2022

CLIMATE RESILIENCE PROJECTS FOR THE ALBEMARLE REGION

NCORR

RISE

Regions Innovating for Strong Economies and Environment

N★C DPS

DEPARTMENT OF PUBLIC SAFETY

EQUAL HOUSING OPPORTUNITY

Contents

LAND ACKNOWLEDGEMENT

We wish to acknowledge and honor the Indigenous communities native to this region and recognize that this vulnerability assessment covers communities and structures that are built on Indigenous homelands and resources. We recognize the Chesapeake, Chowanoke, Croatan, Hatteras, Lumbee, Mattamuskeet, Moratok, Pasquotank, Perquimans, Poteskeet, Roanoke, Secotan, and Yeopim people as the past, present, and future caretakers of this land. We also recognize the unnamed tribes that once oversaw these lands and have since relocated or been displaced.

INTRODUCTION

North Carolina Office of Recovery and Resiliency (NCORR) Overview

In the wake of Hurricane Florence in 2018, the State of North Carolina established the Office of Recovery and Resiliency (NCORR) to lead the state's efforts in rebuilding smarter and stronger. At that time, eastern North Carolina communities were still recovering from Hurricane Matthew in 2016. NCORR manages nearly a billion dollars in U.S. Department of Housing and Urban Development (HUD) funding in two grant types, Community Development Block Grant – Disaster Recovery (CDBG-DR) funds and Community Development Block Grant – Mitigation (CDBG-MIT) funds, aimed at making North Carolina communities safer and more resilient from future storms. Additional funding is provided through the State Disaster Recovery Acts of 2017 and 2018, the Storm Recovery Act of 2019, and the Economic Development Administration Disaster Supplemental Funds. NCORR manages programs statewide that include homeowner recovery, infrastructure, affordable housing, resiliency, and strategic buyouts. To learn more about NCORR programs, visit the ReBuild.NC.Gov website. NCORR is a division of the Department of Public Safety.

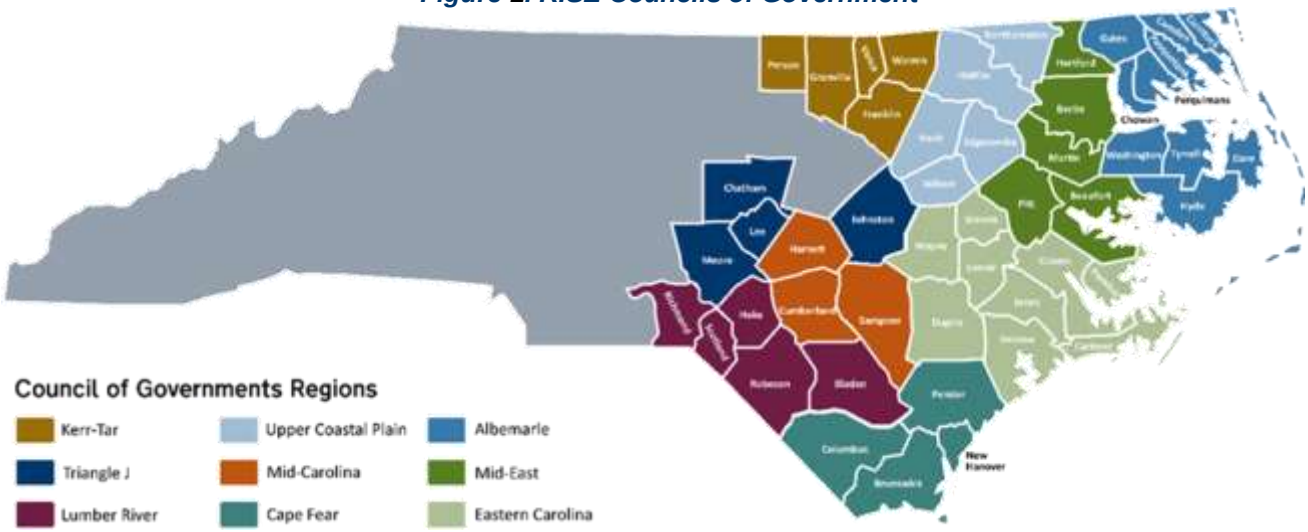
RISE Regional Resilience Portfolio Overview

Developed in partnership with North Carolina Rural Center, NCORR's Regions Innovating for Strong Economies and Environment (RISE) program supports resilience in North Carolina by:

- Facilitating the Regional Resilience Portfolio Program, which provides coaching and technical assistance to regional partners in the eastern half of the state to build multi-county vulnerability assessments, identify priority actions to reduce risk and enhance resilience in their region, and develop paths to implementation.
- Developing the North Carolina Resilient Communities Guide, a statewide resource that will provide tools, guidance, and opportunities for building community resilience.
- Hosting the Homegrown Leaders program, a North Carolina Rural Center leadership training workshop, which operates in the eastern half of the state, that emphasizes resilience as a tool for community economic development.

RISE is funded by the U.S. Economic Development Administration and the U.S. Department of Housing and Urban Development's Community Development Block Grant – Mitigation funds, with in-kind support from NCORR and North Carolina Rural Center. In addition, the Duke Energy Foundation committed $600,000 in grant funding to support the Regional Resilience Portfolio Program.

