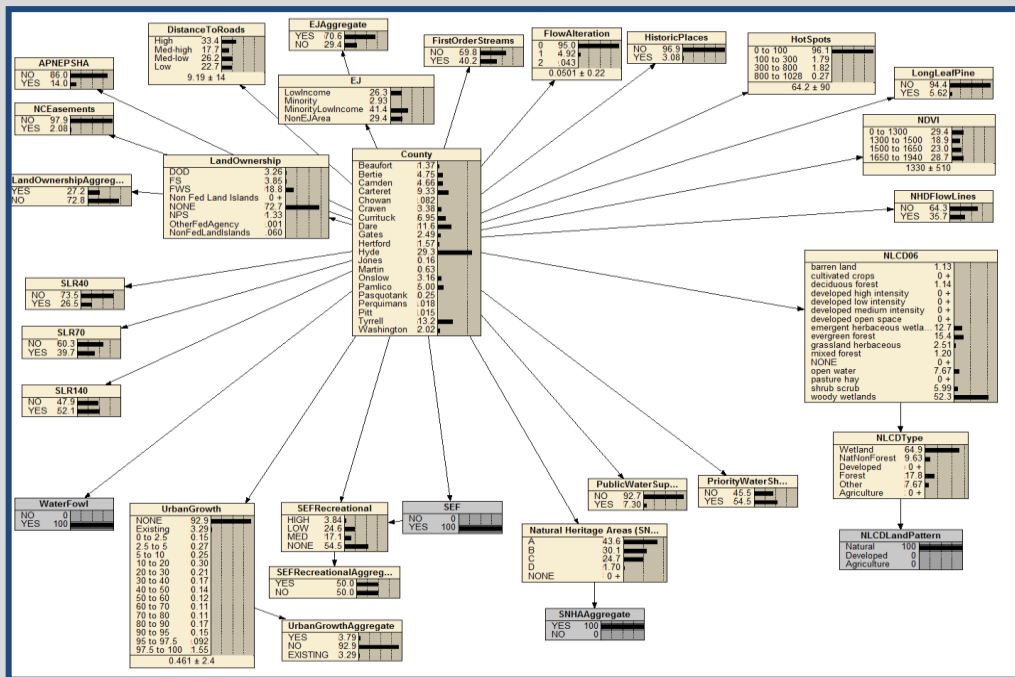
Appendix B Figure 2: Natural Areas Story Map

Conservation Corridor Story

This story had a focus on those areas defined by the essential attributes of habitat and biotic condition characteristics important to all of the SENRLG Team members. These included waterfowl habitats that were connected by biotic corridors and natural heritage areas. The conservation corridor story included the following datasets:

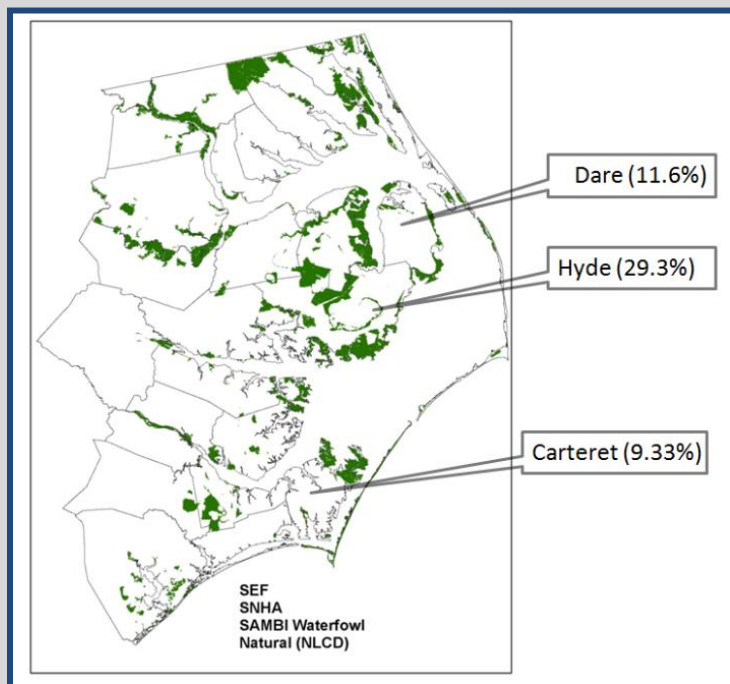
- *Waterfowl Habitat*: Looks at suitable habitats for waterfowl dispersed across the landscape
 - Source: Atlantic Coast Joint Venture (ACJV) as a part of its SAMBI (South Atlantic Migratory Bird Initiative)
- *Significant Natural Heritage Areas (SNHA)*: A polygon coverage identifying sites (terrestrial or aquatic) that has particular biodiversity significance. A site's significance may be due to the presence of rare species, rare or high quality natural communities, or other important ecological features (NC DENR 2012).
 - Source: NC DENR, Div. of Parks and Recreation, Natural Heritage Program
- *Southeast Ecological Framework (SEF)*: Locates important ecological hubs and creates passageways, or corridors, to connect them
 - Source: Southeastern Ecological Framework Project
- *National Land Cover Database (NLCD)*: A landscape condition essential attribute that provides generalized land cover characteristics of the land surface, such as thematic class (for example, urban, agriculture, and forest), percent impervious surface, and percent tree canopy cover (2011)
 - Source: Multi-Resolution Land Characterization Consortium

Two of the datasets used in this story (SEF and Waterfowl Habitat) correspond to the goal of locating corridors for both biodiversity and habitat, respectively. Therefore, this story represents a specific focus on connectivity. Because the SNHA node within the BBN was classed across a range of importance (A–D), a parent node that aggregated the choice of from A, B, C, or D simply became a YES the area was important or NO the area was not identified as important. The county-wide BBN for the conservation corridor story is presented in Appendix B Figure 3 below



Appendix B Figure 3: Conservation Corridor Story BBN

As can be discerned from the BBN using the dark boxes as the essential attribute drivers for recognizing the overlap of geopixels within each of the counties identified in the center box, one can see that Hyde (29.3%), followed distantly by Tyrell (13.2), Dare (11.6%), and then Carteret (9.33%), are the four counties that meet the conditions of this story. Again, the resulting belief map can be interpreted as the area having the most geopixels that meet the intersecting condition of the story (ABF 4). Based on agency expertise and the proximity of Hyde and Dare County, these locations were joined to address the pocosin lake and agricultural land conservation work that many agencies identified as very important to meeting the values of their agency. Upon further discussion of other story lines, the area also tied in with the water map story along the lower Roanoke River. This area is now identified as the Roanoke Retreat Corridor.



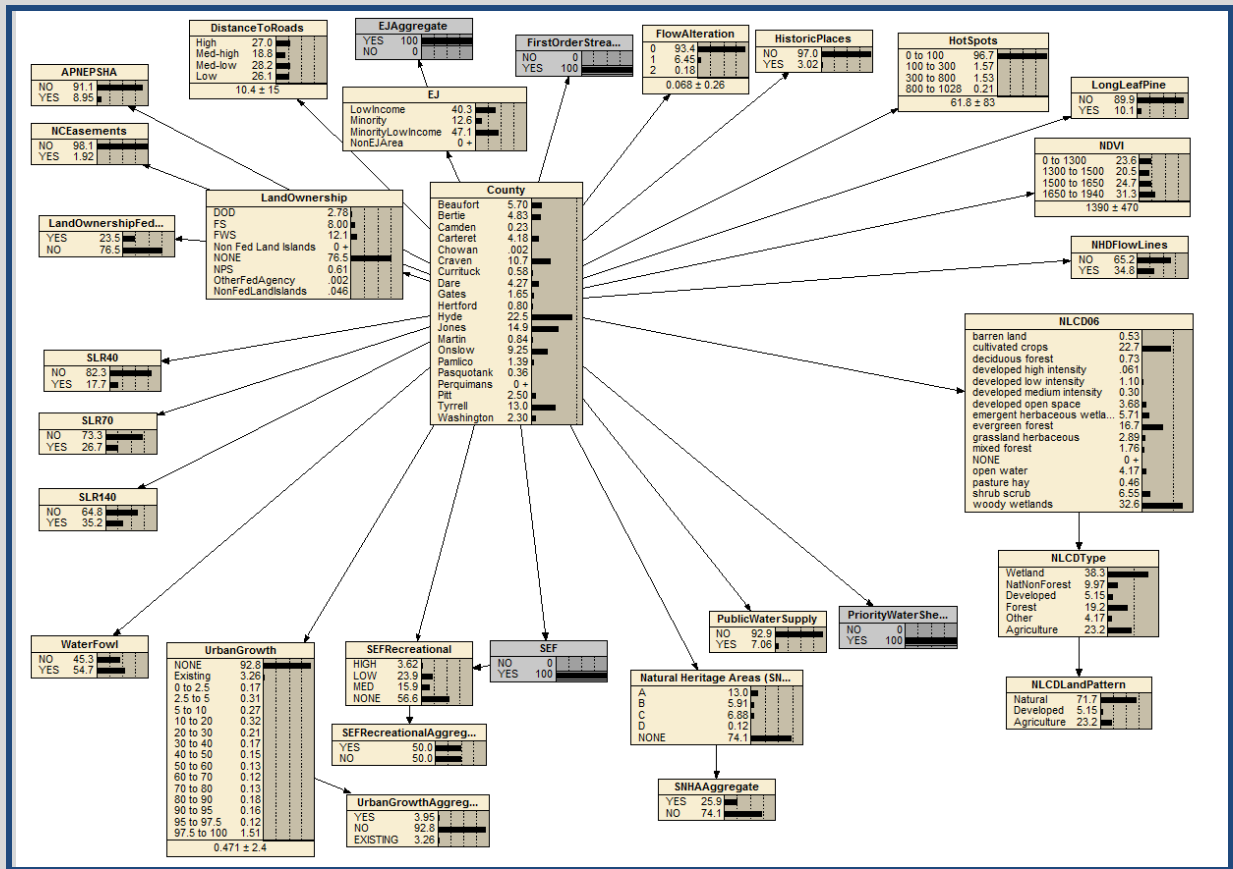
Appendix B Figure 4: Conservation Corridor Story Map