Figure 1. RISE Councils of Government

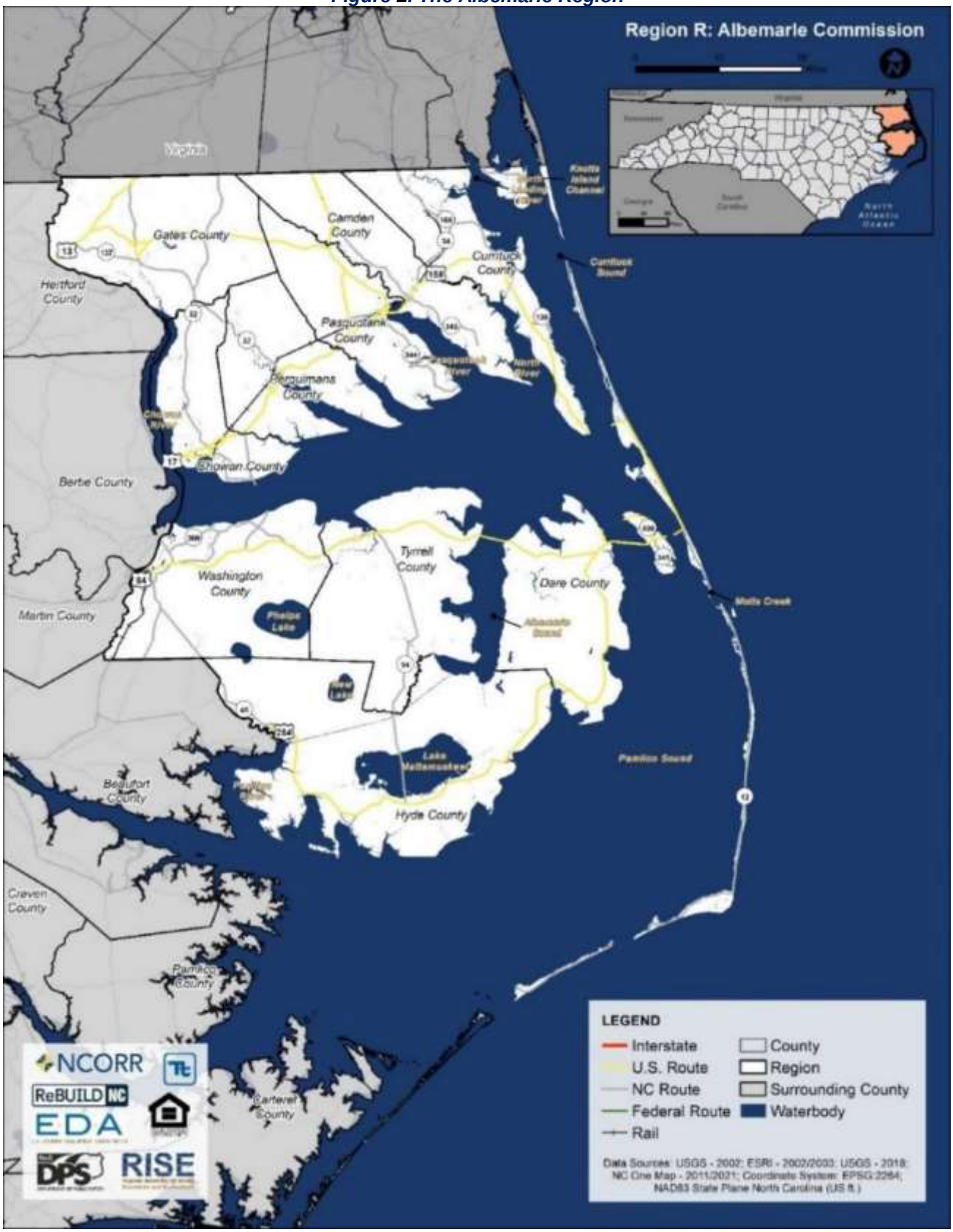


The Albemarle Regional Resilience Portfolio

The RISE Albemarle Regional Resilience Portfolio Program aims to advance the resilience of the region. RISE covers nine areas, which align with the North Carolina Council of Government regions. The Albemarle Region is located in the northeastern corner of North Carolina. The Region includes Camden, Chowan, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrrell, and Washington Counties. The Region is predominantly rural, with expansive wetlands and agricultural land. With a total land area of 6,222 square miles, the Albemarle Region is the largest of the 16 planning regions in the state.

Initially organized in 1969 under the direction of the U.S. Economic Development Administration, the Albemarle Commission is sanctioned as the lead regional organization for Region R (Albemarle Region) by the federal government. The Commission has been addressing regional needs since its doors opened in 1970 and have been instrumental in the development and/or enhancement of regional infrastructure; industrial recruitment business development, labor force development, travel and tourism, community reinvestment /rehabilitation, and health and human services (Albemarle Commission 2020).

Figure 2. The Albemarle Region



Regional Team

The RISE Albemarle Regional Resilience Portfolio Program in the Albemarle Region was led by a Regional Team comprised of an NCORR representative, the Albemarle Commission, Tetra Tech, Inc, and a facilitator. The Albemarle Commission offered project guidance, and Tetra Tech, Inc. provided technical assistance. A local leader was retained by the North Carolina Rural Center to provide facilitation support at the many stakeholder and public meetings held during the planning process.

Stakeholder Partnership

The planning effort in the Albemarle Region was informed by a Stakeholder Partnership to ensure the vulnerabilities identified reflect local priorities. The Stakeholder Partnership:

- Steered the project by providing local input and perspective;
- Reviewed project materials to ensure materials reflect local priorities and address local concerns; and
- Attended monthly meetings.

The partnership was open to all those who were interested in participating and is composed of local leaders from across the region who either live or work within the Albemarle Region. Leaders have backgrounds from various sectors and disciplines, including community organizations, social services, business, and economic development, public health, planning and transportation, and local elected officials. Local leaders met monthly beginning in January 2022 to guide the implementation of the Regional Resilience Portfolio Program.

January 12, 2023

CAMDEN
CHOWAN
CURRITUCK
DARE
GATES
HYDE
PASQUOTANK
PERQUIMANS
TYRRELL
WASHINGTON
COLUMBIA
CRESWELL
DUCK
EDENTON
ELIZABETH CITY
GATESVILLE
HERTFORD
KILL DEVIL HILLS
KITTY HAWK
MANTEO
NAGS HEAD
PLYMOUTH
ROPER
SOUTHERN SHORES
WINFALL

Dear Albemarle Region Residents,

The Albemarle Region, encompassing Camden, Chowan, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrrell and Washington counties, is the largest of the 16 planning regions in the state. The region is working to meet the needs of its residents, employees, and visitors. However, natural hazards continue to challenge and impact the region's social, environmental, and economic systems and infrastructure. The region has been working diligently through collective action and proactive planning efforts to reduce the impacts of future natural hazard occurrences.

The Albemarle Region has developed a Regional Resilience Project Portfolio in response to climate-exacerbated natural hazards. The portfolio proposes actions to address the major concerns identified in the Albemarle Region Vulnerability Assessment and provides an in-depth project overview and implementation pathway for each proposed project. The included projects were identified through input from residents, elected officials, and local leaders with assistance from the North Carolina Office of Resiliency, the North Carolina Rural Center, Tetra Tech, and the Albemarle Commission.

As you read through the Albemarle Region's Portfolio of Projects, think about how these projects might improve the quality of life in our communities and better prepare us for the immediate and long-term future.

Sincerely,

Michael L. Ervin
Executive Director

Lloyd Griffin, Board Chair | Michael Ervin, Executive Director | www.albemarlecommission.org | 512 South Church Street, Hertford, NC 27944 | P: 252.426.5753, F: 252.426.8482

REGIONAL RESILIENCE PORTFOLIO DEVELOPMENT

The Regional Resilience Portfolio Program is a two-part effort consisting of the *Climate Change and Natural Hazards Vulnerability Assessment for the Albemarle Region* and the *Regional Resilience Project Portfolio* (refer to ***Figure 3***). The vulnerability assessment bridges science and local knowledge to analyze current and future hazards and their impacts on the region. The Vulnerability Assessment Summary overviews the findings of this analysis. To view the vulnerability assessment in its entirety please visit the Albemarle Regional Resilience Portfolio website.

The *Regional Resilience Project Portfolio* is a compilation of projects that will provide regional resilience benefits across the Albemarle Region. These projects respond to critical issues highlighted in the Vulnerability Assessment and reflect local priorities identified during the planning process. The number of projects in the full portfolio is limited to allow for greater depth in scoping the project and identifying pathways to implementation, including funding sources. Additional worthy projects considered during the planning process are listed in ***Appendix A***.

Figure 3. The Albemarle Region Regional Resilience Program Process

Planning Process

At the onset of the program, NCORR, the facilitator, and the Albemarle Council of Government (COG) recruited local leaders from the region, representing issues and communities inside and outside government, to serve as the Stakeholder Partnership for the project. The Stakeholder Partnership met over the course of the project to inform and guide its development. The Partnership was open to all those who were interested and either live or work within the region. Partnership membership spanned local government, community organizations, and companies, including:

- Representatives of county governments
- Albemarle Regional Health Services
- Albemarle Planning
- Albemarle-Pamlico National Estuary Partnership (APNEP)
- Wanchese Marine Industrial Park
- United States Coast Guard
- North Carolina Sea Grant
- Green Saves Green
- River City Community Development Corporation

- College of the Albemarle Health Science Program
- Partnership for the Sounds
- Intercounty Public Transport Authority
- Currituck Chamber of Commerce
- Department of Aviation/Emergency Management at Elizabeth City State University
- River City Community Development Corporation
- North Carolina Coastal Federation
- Northeast Academy
- Perquimans County Schools
- Albemarle Commission

Additionally, the project team solicited public input on vulnerabilities and potential solutions through a series of online surveys, virtual meetings, and in-person meetings. During the vulnerability assessment phase, the project team worked with the Regional Stakeholder Partnership to identify top climate hazards and their historic and potential future impacts in the region. Three virtual public workshops were offered in April 2022 allowing members of the public to contribute to the identification of climate and natural hazards vulnerabilities that the region faces. The vulnerability assessment was drafted and responded to comments from the project team, Stakeholder Assessment, and comments submitted during a public comment period in August 2022.

During the project identification phase, the project team again worked with the Stakeholder Partnership to develop a long list of potential projects to build resilience to vulnerabilities and challenges identified in the assessment. Proposed projects included public awareness and messaging, construction and nature-based solutions, program and policy development, and studies and analyses.

The project team and Regional Stakeholder Partnership prioritized 25 projects to present to community members to gain feedback and input. After refining projects based on feedback, the project team used criteria approved by the Regional Stakeholder Partnership to rank projects with a “resilience scorecard”. The project team determined projects to include in the Regional Resilience Project Portfolio by incorporating resilience scorecard results, the information of the Regional Stakeholder Partnership, and the project team’s subject matter expertise. The following criteria and questions were utilized to develop a ‘resilience scorecard rating for each of the 25 potential projects. The resilience scorecard ratings are available in ***Appendix B***.