Water Story

This story had a focus headwater streams and priority watersheds identified for enhanced ecosystem projects associated with road development. In addition, minority and low-income areas and locations containing public drinking water supply sources. The water story attempted to bring in the societal and water quality resources located within the Albemarle-Pamlico region. The water story included the following datasets:

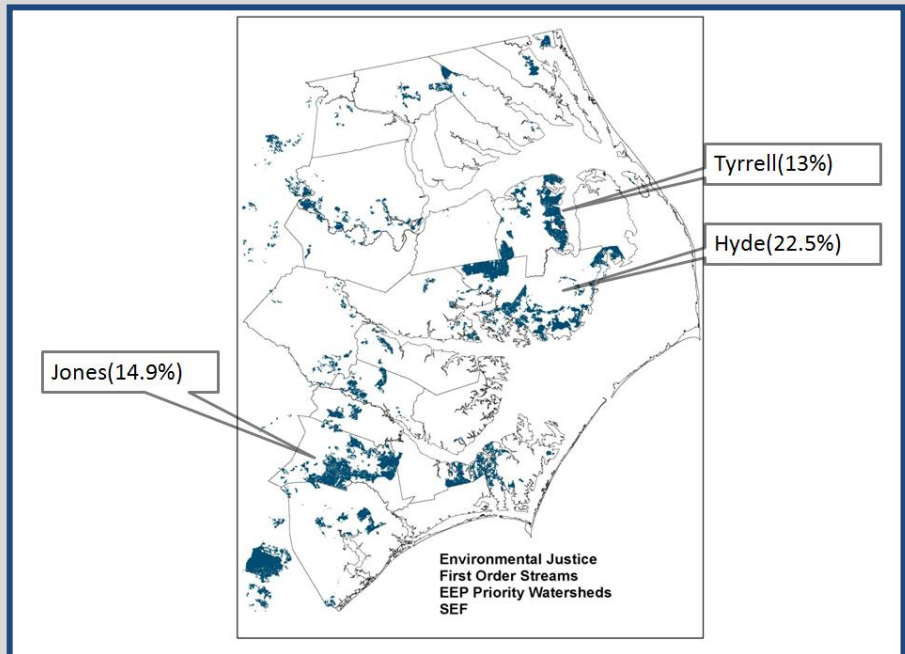
- *Environmental Justice (EJ)*: Used to delineate sensitive areas of the population (e.g., minority and low income) from non-EJ areas
 - Source: U.S. Environmental Protection Agency, Region 4
- *First Order Streams*: A comprehensive set of digital spatial data representing the surface water of the United States using common features such as lakes, ponds, streams, rivers, canals, and oceans
 - Source: National Hydrography Dataset (NHD)
- *Priority Watersheds*: Identifies watershed priorities within each of North Carolina's 17 river basins that demonstrate a balance of challenges and assets, and that represent the best opportunity for watershed improvement
 - Source: NC DENR Ecosystem Enhancement Program (EEP)
- *Southeast Ecological Framework (SEF)*: Locates important ecological hubs and creates passageways, or corridors, to connect them
 - Source: Southeastern Ecological Framework Project
- *Public Water Supply*: Global Positioning System-created points dataset of well locations used to assist governmental agencies and others in making resource management decisions through use of a GIS
 - Source: North Carolina's Source Water Assessment Program

The limiting dataset for this story was the public water supply, which were identified through a buffered point data set of identified well locations. This is a case where the spatial intersection (logical AND) may have proved too reductive in nature and may have benefited from a multiplication operator within the map algebra approach used. For this reason the public water supply was left out of the input to create the story map and instead was used later in the exploratory analysis as a map overlay. The BBN is quite helpful in illustrating counties on which to focus (ABF 5). Hyde County contained 22.5% of the geopixels that meet the conditions of this story due to its high population. However, Jones County and Tyrrell County, other populous counties in the region, are also of considerable interest at 14.9% and 13%, respectively.



Appendix B Figure 5: Water Story BBN

The map developed using the data sets selected for the belief map story is shown in Appendix B Figure 6. This map was then used later in developing the proposed priority areas by the SENRLG Team which included a review of public water supply as an additional overlay in the decision making process.



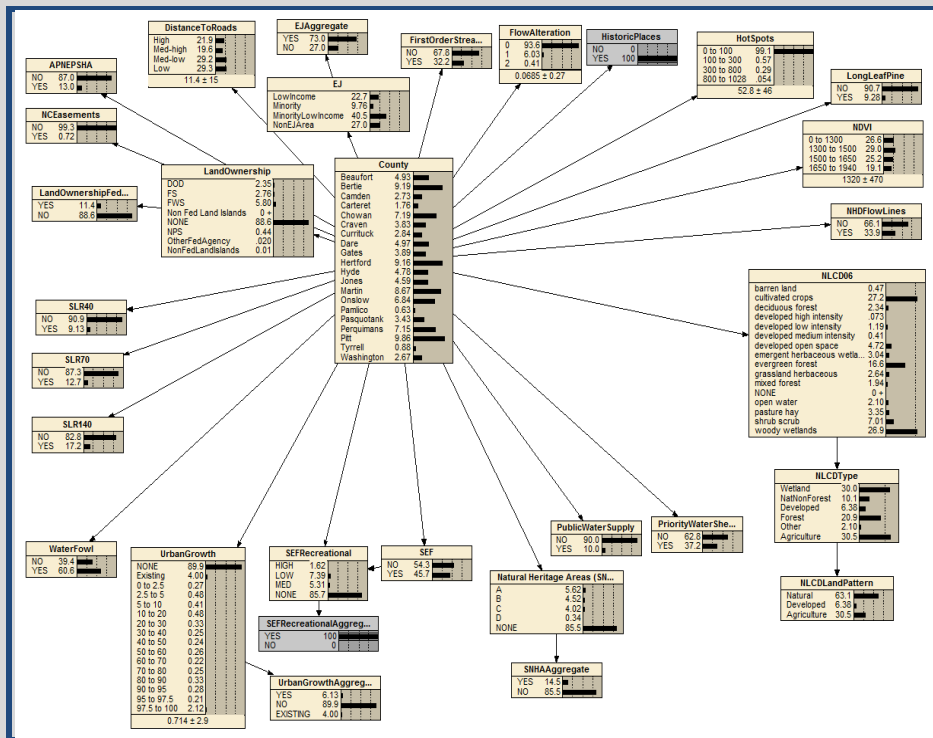
Appendix B Figure 6: Water Story Map

Recreation/Tourism Story

This story had a focus on those areas where there were existing locations for tourism with high recreation potential. It is particularly linked to the cultural and societal essential attributes. The story also addresses the concept of protecting and considering future areas of tourism and recreation. This story included the following datasets:

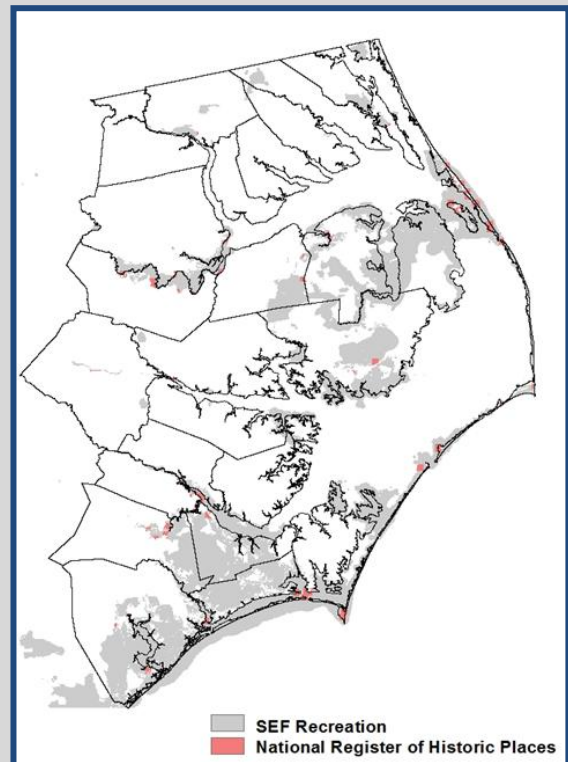
- *Registered Historic Places*: Single points of registered historic places
 - Source: National Parks Service (NPS)
- *Southeast Ecological Framework (SEF) Recreational*: Locates important ecological hubs and creates passageways, or corridors, to connect them as they relate to recreational potential, e.g., boating waterways
 - Source: Southeastern Ecological Framework Project

Similar to the public water supply in the drinking water story the registered historic place proved too limiting as a spatial intersection using the AND operator in the map algebra equation for this story map. Therefore registered historic places were used in the exploratory analysis only. The resulting BBN with the spatial intersection of both datasets for this story is less telling as to which county to focus on, since historic places and recreational opportunities appeared to exist relatively uniformly throughout the region. In essence the historical sites all overlapped with the recreational opportunities, but the restrictive nature of the AND operator left little of the map to begin to focus discussion on in relation to agency priorities. Thus, the reductive nature of the point dataset for registered historic sites limited the output areas to where the historical sites were buffered with 5x5 pixels. The 5x5 pixel buffer around historic sites was done with the assumption that historic sites, such as structures and places of significance, encompass more than a single point in geographic space. The size of the buffer was decided on by a group of stakeholders in the decision process. However, as you can see from the BBN in Appendix B Figure 7 no clear county on which to focus on is revealed as was the case in the water story BBN.



Appendix B Figure 7: Recreation/Tourism BBN

However, the story map itself is potentially more illustrative, and shows that a large amount of the geopixels meeting the conditions of this story are along major waterways and on the barrier islands (ABF 8). Further with the SEF Recreational layer overlaid onto the resulting story map, the group found it useful in helping to locate recreational areas along the potential retreat corridors for connectivity across the landscape perspective.



Appendix B Figure 8: Recreation/Tourism

Appendix B: Geospatial Story Maps and Data Sources (Continued)

Atlantic Coast Joint Venture. (2012). SAMBI Waterfowl. Available from <http://www.acjv.org/>

National Hydrography Dataset. (2012). First Order Streams. Available from <http://nhd.usgs.gov/data.html>

National Parks Service. (2012). National Register of Historic Places retrieved from www.nps.gov/nr/

North Carolina Department of Environment and Natural Resources Natural Heritage Program. (2012). Significant Natural Heritage Areas. Available from www.ncnhp.org

North Carolina Department of Environment and Natural Resources. (2012). Priority Watersheds. Available from <http://portal.ncdenr.org/web/eep/priorities-map>

North Carolina's Source Water Assessment Program. (2012). Public Water Supply. Available from <http://swap.deh.enr.state.nc.us/swap/>

Oak Ridge National Laboratory. (2008). Distance to Roads. Available from <http://www.ornl.gov/sci/gist/>

National Aeronautics and Space Administration & Oak Ridge National Laboratory Distributed Active Archive Center. (2010). MODIS Normalized Difference Vegetation Index (NDVI). Available from <http://daac.ornl.gov/MODIS/MODIS-menu/products.html>

RENCI at East Carolina University (ECU). (2012). Sea Level Rise. Available at <http://www.ecu.edu/renci/>

US Geological Survey (USGS) Gap Analysis Program (GAP). (2011). Protected Areas Database of the United States. Available from <http://gapanalysis.usgs.gov/padus/download/>

U.S. Environmental Protection Agency, Region 4 (2002). Southeast Ecological Framework. Available from <http://geoplan.ufl.edu/epa/data.html>

U.S. Environmental Protection Agency, Region 4 (2002). Environmental Justice. Available from <http://epa.gov/region4/ej/resources.html>

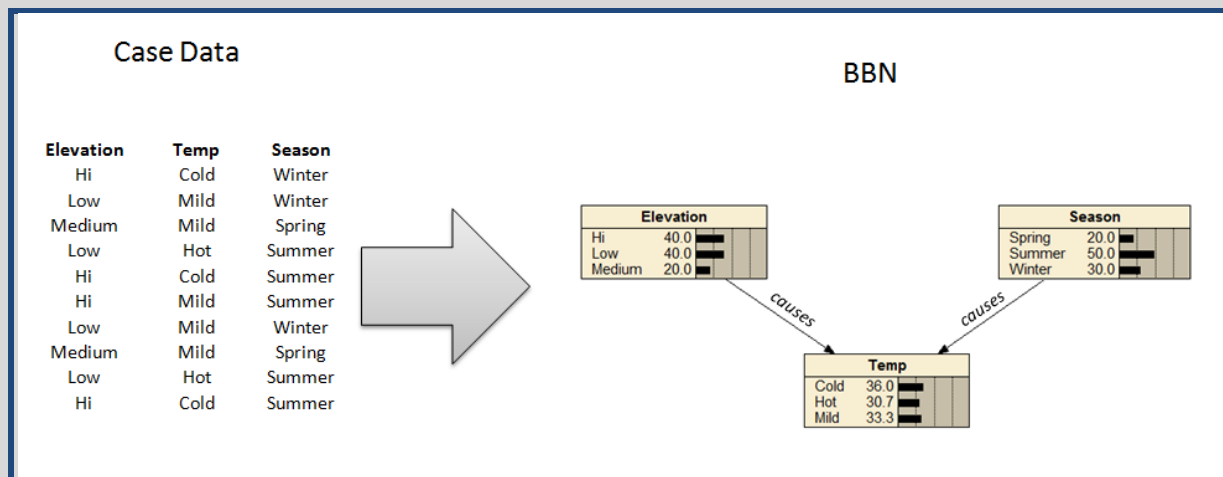
Appendix C: Bayesian Belief Networks and Map Algebra Explained

Bayesian Belief Networks (or BBNs) have been increasingly adopted across a range of applications from medical diagnosis (Lauritzen & Spiegelhalter 1988) to predicting land cover (Aitkenhead & Aalders 2008) and determining habitat populations (Lee & Rieman 1994). The methodological foundations of BBNs were pioneered in the 18th century by Thomas Bayes. Bayes' Theorem (Equation 1) rest on the causal connection of events and probability (translated as belief). Bayes' Theorem can be read that the probability of A (hypothesis) given B (evidence) is equal to the probability of B given A multiplied by the probability of A divided by the probability of B.

$$P(A | B) = P(B | A) \times P(A) / P(B)$$

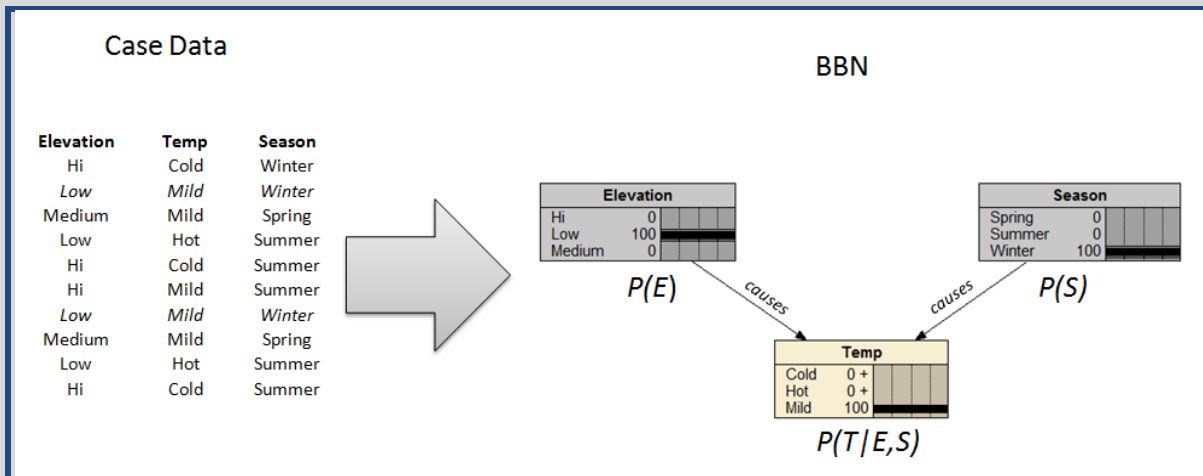
Equation 1 : Bayes' Theorem

What follows is the ability to infer beliefs throughout a network. To briefly illustrate BBNs and their usage, consider the following example starting with the belief that temperature is influenced by elevation and annual season (Fig. 1). The initial state(s) of the BBN nodes in Appendix C Figure (ACF) 1 is shown by the belief bar values based on the existing probabilities, a prior, case data (N=10). An important part of understanding the way that BBNs work is in knowing that the belief bar values for a specific node always sum to 100%.



Appendix C Figure 1: Case Data and BBN Example at Initial State

This nodal relationship defined between the variables in this BBN example can be translated as temperature is dependent on elevation and season as indicated by notation of causal (or influence) linkage arrows. Once compiled, the BBN software (Netica by Norsys Software Corporation 2012) creates conditional probability tables utilizing an algorithm formulated in Lauritzen & Spiegelhalter (1988). When we enter the findings (or evidence), elevation/low and season/winter, we get the resultant beliefs, a posterior, shown in Appendix C Figure 2.



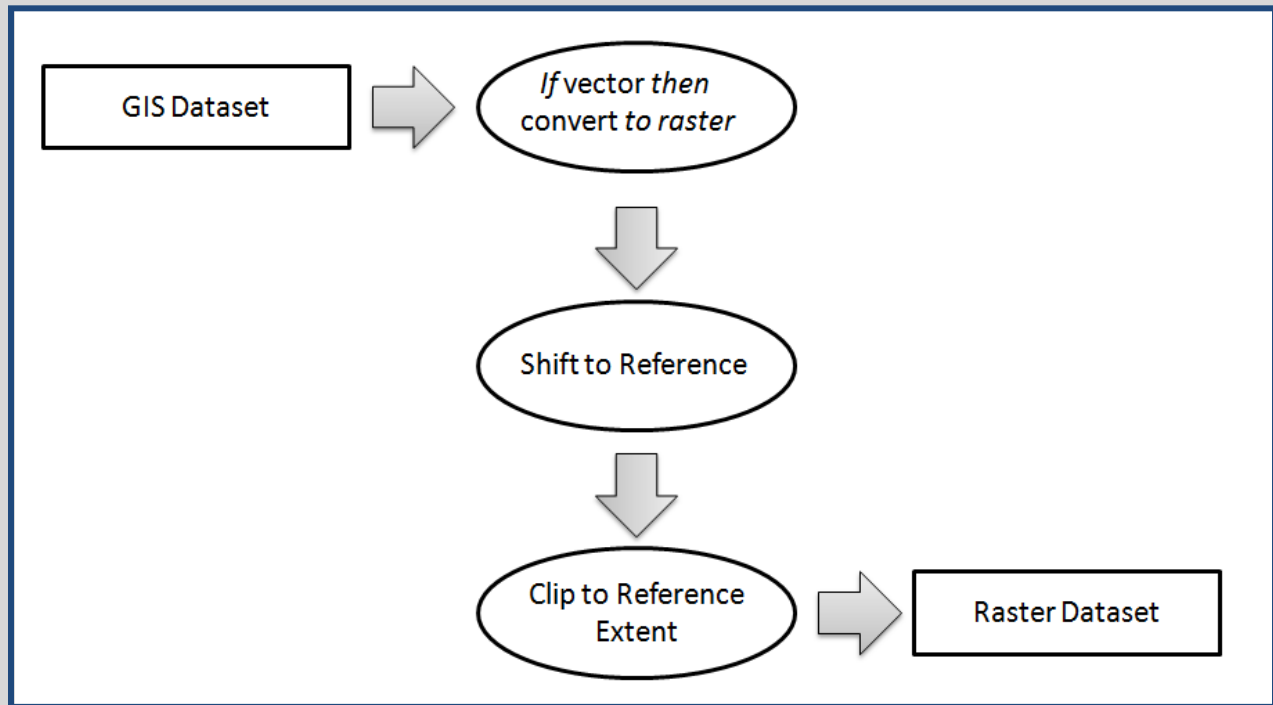
Appendix C Figure 2: Case Data and BBN Example with Evidence

It is this ability to interact dynamically with the BBN that facilitates the exploratory aspects of this type of analysis. In this sense, the BBNs correspond well to MacEachren's (1995) presentation of geovisualization, where the user is not presented with a single passive static view, but rather an active process where map data, imbued within the BBN, goes beyond simple information communication to that of an enabler of knowledge construction.

Integrated GIS and BBN Data for Exploratory Analysis

The raster cell-by-cell comparison technique commonly referred to as map algebra has become a standard method for Geographic Information Systems (GIS) spatial analysis and modelling (Bolstad 2012). Integrating spatial data with BBNs, at the resolution of pixels, allows for the opportunity to perform probabilistic map algebra. Belief maps (or probability maps) can then be created by transferring the results of probabilistic map algebra back into GIS. This approach is particularly suited to the exploration of environmental datasets (e.g., habitat, soil type, and watershed areas), which tend to be represented as continuous phenomena distributed across space (Yuan 2001).

Map algebra starts with the assumption of compatible cell sizes and boundaries. Taking one or more raster layers, the map algebra approach then allows you to apply any number of mathematical or logical functions across grids. The cartographic model as a visual way to show the process of a combination of operations performed on spatial datasets (Bolstad 2012) is useful to illustrate the steps required to prepare both vector and raster datasets for the probabilistic map algebra format (ACF 3). While performing these steps it is important to be aware of modifiable areal unit issues unavoidably introduced during aggregation, disaggregation, and re-sampling of data (Unwin 1996, Openshaw 1984).



Appendix C Figure 3: Cartographic Model of Data Preparation

Central to the probabilistic map algebra approach is the concept of the geopixel, which provides an explicit spatial context to the BBN. The geopixel is simply taxonomy for each raster cell of the prepared datasets. This taxonomy can be created by utilizing a scripting language (e.g., Python) with access to the spatial and attribute data (e.g., GDAL). Corman et al. (1990) provide a definition of algorithm as a sequence of computational steps that transform an input set of values to an output set of values. Berg et al. (2008) provide formatting guidelines for algorithms. The following two algorithms illustrate techniques for generating the geopixel taxonomy and BBN data content.

Algorithm GENERATE-GEOPIXELS(P)

Input. A set P of pixels in the reference raster.

Output. A list \mathcal{L} pixel values in row-column order.

1. $rows \leftarrow$ number of rows in P .
2. **for** r **in** $range[rows]$
3. $cols \leftarrow$ number of columns in P
4. **for** c **in** $range[cols]$
5. **do** Append $r_i c_j$ to \mathcal{L} .

Appendix C Figure 4: Algorithm for Generating GeoPixels

The output from the algorithm in Appendix C Figure 4 is a list of geopixels, \mathcal{L} , named by row and column number. This list of geopixels becomes the spatial hypothesis node in the BBN. Each state of a hypothesis node represents a different hypothesis specific to

the relationships defined in the BBN (Krieg 2001). The spatial hypothesis node maintains the ability to make the spatial linkage, via geopixel, back to the GIS.

Algorithm GENERATE-BBN-NODE(P)
Input. A set P of pixels in the reference raster.
Output. A list \mathcal{L} classified data values in row-column order.

1. $rows \leftarrow$ number of rows in P
2. **for** r **in** $range[rows]$
3. $cols \leftarrow$ number of columns in P
4. **for** c **in** $range[cols]$
5. $val \leftarrow$ classified data value at $r_i c_j$
6. **do** Append val to \mathcal{L} .

Appendix C Figure 5: Algorithm for Generating BBN Node Content

The output from the algorithm in Appendix C Figure 5 is a list of classified data values, \mathcal{L} , which will become the values used to build the BBN node states. Appendix C Figure 6 shows the algorithm utilized to export the data out of the BBN and back into a format digestible by a GIS. While the iterative process is very similar to the previous two algorithms, a notable difference is the list of pixels (geopixels), \mathcal{L} , and output of a raster dataset, P .

Algorithm GENERATE-BELIEF-MAP(\mathcal{L})
Input. A list \mathcal{L} of selected pixel values from the BBN.
Output. A set P of pixels as a new raster dataset.