Table 1: Ranking Criteria

Category	Considerations
Reduction in Risk	How many hazards are addressed? What is the probability the hazard(s) will occur?
	Does the project protect life or property or both?
	Does the project address current and future hazards?
	Does the project reduce the risk at a regional scale?
	Does the project reduce a non-climate stressor?
Scale	Is the project regional?
	Can the project be replicated?
Cost	What is the range of cost? Low (Under $50K)? Medium ($50k-$1m)? High (Over $1m)?
Benefits	Do benefits outweigh the costs?
Timeframe	How long will it take to implement the project? Short: Less than 5 years. Medium: 5-15 years. Long: More than 15 years

Category	Considerations
Feasibility	Is the project technically and legally possible?
	Will permitting be required?
	Are project sponsors identified, engaged, and have the capacity to implement the project?
	Is a funding source identified?
Socioeconomic	Does the project aid in building a strong economy?
	Does the project supports improving community infrastructure (e.g., road network)?
Climate Justice and Equity	Does the project benefit areas with a high Social Vulnerability Index?
	Does the project have a positive, qualitative impact on populations that identify as Black, Indigenous, or People of Color (BIPOC)?
	Does the project improve health resources?
Environmental Impacts	Does the project address drivers of climate change?
	Does the project use nature-based solutions?
	Does the project provide habitat restoration for threatened and endangered species?
Public and Stakeholder Support	Is there strong support for the project? Was it ranked as a high priority by the stakeholder partnership and community?

The Regional Stakeholder Partnership was surveyed to determine potential project sponsors and overall support for the projects. The survey results were averaged for each project for inclusion in the resilience scorecard. The results from the resilience scorecard and general support of the Regional Stakeholder Partnership were combined to identify the projects most likely to be successfully implemented. The resilience scorecard results are located in ***Appendix B***. These prioritized projects are included in this project portfolio. The remaining 18 projects that are not included in the portfolio are included in ***Appendix A*** for reference. The project team then conducted additional, targeted outreach to state and local stakeholders to further research and refine each project. At a public workshop conducted on November 10, 2022, RISE staff solicited feedback from community members and local officials on the proposed project list, in addition to educating attendees about the Albemarle Regional Resilience Portfolio Program and providing the findings of the Vulnerability Assessment. Following a presentation, participants were invited to explore and interact with the printed project boards and provide feedback on the prioritized projects. A final public comment period on the Project Portfolio was held in November and early December 2022.

Vulnerability Assessment Summary

The Climate Change and Natural Hazards Vulnerability Assessment for the Albemarle Region describe past problems and future risks associated with extreme weather events such as hurricanes, flooding, extreme temperatures, droughts, and wildfires as well as the impact of climate change on these existing hazards. The Vulnerability Assessment outlines the impacts of these climate hazards on housing, the environment, and the economy. Climate change and non-climate stressors create cascading impacts, which lead to new vulnerabilities in the region. Together, climate hazards, non-climate stressors, and regional challenges create specific vulnerabilities for socially vulnerable populations, housing, critical infrastructure, the economy, and natural resources.

The following hazards pose a significant threat to the Albemarle Region, based on scientific study, disaster history, and input from local leaders.

A summary of the full Vulnerability Assessment on the impact of natural hazards and climate change for the Albemarle Region is outlined below:

Social Vulnerability and Equity, Health, and Safety

- The Albemarle Region is home to many socially vulnerable populations that are at higher risk of the impacts of natural hazards and climate change due to many factors including lack of resources or ability to respond to and recover from events.
- Some hazards such as hurricanes present a direct and immediate risk to life and safety while other hazards, such as drought present indirect health risks and may be more impactful to the region in the long term.
- Equitable responses to risk are needed to address rising temperatures and increasing severity and frequency of natural hazard events.

Housing, Critical Infrastructure, and Community Support Systems

- The region's housing, critical infrastructure, and community support systems have been impacted by natural hazard events. These impacts are likely to increase in the future as hazard events increase in frequency and intensity due to climate change.
- Upgrades and retrofits of housing, critical infrastructure, and community support systems are necessary to adjust for today's conditions and prepare for continued changes due to climate change impacts.

Economy

- The large agricultural industry in the Albemarle Region is at risk of damage from severe weather events and saltwater intrusion.
- The region's tourism industry, especially in Date and Currituck Counties, is at risk from the impacts of coastal hazards such as hurricanes, floods, erosion, sea level rise, and the compounding effects of these hazards by climate change.
- The region is dominated by low-lying coastal areas which are more susceptible to sea level rise, elevated groundwater tables, saltwater intrusion, and increased flooding.

Natural Environmental Systems

- Climate change is already impacting natural systems in the region. Sea level rise is causing saltwater intrusion, resulting in the loss of coastal forests. Additionally, elevated groundwater tables are limiting the ability of soils to absorb stormwater causing increased occurrences of localized flooding and the ability of onsite wastewater treatment systems to properly treat wastewater.
- Climate change is causing rising temperatures and stronger weather events which stress natural environmental systems.
- Already stressed natural environmental systems are being impacted by invasive species, partially driven by shifting ranges of species due to rising temperatures.

Historical and Cultural Resource

- Historic structures in the Albemarle Region have a higher risk of severe weather and flooding as they were not built to modern standards and before the special flood hazard area (SFHA) maps were produced.
- Long-term exposure to hazards can result in the degradation of historical and cultural assets.
- Cultural events can be threatened by unsafe weather conditions.