1. $rows \leftarrow$ number of rows in P
2. **for** r **in** $range[rows]$
3. $cols \leftarrow$ number of columns in P
4. **for** c **in** $range[cols]$
5. **if** $r_i c_j$ within \mathcal{L}
6. **then** add $r_i c_j$ to P

Appendix C Figure 6: Algorithm for Moving Data from BBN to GIS

From the output of a raster dataset, P , we can create what we will call belief maps. These maps are a result of the probabilistic map algebra approach and BBN exploration. The term “belief map” is used because the results are based on interactive state changes (entering evidence) within the BBN, which adjust the probability distribution along the geopixels node. This resulting distribution can then be used to generate belief maps that illustrate where the probabilistic conditions are met. The list of pixels (geopixels), \mathcal{L} , is defined by the probability threshold specific to the interest in the study. For instance, if we are only interested in the highest probabilities across the range of belief bar values for geopixel, we will only include those in \mathcal{L} .

The probabilistic map algebra approach used in this project corresponds with GIS overlay operations. By considering only the highest tier of probability, the operation is similar to a spatial intersection (logical AND), which combines data from layers only where there is a coincidental overlap. Alternative approaches could be utilized, such as a spatial union (one or the other) or an exclusive OR (one or the other but not both). These operations can easily be performed within a typical desktop GIS without the use of a BBN. By incorporating a BBN, explicit coding probability is visually presented in a way that connects causally related datasets and allows for dynamic interactive query.

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Appendix D: Regional and Local Stakeholders in Albemarle-Pamlico

Below is an initial list of potential stakeholders for each of the priority focus areas. While the following list is comprehensive, it is not final and may be modified depending on the decided focus area, project, and local input. In addition, many of the existing federal partnership program organizations are not identified.

- Onslow Bight Connectivity (Onslow and Jones Counties)
 - Albemarle Pamlico National Estuary Program
 - American Rivers
 - Atlantic Coast Joint Venture
 - Audubon Society
 - Center for Disease Control
 - County Governments
 - Environmental Law Institute
 - Federal Emergency Management Agency
 - Longleaf Alliance
 - Metropolitan Planning Organizations
 - National Forest Foundation
 - North Carolina State Agencies and Programs
 - NC Center for Geographic Information and Analysis
 - NC Coastal Federation
 - NC Coastal Land Trust
 - NC Division of Soil and Water
 - NC Forest Service
 - NC Natural Heritage Program
 - NC Paddle Trails Association
 - NC State Historic Preservation Office
 - NC State University: College of Forestry and Environmental Resources
 - NC Wildlife Resources Commission
 - Onslow Bight Conservation Forum
 - River Network
 - South Atlantic Landscape Conservation Cooperative
 - Southeast Aquatic Resources Partnership
 - The Conservation Fund
 - The Nature Conservancy
 - Trust for Public Land
 - Water Resources Research Institute
 - Weyerhaeuser

Appendix D (continued)

- Roanoke Retreat Corridor through Hyde, Tyrrell, Beaufort, and Martin Counties)
 - Albemarle Pamlico National Estuary Program
 - Albemarle Resource Conservation and Development
 - American Rivers
 - Audubon
 - Center for Disease Control
 - Conservation Fund
 - County Governments
 - Ducks Unlimited
 - Environmental Defense Fund
 - Environmental Law Institute
 - Federal Emergency Management Agency
 - Longleaf Alliance
 - Metropolitan and Rural Planning Organizations
 - Mid-East Regional Conservation and Development
 - National Forest Foundation
 - North Carolina State Agencies and Programs
 - NC Center for Geographic Information and Analysis
 - NC Coastal Land Trust
 - NC Coastal Federation
 - NC Coastal Land Trust
 - NC Department of Cultural Resources
 - NC Department of Transportation
 - NC Division of Coastal Management
 - NC Division of Marine Fisheries
 - NC Division of Soil and Water
 - NC Division of State Parks and Recreation
 - NC Division of Water Resources
 - NC Division of Water Quality
 - NC Forest Service
 - NC Natural Heritage Program
 - NC Paddle Trails Association
 - NC State Historic Preservation Office
 - NC State University: College of Forestry & Environmental Resources
 - NC Wildlife Resources Commission
 - Partnership for the Sounds
 - River Network
 - Roanoke Mayors Association
 - Roanoke River Partners
 - South Atlantic Landscape Conservation Cooperative
 - Southeast Aquatic Resources Partnership
 - The Nature Conservancy
 - Trust for Public Land
 - Water Resources Research Institute

Appendix D (continued)

- The Outer Banks and Sound Front Line (Dare County)
 - Albemarle Pamlico National Estuary Program
 - Albemarle Resource Conservation and Development
 - American Rivers
 - Audubon
 - Cape Hatteras National Seashore
 - Center for Disease Control
 - County Governments
 - Environmental Law Institute
 - Federal Emergency Management Agency
 - Metropolitan Planning Organizations
 - North Carolina State Agencies and Programs
 - NC Center for Geographic Information and Analysis
 - NC Coastal Federation
 - NC Coastal Land Trust
 - NC Department of Cultural Resources
 - NC Department of Transportation
 - NC Division of Coastal Management
 - NC Division of Marine Fisheries
 - NC Division of Soil and Water
 - NC Division of State Parks and Recreation
 - NC Division of Water Quality
 - NC Forest Service
 - NC Natural Heritage Program
 - NC Paddle Trails Association
 - NC State Historic Preservation Office
 - NC Wildlife Resources Commission
 - NC Forestry Association
 - Partnership for the Sounds
 - River Network
 - South Atlantic Landscape Conservation Cooperative
 - Southeast Aquatic Resources Partnership
 - The Conservation Fund
 - The Nature Conservancy
 - Trust for Public Land
 - Water Resources Research Institute

Appendix E: Funding Resource Matrix

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
ACE	Aquatic Plant Control	X	X	X	X				
ACE	Beach Erosion Control Projects	X		X	X				
ACE	Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works			X	X			X	
ACE	Emergency Operations Flood Response and Post Flood Response			X	X			X	
ACE	Flood Plain Management Services	X		X	X			X	
ACE	Protection of Essential Highways, Highway Bridge Approaches, and Public Works			X	X			X	X
ACE	Flood Control Projects			X	X			X	
ACE	Navigation Projects				X			X	
ACE	Snagging and Clearing for Flood Control			X	X			X	
ACE	Protection, Clearing and Straightening Channels				X			X	
ACE	Planning Assistance to States	X	X		X	X	X	X	X
ACE	Emergency Advance Measures for Flood Prevention			X	X				