Cascading Impacts

- Several hazards are likely to occur during the same event in the region. Hurricanes bring high winds, heavy rainfall, coastal flooding, and erosion that can result in unintended releases of chemicals and contaminants that threaten water quality.
- The occurrence of some hazards increases the likelihood of other hazards. Extreme temperatures and drought result in an increased risk for wildfire events.

Summaries of the most significant impacts identified for each of the hazards of concern in the Albemarle Region are included below.

Drought

- Droughts could pose a significant risk to the region's agricultural industry.
- The area north of Elizabeth City on the Pasquotank River is reliant on surface water and is at higher risk of the impacts of severe drought.

Erosion

- Numerous areas along the Outer Banks experience erosional rates of more than two meters per year, placing oceanfront development at high risk.
- Estuarine shorelines are also at risk for erosion. Additionally in the future, sea level rise threatens estuarine shorelines that are unable to migrate leading to a significant loss of estuarine habitat.

Extreme Temperature

- Due to climate change, extreme heat events are likely to become more frequent and severe in the region, while extreme cold events should become less frequent and less severe.
- Socially vulnerable populations that lack access to proper heating and cooling infrastructure are most at risk of extreme temperature health impacts.
- Droughts associated with extreme heat events could pose significant risks to the region's agricultural industry.

Flood

- The region is exposed to various types of flooding, with coastal flooding and stormwater flooding being the largest concerns.
- Forty-four percent of the region's population and twenty percent of the region's buildings are in the 1 percent annual-chance floodplain.
- Sea level rise is likely to increase the frequency and severity of coastal flooding. Flood maps do not account for sea level rise and therefore under-represent future risk. The region's rate of sea level rise (roughly 0.18 inches per year) is higher than the global average and roughly twice as fast as the southern portions of the state (NC Climate Science 2020).
- Heavy rainfall is becoming more frequent in the Albemarle Region.
- Stormwater infrastructure is not designed to handle larger rainfall events. Additionally, elevated groundwater tables that occur periodically during the year associated with sea level rise, reduce the capability available for stormwater infiltration in the subsurface soil.

Invasive Species

- Invasive species pose significant risks to the region, with its extensive agricultural lands and natural ecosystems.
- Changing conditions due to climate change and other types of habitat disruption may increase the likelihood of invasive species moving into the Albemarle Region.

Hurricanes and Severe Storms

- The region experiences a variety of severe weather events including numerous secondary hazards like wind, tornados, lightning, and hail.
- Hurricanes and storms, like Hurricane Matthew in 2018, cause significant damages and impacts making recovery slow, often occurring over many years.
- The frequency and severity of these events are likely to increase in the future due to climate change.

Water Quality Issues

	• Hazards such as storms and floods can result in accidental spills and releases that can contaminate groundwater and surface water. • Runoff of nutrients can cause a growing environment for harmful algal blooms, which are environmentally damaging and pose health risks for humans. • Warming temperatures and increasing heavy precipitation increase the likelihood of harmful algal blooms. • Rising sea levels contribute to elevated groundwater tables that limit the ability of the soil to absorb stormwater and affect the ability of septic systems to treat wastewater. • Rising sea levels and groundwater withdrawal contribute to saltwater intrusion in the region's coastal areas and are likely to worsen over time. • Saltwater intrusion is leading to the abandonment of some agricultural land and may necessitate expensive treatment measures to maintain drinking water in impacted areas.
Wildfire	
	• Increasing frequency and severity of wildfires will lead to increased damages to natural systems and potential damages to structures. • Projected increases in wildfire risks and associated emissions can have harmful impacts on health.

PORTFOLIO OF PROJECTS

The Portfolio of Projects describes high-priority projects identified for the Albemarle Region by the Stakeholder Partnership after a review of past impacts, the vulnerability assessment, and strategies that have been used before in the Albemarle Region or elsewhere in the nation. These project ideas were further developed through community input and expert consultation. This portfolio outlines implementation steps, funding opportunities, and potential project partners to enable a clear path toward implementation for each project. A summary of the projects included in the portfolio is located on the following pages.

SUMMARY TABLE OF PROPOSED PROJECTS

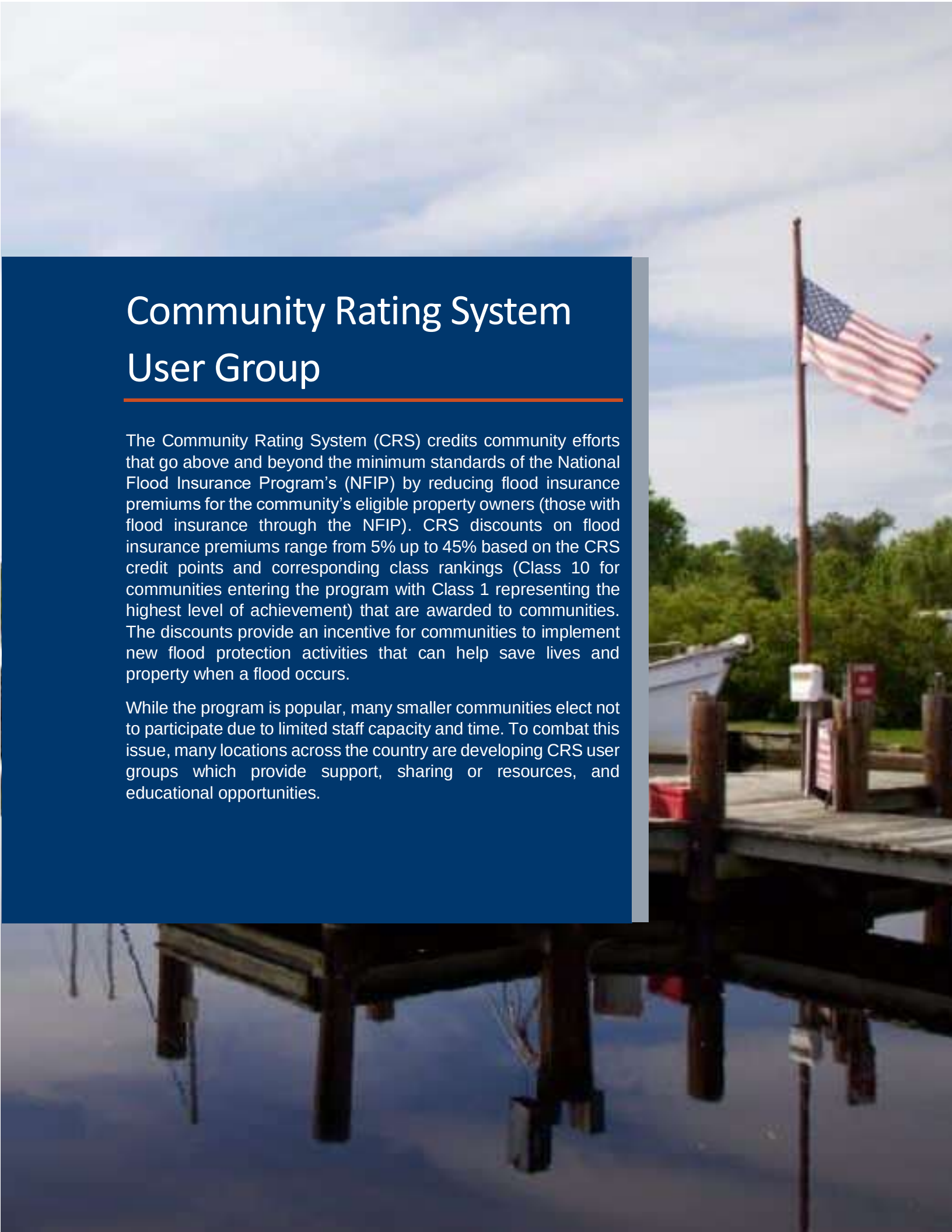
Project Name	Project Description	Lead Agency
Community Rating System User Group	**PROBLEM** The Albemarle Region has a high flood exposure. At the same time, flood insurance rates are becoming more expensive. Some residents are considering dropping their flood insurance as a result. **SOLUTION** Establish regional coordination through the Albemarle Commission to encourage each county/municipality to enroll in the CRS program to reduce the cost of flood insurance. Provide leadership for the development of a CRS User Group that will meet throughout the year. This group consists of municipal, county, regional, and state networks that collaborate to meet local flood mitigation goals and support one another in qualifying for CRS credit.	Albemarle Commission, county and municipal floodplain managers, non-profit organizations, and other CRS professionals.
Public Outreach	**PROBLEM** Hazards have long-lasting and repetitive impacts, and long recovery times, and cause a variety of lingering issues such as substandard housing. Without public awareness about these hidden impacts, the public is less likely to make personal choices to mitigate their property. **SOLUTION** Develop a multi-faceted public awareness program, partnering with non-profit organizations, academia, and businesses. Use museums, planetariums, and education centers in the Albemarle Region to conduct outreach on past hazard events and frame potential future impacts.	The Albemarle Commission, in conjunction with the CRS User Group, will serve as the lead implementer. Federal, state, academic, environmental, and non-profit organizations will be engaged in developing outreach materials, hosting outreach events, or leading trainings on hazard-related topics or outreach strategies.

Project Name	Project Description	Lead Agency
Stormwater Working Group	**PROBLEM** Throughout the Albemarle Region, stormwater infrastructure is undersized, failing, or in need of maintenance. All of these factors increase the risk of flooding, especially as heavy rainfall events increase in frequency and severity, and development increases the volume of stormwater runoff. **SOLUTION** Establish a Working Group to evaluate the region's stormwater capabilities, identify needs, and develop collaborative approaches to reducing stormwater flooding in the Albemarle Region.	The Albemarle Commission will serve as the lead implementer. Supporting agencies in this project will include all interested county and municipal agencies responsible for stormwater management and maintenance, non-profit organizations that can provide outreach support, academic organizations that can provide data, and state agencies that provide support for planning.
Stormwater and Watershed Management Planning	**PROBLEM** To bring stormwater management in the Albemarle Region to a level that will address current and future needs and account for new development and a changing climate, robust planning needs to be completed to identify strategies and maintenance requirements at the local and watershed level scales. **SOLUTION** Provide training and collaboration opportunities that will result in development of stormwater management plans and watershed master plans throughout the Albemarle Region. Distribute outreach materials to address stormwater flooding issues.	The Albemarle Commission will serve as the lead implementer of the project and host workshops on the proper development of stormwater management plans for municipalities and counties. The Commission will also provide additional workshops on the development of watershed master plans. The Commission will host guidance materials and example model documents on its website.
Harmful Algal Bloom (HAB) Research, Prevention, and Identification	**PROBLEM** Harmful Algal Blooms (HABs) present unique ecosystem and health hazards. HABs have occurred in the past in the region but have become a more frequent problem in the last ten years. While there has been research and involvement by many partners, an exact cause has not yet been determined. **SOLUTION** Conduct outreach to educate the public on the harms of HABs, identification, and reporting of blooms, and how to reduce exposure. Work with partners to develop a response protocol for notification of the blooms to stakeholders in the region.	The Albemarle Commission and Albemarle Resource Conservation and Development Council will serve as the lead implementer at the beginning of the project and invite local, state, academic, environmental, and non-profit organizations to participate in a meeting to provide updates on recent progress and actions. The goal of the meeting will be to increase collaboration across interested stakeholders and determine what next steps are needed to address this issue in the region.