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
ACE	State Memorandum of Agreement Program for the reimbursement of Technical Services	X	X		X	X	X	X	
ACE	Collaborative Research and Development				X			X	
ACE	Department of Defense Appropriation Act of 2003							X	X
ACE	Environmental Protection and Restoration: Specifically Authorized Project	X	X	X	X	X	X	X	
ACE	Environmental Protection and Restoration: Project Modification for Improvement of the Environment	X	X	X	X	X	X	X	
ACE	Environmental Protection and Restoration: Beneficial Use of Dredge Material			X	X		X	X	
ACE	Environmental Protection and Restoration: Aquatic Ecosystem Restoration	X	X		X	X	X		
ACE	Environmental Protection and Restoration: Estuary Habitat Restoration	X	X		X	X	X		
BOEM	Minerals Management Service Environmental Studies Program	X	X		X	X	X	X	
BOEM	Marine Minerals Activities	X				X		X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
BOEM	Federal Oil and Gas Royalty Management					X		X	
BOEM	Marine Gas Hydrate Research Activities							X	
DOD	Procurement Technical Assistance for Business Firms							X	
DOD	Basic Applied Scientific Research							X	
DOD	Science, Technology, Engineering & Mathematics for K-12 & Institutions of Higher Learning							X	
DOD	Military Construction, National Guard							X	X
DOD	National Guard Military Operations and Maintenance Projects	X		X		X		X	
DOD	National Guard Challenge Program	X						X	
DOD	Basic Scientific Research		X		X			X	
DOD	Competitive Grants: Promoting K-12 Student Achievement at Military-Connected Schools							X	
DOD	Invitational Grants for Military-Connected Schools							X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
DOD	Community Economic Adjustment							X	
DOD	Community Economic Adjustment Assistance for Establishment, Expansion, Realignment, or Closure of a Military Installation	X	X		X			X	
DOD	Community Economic Adjustment Planning Assistance for Joint Land Use Studies	X	X		X			X	
DOD	Community Economic Adjustment Planning Assistance for Reductions in Defense Industry Employment	X	X		X			X	
DOD	Community Economic Adjustment Diversification Planning							X	
DOD	Research and Technical Assistance	X	X		X			X	
DOD	Basic, Applied, and Advanced Research in Science and Engineering							X	
DOD	Donations/Loans of Obsolete DOD Property							X	X
DOD	Research and Technology Development							X	
DOT	Airport Improvement Program	X			X			X	
DOT	Aviation Research Grants	X			X			X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
DOT	Highway Research and Development Program	X			X	X		X	
DOT	Highway Planning and Construction	X			X	X		X	
DOT	Highway Training and Education							X	
DOT	National Motor Carrier Safety		X					X	
DOT	Recreational Trails Program	X			X			X	
DOT	Transportation Infrastructure Finance and Innovation Act Program	X		X	X			X	
DOT	Motor Carrier Research and Technology Programs		X					X	
DOT	Railroad Safety			X				X	
DOT	Railroad Development	X	X		X			X	
DOT	Capital Assistance to States - Intercity Passenger Rail Service	X						X	
DOT	Railroad Rehabilitation and Improvement Financing Program	X						X	
DOT	Maglev Project Selection Program	X						X	
DOT	High-Speed Rail Corridors and Intercity Passenger Rail Service - Capital Assistance Grants	X						X	
DOT	Rail Line Relocation and Improvement	X		X				X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
DOT	Federal Transit Capital Investment Grants	X						X	
DOT	Metropolitan Transportation Planning	X						X	
DOT	Federal Transit Formula Grants							X	
DOT	Formula Grants for other than Urbanized Areas							X	
DOT	Capital Assistance Program for Elderly Persons and Persons with Disabilities							X	
DOT	Public Transportation Research	X		X	X			X	
DOT	State Planning and Research							X	
DOT	Clean Fuels					X		X	
DOT	Paul S. Sarbanes Transit in the Parks	X	X	X	X	X	X	X	X
DOT	New Freedom Program							X	
DOT	Alternatives Analysis	X						X	
DOT	Capital Assistance Program for Reducing Energy Consumption and Greenhouse Gas Emissions					X		X	
DOT	State and Community Highway Safety		X					X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
DOT	Alcohol Impaired Driving Countermeasures Incentive Grants I		X					X	
DOT	State Traffic Safety Information System Improvement Grants		X					X	
DOT	National Highway Traffic Safety Administration Discretionary Safety Grants		X					X	
DOT	Pipeline Safety Program Base Grants					X		X	
DOT	University Transportation Centers Program							X	
DOT	Technical Assistance Grants					X		X	
DOT	PHMSA Pipeline Safety Research and Development "Other Transaction Agreements"	X			X	X	X		
DOT	Federal Ship Financing Guarantees							X	
DOT	America's Marine Highway Grants					X		X	
DOT	Surface Transportation - Discretionary Grants for Capital Investment							X	
DOT	National Infrastructure Investments							X	
EPA	Air Pollution Control Program Support					X		X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	State Indoor Radon Grants					X		X	
EPA	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act			X		X		X	
EPA	Community Action for a Renewed Environment Program	X			X	X		X	
EPA	Internships, Training and Workshops for the Office of Air and Radiation					X		X	
EPA	National Clean Diesel Emissions Reduction Program					X		X	
EPA	State Clean Diesel Grant Program					X		X	
EPA	Climate Showcase Communities Grant Program	X			X	X		X	
EPA	Temporally Integrated Monitoring of Ecosystems and Long-Term Monitoring Program				X	X	X	X	
EPA	Environmental Finance Center Grants	X			X	X	X	X	
EPA	Compliance Assistance Support of Services to the Regulated Community and Other Assistance Providers	X			X	X	X		
EPA	Surveys, Studies, Investigations and Special Purpose Activities Relating to Environmental Justice	X			X	X	X	X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Capacity Building Grants and Cooperative Agreements for Compliance Assurance and Enforcement Activities in Indian Country and other Tribal Areas	X			X	X	X	X	
EPA	State Environmental Justice Cooperative Agreement Program	X			X	X	X	X	
EPA	Construction Grants for Wastewater Treatment Works				X	X		X	
EPA	Water Pollution Control State, Interstate, and Tribal Program Support				X	X		X	
EPA	Surveys, Studies, Investigations, Demonstrations, and Training Grants	X			X	X		X	
EPA	State Public Water System Supervision					X		X	
EPA	State Underground Water Source Protection				X	X		X	
EPA	Surveys, Studies, Investigations, Demonstrations, and Training Grants and Cooperative Agreements	X			X	X	X		
EPA	Targeted Watershed Grants	X			X	X	X	X	
EPA	Water Quality Management Planning	X			X	X	X		
EPA	National Estuary Program	X	X		X	X	X	X	X

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Capitalization Grants for Clean Water State Revolving Funds				X	X		X	
EPA	Nonpoint Source Implementation Grants	X			X	X	X	X	
EPA	Regional Wetland Program Development Grants	X			X		X	X	
EPA	National Wetland Program Development Grants and Five-Star Restoration Training Grant	X			X	X	X		
EPA	Water Quality Cooperative Agreements				X	X		X	
EPA	Wastewater Operator Training Grant Program					X		X	
EPA	State Grants to Reimburse Operators of Small Water Systems for Training and Certification Costs					X		X	
EPA	Beach Monitoring and Notification Program Implementation Grants				X	X	X		
EPA	Water Protection Grants to the States					X		X	
EPA	Water Security Training and Technical Assistance and Water Security Initiative Contamination Warning System Pilots					X		X	
EPA	Wetland Program Grants - State/Tribal Environmental Outcome Wetland Demonstration Program	X			X			X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Assessment and Watershed Protection Program Grants	X			X	X		X	
EPA	Science to Achieve Results Research Program	X			X	X	X	X	
EPA	Surveys, Studies, Investigations and Special Purpose Grants within the Office of Research and Development	X		X	X	X	X	X	
EPA	Office of Research and Development Consolidated Research/Training/Fellowships	X		X	X	X	X	X	
EPA	Regional Environmental Monitoring and Assessment Program Research Projects	X			X	X	X	X	
EPA	Greater Research Opportunities: Fellowships for Undergraduate Environmental Study	X			X	X	X	X	
EPA	Science to Achieve Results Fellowship Program	X			X	X	X	X	
EPA	P3 Award: National Student Design Competition for Sustainability	X			X	X	X	X	
EPA	Regional Applied Research Efforts	X			X	X	X	X	
EPA	State Senior Environmental Employment Program					X		X	
EPA	Environmental Justice Small Grant Program	X			X	X	X	X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Performance Partnership Grants	X			X	X	X	X	X
EPA	Environmental Information Exchange Network Grant Program and Related Assistance	X			X	X	X	X	
EPA	Protection of Children and Older Adults from Environmental Health Risks	X			X	X	X	X	
EPA	Surveys, Studies, Investigations and Special Purpose Grants within the Office of the Administrator					X		X	
EPA	Environmental Policy and Innovation Grants	X			X	X		X	
EPA	Consolidated Pesticide Enforcement Cooperative Agreements					X		X	
EPA	Toxic Substances Compliance Monitoring Cooperative Agreements					X		X	
EPA	TSCA Title IV State Lead Grants Certification of Lead-Based Paint Professionals					X		X	
EPA	Pollution Prevention Grants Program					X		X	
EPA	Multi-Media Capacity Building Grants for States and Tribes					X		X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Pesticide Environmental Stewardship Regional Grants	X				X			
EPA	Research, Development, Monitoring, Public Education, Training, Demonstrations, and Studies					X		X	
EPA	Source Reduction Assistance				X	X	X		
EPA	National Community-Based Lead Outreach and Training Grant Program					X		X	
EPA	Hazardous Waste Management State Program Support					X		X	
EPA	Superfund State, Political Subdivision, and Indian Tribe Site-Specific Cooperative Agreements					X		X	
EPA	Underground Storage Tank Prevention, Detection and Compliance Program				X	X			
EPA	Leaking Underground Storage Tank Trust Fund Corrective Action Program				X	X			
EPA	Superfund Technical Assistance Grants for Community Groups at National Priority List Sites					X		X	
EPA	Solid Waste Management Assistance Grants					X		X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Superfund State and Indian Tribe Core Program Cooperative Agreements					X		X	
EPA	Chemical Emergency Preparedness and Prevention Technical Assistance Grants Program					X		X	
EPA	Alternative or Innovative Treatment Technology Research, Demonstration, Training, and Hazardous Substance Research Grants					X		X	
EPA	Brownfields Training, Research, and Technical Assistance Grants and Cooperative Agreements					X		X	
EPA	Brownfield Job Training Cooperative Agreements					X		X	
EPA	Headquarters and Regional Underground Storage Tanks Program					X		X	
EPA	State and Tribal Response Program Grants					X			
EPA	Brownfields Assessment and Cleanup Cooperative Agreements					X			
EPA	Environmental Policy and State Sustainability Grants	X			X	X	X	X	
EPA	National Environmental Education Training Program							X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
EPA	Environmental Education Grants							X	
EPA	National Network for Environmental Management Studies Fellowship Program							X	
FWS	Sport Fish Restoration Program	X	X		X	X		X	X
FWS	Fish and Wildlife Management Assistance	X	X		X	X	X	X	X
FWS	Wildlife Restoration and Basic Hunter Education	X	X		X			X	X
FWS	Coastal Wetlands Planning, Protection and Restoration Act	X	X	X	X	X	X		
FWS	Cooperative Endangered Species Conservation Fund	X	X						
FWS	Clean Vessel Act				X	X		X	
FWS	Sportfishing and Boating Safety Act							X	X
FWS	North American Wetlands Conservation Fund	X			X			X	
FWS	Enhanced Hunter Education and Safety Program							X	X
FWS	Wildlife Conservation and Restoration	X	X					X	
FWS	Multistate Conservation Grant Program	X	X					X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
FWS	Coastal Program	X	X						
FWS	Partners for Fish and Wildlife	X	X	X	X			X	X
FWS	Landowner Incentive Program	X	X					X	X
FWS	State Wildlife Grants	X	X						
FWS	Neotropical Migratory Bird Conservation	X	X					X	
FWS	Migratory Bird Joint Ventures	X	X		X			X	
FWS	Challenge Cost Share		X					X	
FWS	Federal Junior Duck Stamp Conservation and Design	X	X		X	X	X	X	
FWS	Marine Turtle Conservation Fund	X	X		X				
FWS	Service Training and Technical Assistance	X	X					X	
FWS	Research Grants	X	X	X	X	X	X	X	
FWS	Undesirable/Noxious Plant Species		X					X	
FWS	National Outreach and Communication Program		X		X			X	
FWS	Visitor Facility Enhancements - Refuges and Wildlife						X		
FWS	Migratory Bird Monitoring, Assessment and Conservation	X	X				X		