Community Rating System User Group

The Community Rating System (CRS) credits community efforts that go above and beyond the minimum standards of the National Flood Insurance Program's (NFIP) by reducing flood insurance premiums for the community's eligible property owners (those with flood insurance through the NFIP). CRS discounts on flood insurance premiums range from 5% up to 45% based on the CRS credit points and corresponding class rankings (Class 10 for communities entering the program with Class 1 representing the highest level of achievement) that are awarded to communities. The discounts provide an incentive for communities to implement new flood protection activities that can help save lives and property when a flood occurs.

While the program is popular, many smaller communities elect not to participate due to limited staff capacity and time. To combat this issue, many locations across the country are developing CRS user groups which provide support, sharing or resources, and educational opportunities.



COMMUNITY RATING SYSTEM USER GROUP

Problem

The Albemarle Region is exposed to a variety of flooding types including riverine, coastal, and stormwater-related flooding. Flooding often coincides with other hazards such as storms and erosion and flood related hazards have long-lasting impacts in the region.

Roughly 20 percent of the region's building stock and 44 percent of the region's population are located in the SFHA.

While each county in the region contains extensive flood hazard zones, Dare County, Tyrrell County, and southeastern Hyde County are dominated by the 1 percent annual chance flood hazard zones or Special Flood Hazard Area (SFHA). Homeowners living in the SFHA that have a mortgage are federally required to carry flood insurance. Roughly 20 percent of the region's building stock and 44 percent of the region's population are located in the SFHA.

Flooding is not limited to the SFHA. Stormwater related and flash flooding routinely occurs in areas outside the SFHA within the region. Other than Chowan County and Gates County, ***a severe storm surge from a Category 4 hurricane has the potential to impact nearly the entire region.***

Homeowners who do not have a mortgage or are located outside of the SFHA are not required to carry flood insurance. High flood insurance costs often result in these homeowners electing to not carry flood insurance, placing themselves at high risk for potential financial ruin in the event of a flood. Flooding also has economic impacts on revenue collection for municipalities since frequent flood issues such as repetitive losses or access issues caused by flood waters can decrease property tax values. The CRS program provides municipalities with the ability to reduce the cost of flood insurance for residents, encourages greater flood insurance coverage, and provides a roadmap for increasing the quality of floodplain management. While the benefits of the CRS program are looked upon favorably, municipalities often note a lack of staffing to administer the program forms a major barrier. Even well-staffed municipalities may be hesitant to join due to the time requirements to administer the program and a lack of guidance to assist in implementing and maintaining a local CRS program.

According to FEMA, there are roughly 45 CRS user groups spread across the country. These user groups provide participants with resources to be successful in joining the CRS program and maintaining and improving class rankings.

FEMA 2022

While a CRS User group exists in the Outer Banks, other communities in the region do not currently participate. Currituck County, Dare County, and municipalities in Dare County currently make up the OBX CRS User group. The focus for this group is on coastal issues related to CRS. Creation of another CRS User group with a focus on the needs of inland communities in the region would be helpful. The CRS User Group could assist in implementing the Public Outreach project also identified in the portfolio.

Hazards Addressed
Flood

Sectors Addressed
The following sectors will be supported by this project:

- Social Vulnerability and Equity, Health, and Safety
- Housing, Critical Infrastructure, and Community Support Systems
- Economy
- Natural Environmental Systems

Location/Service Area
Albemarle Region.

Potential Impact

Development of a CRS User Group in the Albemarle Region could support municipalities that currently participate in the CRS program, would like to join the CRS program, or are simply interested in improving their floodplain management program. This group may consist of municipal, county, regional, and state partners as well as non-profits that share similar missions. Working together, sharing resources, and learning from one another makes participation in the CRS program easier and less burdensome for staff in local governments.

Population(s) Served
This project will serve the entire population of the Albemarle Region, with financial benefits for NFIP flood insurance policyholders in communities that join and/or increase their class ranking in the CRS program.

Municipalities like the Town of Nags Head (Class 5, 25% discount) have used the CRS program to guide how flood related outreach is conducted. Using successful CRS participants in the region as a model able to be replicated can increase participation and success in the CRS program.

Town of Nags Head 2022

Roles of Lead and Supporting Agencies

This project will establish a CRS User Group involving county and municipal floodplain managers, non-profit organizations, and other CRS professionals.

Lead Implementer
The Albemarle Commission will serve as the organizer and lead implementer for the CRS User Group. The Albemarle Commission will be responsible for scheduling the meetings, inviting participants, and developing agendas with input from the group.

Supporting Agencies
All local governments in the Albemarle Region will be invited to participate in the CRS User Group. Representatives of each county/town, the state, FEMA, and the ISO/CRS specialists that service municipalities in the region will also be invited to participate to encourage collaboration and the development of working relationships that will lead to success.