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
FWS	Recovery Act Funds - Habitat Enhancement, Restoration and Improvement	X	X					X	
FWS	Endangered Species Conservation - Recovery Implementation	X	X		X	X	X	X	
FWS	Natural Resource Damage Assessment, Restoration and Implementation			X	X				
FWS	National Wildlife Refuge Fund	X	X	X	X	X	X	X	X
FWS	Endangered Species - Candidate Conservation Action Funds	X	X	X	X	X	X	X	X
FWS	National Fish and Wildlife Foundation		X					X	
FWS	National Wetlands Inventory			X	X			X	
FWS	Endangered Species Conservation - Wolf Livestock Loss Compensation and Prevention		X					X	
FWS	Cooperative Landscape Conservation	X	X	X	X	X	X	X	X
FWS	Adaptive Science	X	X						
FWS	Wildlife Without Borders - Amphibians in Decline	X	X		X	X		X	X
FWS	Wildlife Without Borders - Critically Endangered Animal Conservation Fund	X	X			X		X	X

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
FWS	National Fire Plan - Wildland Urban Interface Community Fire Assistance			X				X	
FWS	National Fire Plan - Rural Fire Assistance			X				X	
NOAA	NOAA Mission-Related Education Awards				X			X	
NOAA	Ocean Exploration				X			X	
NOAA	Integrated Ocean Observing System				X			X	
NOAA	Inter-jurisdictional Fisheries Act of 1986		X	X				X	
NOAA	Sea Grant Support				X			X	
NOAA	Coastal Zone Management Administration Awards	X			X	X			X
NOAA	Coastal Zone Management Estuarine Research Reserves	X			X			X	
NOAA	Financial Assistance for National Centers for Coastal Ocean Science	X	X		X	X	X	X	X
NOAA	Fisheries Development and Utilization Research and Development Grants and Cooperative Agreements Program		X					X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
NOAA	Marine Sanctuary Program		X		X			X	X
NOAA	Climate and Atmospheric Research					X		X	
NOAA	National Oceanic and Atmospheric Administration Cooperative Institutes							X	
NOAA	Marine Fisheries Initiative		X					X	
NOAA	Cooperative Fishery Statistics		X					X	
NOAA	Southeast Area Monitoring and Assessment Program		X					X	
NOAA	Marine Mammal Data Program		X					X	
NOAA	Environmental Sciences, Applications, Data, and Education							X	
NOAA	Regional Fishery Management Councils		X						
NOAA	Short Term Climate Fluctuations					X			
NOAA	Independent Education and Science Projects and Programs							X	
NOAA	Automated Flood Warning Systems			X				X	
NOAA	Unallied Industry Projects		X				X		
NOAA	Unallied Management Projects		X				X		
NOAA	Cooperative Science and Education Program	X	X						

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
NOAA	Weather and Air Quality Research					X			
NOAA	Special Oceanic and Atmospheric Projects				X	X			
NOAA	Hydrologic Research				X				
NOAA	Habitat Conservation	X	X	X	X	X	X		
NOAA	Meteorologic and Hydrologic Modernization Development				X	X			
NOAA	Congressionally Identified Awards and Projects				X	X		X	
NOAA	Unallied Science Program		X		X	X	X		
NOAA	Coastal Services Center	X	X	X	X	X	X	X	
NOAA	Atlantic Coastal Fisheries Cooperative Management Act		X						
NOAA	Fisheries Disaster Relief			X					
NOAA	Center for Sponsored Coastal Ocean Research - Coastal Ocean Program	X		X		X		X	
NOAA	Educational Partnership Program							X	
NOAA	Coral Reef Conservation Program	X			X	X			

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
NPS	National Historic Landmark								X
NPS	National Register of Historic Places							X	X
NPS	Technical Preservation Services								X
NPS	Land and Water Conservation Fund							X	X
NPS	Disposal of Federal Surplus Real Property for Parks, Recreation, and Historic Monuments							X	X
NPS	Rivers, Trails and Conservation Assistance	X			X			X	
NPS	Native American Graves Protection and Repatriation Act							X	X
NPS	National Center for Preservation Technology and Training							X	X
NPS	American Battlefield Protection							X	X
NPS	Hydropower Recreation Assistance				X			X	
NPS	Civil War Battlefield Land Acquisition Grants	X						X	X
NPS	Save America's Treasures								X
NPS	Preservation of Historic Structures on the Campuses of Historically Black Colleges and Universities								X

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
NPS	Abandoned Mine Hazard Mitigation		X					X	X
NPS	National Trails System Projects	X						X	X
	Cooperative Ecosystem Studies Unit (CESU)	X	X	X	X	X	X		
NPS	Challenge Cost Share	X	X	X	X	X	X	X	X
NPS	Natural Resource Protection & Preservation	X	X	X	X	X	X	X	X
NPS	Preserve America								X
NPS	Cultural Resource Management							X	X
NPS	National Fire Plan-Wildland Urban Interface Community Fire Assistance			X				X	X
NPS	National Fire Plan - Rural Fire Assistance			X				X	X
NPS	Interpretation & Education								X
NPS	Historic Preservation Fund Grant-In-Aid								X
NRCS	Wetlands Reserve Program				X				
NRCS	Resource Conservation and Development	X			X		X		
NRCS	Soil and Water Conservation	X							
NRCS	Soil Survey								

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
NRCS	Watershed Protection and Flood Prevention			X	X				
NRCS	Plant Materials for Conservation		X						
NRCS	Environmental Quality Incentives Program	X	X				X		
NRCS	Farm and Ranch Lands Protection Program	X							X
NRCS	Wildlife Habitat Incentive Program	X	X						
NRCS	Watershed Rehabilitation Program				X				
NRCS	Agricultural Management Assistance	X			X	X	X		
NRCS	Grassland Reserve Program	X	X		X				
NRCS	Conservation Security Program	X	X		X	X	X		
NRCS	Healthy Forests Reserve Program		X				X		
NRCS	Emergency Watershed Protection Program			X	X		X		
NRCS	Conservation Stewardship Program	X			X		X		
NRCS	Agricultural Water Enhancement Program	X			X		X		

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
USFS	Forestry Research	X	X	X	X			X	X
USFS	Cooperative Forestry Assistance		X	X				X	
USFS	Schools and Roads - Grants to States	X	X		X	X	X	X	
USFS	Schools and Roads - Grants to Counties	X	X		X	X	X	X	
USFS	Rural Development, Forestry, and Communities							X	
USFS	Forest Products Lab: Technology Marketing Unit	X						X	
USFS	Urban and Community Forestry Program	X						X	
USFS	Forest Legacy Program	X	X		X		X		
USFS	Forest Stewardship Program	X	X		X		X		
USFS	Collaborative Forest Restoration	X	X	X	X		X		
USFS	Forest Health Protection			X					
USFS	Wood Education and Resource Center					X		X	
USFS	National Forest Foundation	X						X	
USFS	National Fish and Wildlife Foundation		X					X	
USFS	Community Wood Energy Program						X	X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
USFS	Recovery Act of 2009: Capital Improvement and Maintenance	X			X				
USFS	Community Forest and Open Space Conservation Program	X			X		X	X	
USFS	Watershed Restoration and Enhancement Agreement Authority		X	X	X				
USGS	Cooperative Water Program	X	X	X	X	X	X		
USGS	Assistance to State Water Resources Research Institutes				X	X	X		
USGS	Earthquake Hazards Reduction Program			X				X	
USGS	National Spatial Data Infrastructure Cooperative Agreements Program	X	X	X	X	X	X	X	X
USGS	National Cooperative Geologic Mapping Program	X			X			X	
USGS	Gap Analysis Program	X	X						
USGS	Cooperative Research Units Program		X				X		
USGS	Cooperative Research Units Training Program		X					X	
USGS	National Land Remote Sensing Education Outreach and Research	X						X	

Agency	Program	Landscape Condition	Biotic Condition	Natural Disturbance	Hydrology Geomorphology	Physical Chemical	Ecological Processes	Social	Cultural
USGS	Minerals Resources External Research Program	X			X	X			
USGS	National Geospatial Program: Building the National map	X	X	X	X	X	X	X	X
USGS	Energy Cooperatives to Support the National Coal Resources Data System	X			X	X		X	
USGS	National Climate Change and Wildlife Science Center	X	X				X		

Appendix F: Model Forest Policy Program

Albemarle-Pamlico Local Community Engagement

This is a description of how the Model Forest Policy Program and its Climate Solutions University could partner to achieve the goals of SENRLG: resource and community resilience.

Climate Solutions University (CSU) helps communities design and implement climate adaptation plans that protect local forest and water resources and support viable economies. Through a peer learning network that links communities across the U.S., CSU provides training, expertise, and support to cutting edge natural resource planning communities. CSU strengthens local leadership and public engagement and promotes the following outcomes: protection of forests, streams, human and ecological health; preservation of natural resource based economies; and builds broad public support. CSU breaks a complicated, and often overwhelming, process into manageable components.

In training over 19 rural communities in climate adaptation strategies, we have discovered a number of “keys to success” to insure that resource based strategies take hold in a local community. Some of these include:

- 1. Locals Trust Locals** Engagement of local organizations and leaders is key to building additional community engagement, goodwill, and political support.
- 2. Economic resilience is a broad based motivational goal** More often than not, the economic implications of doing nothing must be discovered and demonstrated by the local community to achieve the maximum level of buy in for truly effective action.
- 3. Investment in unified message building and delivery will pay dividends** Understanding how local communities communicate and what messages will resonate with them is also essential in building support and momentum. Local community members must be involved in this process.

Structure

Within our normal programming, our participating communities are reliant on state and federal agency contacts to provide them with the data and information needed to build a reality based climate adaptation plan. SENRLG could provide the strength of its members and resources in this role while the CSU Program would provide the educational training forum for the local community that reinforces climate adaptation strategies and their implementation.

Appendix F: Model Forest Policy Program (continued)

Sequence

1. SENRLG identifies stakeholders from one or more communities.
2. MFPP engages those stakeholders and provides the 10 month Climate Solutions University program. This program will lead these local stakeholders through a full assessment of the local climate, economic, forest and water risks associated with climate change and help them develop a community driven plan.
3. SENRLG works with the local community to enhance the community driven plan with additional information and resources.
4. SENRLG and the community work together to implement the plan.

Staffing

To be successful in the Climate Solutions University program, communities are required to provide a dedicated 1/2- 3/4 time project leader position. This equates to a 20-30 hour per week minimum to conduct the local project activities.

This is in addition to a commitment from the community to build and engage a local stakeholder team that commits to regular participation throughout the assessment, planning, and implementation process. Additionally, a “knowledge partner” such as a university or agency is essential to research and assess funding (potential role for SENRLG).

Funding

MFPP could provide up to \$10,000 towards the project leader required to facilitate this program. Additional funding resources from SENRLG partners would ensure that this position is fully funded.

Appendix G: Climate Solutions University



Climate Solutions University

BUILDING FOREST & WATER CLIMATE ADAPTATION CAPACITY

A Collaboration of Model Forest Policy Program and Cumberland River Compact

BACKGROUND & MISSION

The [Model Forest Policy Program](#) (MFPP) is a national nonprofit organization that advocates for forest policies and practices that restore and sustain healthy productive forests, clean and abundant water supplies, and economically thriving climate-resilient communities.

Climate Solutions University: Forest and Water Strategies (CSU) is the flagship program of the Model Forest Policy Program. Established in collaboration with the [Cumberland River Compact](#), the CSU program empowers rural communities to design and implement climate adaptation plans that safeguard local forest and water resources and support viable rural economies.

CURRICULUM FOR CLIMATE SOLUTIONS UNIVERSITY

Each participating community leads a project team through a four-step multi-year process:

1. Build a strong and diverse stakeholder team;
2. Conduct in-depth assessments of the local risks and opportunities related to climate, forest, water and economic conditions;
3. Analyze the assessment findings and develop a specific and actionable climate adaptation plan that protects forest and water resources; and
4. Implement the action plan with measurable results and adaptive management as needed.

The work is facilitated through monthly webinars, coaching conference calls, weekly one-on-one community check-ins and additional customized coaching and consultation as needed to meet local team needs. Throughout the process, communities engage scientific expertise and resources from local academic institutions and state and federal agencies. The Model Forest Policy Program continues to partner with communities for up to five years beyond the planning process as each works to implement the identified policies and projects.

SELECTION PROCESS

Each year, the CSU Program selects 4-6 communities to participate, as a class, in the climate planning process, which culminates in actionable local adaptation plans. To date, CSU has worked with 19 communities, and invites applications from community leaders of local government agencies, watershed organizations, and nonprofits or civic organizations. Communities are selected on a competitive basis using criteria that include a broad geographic range and diversity of perspectives (e.g. cultural, economic, regional, and ecosystem), natural resources at risk, and the need for support balanced by the capacity to successfully conduct the project and follow through with implementation.



www.mfpp.org P.O. Box 328 ~ Sagle, ID 83860 tel. (509) 432-8679 nwilliam@mfpp.org
www.cumberlandrivercompact.org ~ Nashville, TN tel. (615) 837-1151 gwengriffith@gmail.com

Appendix G: Climate Solutions University (continued)

Climate Solutions University

Forests and Water Strategies (CSU)

Local Plans Provide:

- Cost Effective Solutions and Risk Reduction
- Protected Community Water Supply
- Reduced Impacts of Floods and Drought
- Economic Stability



THE NETWORK OF CSU COMMUNITIES CREATES OUTCOMES SUCH AS THESE:

- **In Cookeville, TN**, the Comprehensive Plan 2030 was the first in TN to incorporate climate readiness provisions.
- **In Sumner County, TN**, the 2035 Comprehensive Plan now calls for adaptation measures, including steep slope protection and a county-wide 2% increase in tree canopy – reversing tree loss trends along headwater streams.
- **In Greene County, TN**, new initiatives are underway to increase riparian zone protection and avoid the risks of development in flood plains.
- **In Durango, CO**, Mountain Studies Institute is helping develop a climate change monitoring plan for the San Juan Resource Management Plan.
- **In Keene, NH**, the Sustainability Project members facilitated the adoption of the Asheulot River 10-year Implementation Plan; the first river protection document in the state to address climate change.
- **In Moab, UT**, the Canyonlands Watershed Council received \$50,000 and recently created the Moab Area Watershed Partnership covering over 11,000 square miles and five designated impaired water bodies.
- **In Missoula, MT**, the Clark Fork Coalition is integrating county adaptation plans with U.S. Forest Service climate strategies.
- **In Whatcom County, WA**, the Nooksack Salmon Enhancement Association climate adaptation findings are informing the regional salmon recovery plans, including opening and restoring salmon spawning and flood plain habitat.
- **In Alger County, MI**, the Superior Watershed Partnership identified forest and water climate risks common across the Great Lakes; their adaptation strategies include shore line protection zones, riparian habitat restoration, and support for rural forestry and tourism economy.

“Without the CSU framework, the challenge of finding relevant information and applying it in a useful manner would be overwhelming.” Carolyn Livensperger, Mountain Studies Institute, CO

For more information contact Model Forest Policy Program or Cumberland River Compact
www.mfpp.org ~ P. O. Box 328, Sagle, ID 83860 ~ tel. (509) 432-8679 ~ ngilliam@mfpp.org
www.cumberlandrivercompact.org ~ Nashville, TN ~ tel. (615) 837-1151 ~ gwengriffith@gmail.com

Web Site References

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