Current participants in the CRS program located in the Albemarle Region will be at the top of the recruitment list. These participants will

be able to discuss how to avoid roadblocks and other best management practices that are specific to the region.

The following counties in the region participate in the CRS program and have the following class rankings and flood insurance premium discounts for eligible policyholders:

- Camden County – Class 7, 15% discount
- Currituck County – Class 6, 20% discount
- Dare County – Class 6, 20% discount
- Hyde County – Class 8, 10% discount
- Washington County – Class 7, 15% discount

The following municipalities in the region participate in the CRS program:

- Town of Creswell, Washington County – Class 7, 15% discount
- Town of Duck, Dare County – Class 6, 20% discount
- Town of Edenton, Chowan County – Class 7, 15% discount
- Town of Kill Devil Hills, Dare County – Class 5, 25% discount
- Town of Kitty Hawk, Dare County – Class 6, 20% discount
- Town of Manteo, Dare County – Class 5, 25% discount
- Town of Nags Head, Dare County – Class 5, 25% discount
- Town of Plymouth, Washington County – Class 8, 10% discount
- Town of Roper, Washington County – Class 8, 20% discount
- Town of Southern Shores, Dare County – Class 6, 20% discount

Other potential participants will include CRS professionals such as planners, emergency managers, public information officers, and non-profit or academic groups that may have an interest in partnering on projects that would benefit CRS programs such as outreach. Examples of such groups include the Nature Conservancy, Wetlands Watch, and the Albemarle-Pamlico National Estuary Partnership.

Cost Estimate

The cost for the implementation of this project is estimated to be low (under $10,000) and mainly involves the costs of hosting meetings and storing meeting recordings and CRS support documentation on an online platform.

Funding Sources

While initial startup of the project would be low cost, larger CRS User Group projects may require supplemental grant funding. The CRS User Group will need to discuss how the best approach for the funding and if it is more feasible to apply as a group or individually. Some of this may be dependent on the type of project proposed.

Benefits Provided

Physical Benefits

Certain mitigation measures such as acquisition and elevation projects may be implemented by municipalities to reduce flood risk and earn credit in the CRS program.

Socioeconomic Benefits

This project will encourage improved flooding resilience in the Albemarle Region through increased flood insurance coverage and improved floodplain management. Reduced flood insurance costs will provide economic relief to flood insurance policyholders in communities that elect to participate in the CRS program.

Environmental Benefits

Education on the importance of natural floodplain function and conservation of open space is likely to increase in the Albemarle Region as more communities participate in the CRS program.

Equitable Outcomes

The Albemarle Region is home to numerous socially vulnerable populations and many of these populations are located in areas with high flood risk. Nearly half of residents located in the SFHA may have

one or a combination of factors that increase social vulnerability including persons over 65 or below 5 years of age, those below the poverty line, and those living with a disability. This project would address floodplain management services for these populations and provide economic relief for flood insurance policyholders in communities that join the CRS.

Steps for Implementation

Phase 1: Coordination with State NFIP Director- In Phase 1, the Albemarle Commission should reach out to the State NFIP director to express interest in the formation of a CRS User Group and learn about the specific requirements for becoming an official State CRS User Group.

Phase 2: Community & Stakeholder Interest- In Phase 2, the Albemarle Commission will reach out to counties, municipalities, State Floodplain Management Officials, non-profit groups, and staff from ISO/CRS specialists that service municipalities in the Albemarle Region that may be interested in participating in a User Group to determine the level of interest and schedule a kickoff meeting. Representatives of each county/town, the state, FEMA, and the ISO/CRS specialists that service municipalities in the Albemarle Region will be invited to participate in the User Group.

Phase 3: Develop Vision, Goals, and Focus Areas- In Phase 3, the Commission will work with participants to develop a vision and goals for the group. The group will also identify potential focus areas and topics of discussion, guest speakers for future meetings, determine meeting frequency, and any other relevant decisions needed to meet the requirements of becoming an official CRS User Group.

Recordings of the meetings could be made available online to allow those that were unable to join or would like to refer to items of discussion. Topic areas could include each of the CRS Coordinator's Manual's areas of focus:

- Public Information Activities,
- Mapping and Regulations,
- Flood Damage Reductions, and
- Warning and Response

The User Group should consider dedicating one meeting a year to focus on educating communities on how to create and sustain CRS programs to encourage greater enrollment.

Phase 4: Development of an Online Presence- In Phase 4, The Commission will organize an online catalog for CRS related materials and meeting recordings. Emphasis will be placed on maintaining a catalog of template materials that CRS communities can use to improve their floodplain management programs while gaining additional points. CRS approved outreach materials, plans, logs, etc. are already being used by some communities in the region to earn points in the program. These materials can be collected in an online catalog for quick reference and to prevent communities from needing to "reinvent the wheel," saving time and sharing resources.

Phase 5: Opportunities for Collaboration- In Phase 5, the User Group will explore opportunities for collaboration and potential multi-jurisdictional efforts such as floodplain management plans and programs for public information. There are opportunities for jurisdictions to share information and work together to develop materials that will save time for those involved.

Phase 6: Meetings, Information Sharing, and Networking- In Phase 6, the User Group will conduct regular meetings to address CRS topics as well as networking opportunities for CRS professionals. As an official CRS User Group, continuing education credits can be awarded for these events for Certified Floodplain Managers (CFM). Members of the User Group will be encouraged to represent the User Group and report back on any outside conferences or workshops they attend related to floodplain management and CRS.

Implementation Timeframe

This project has a short implementation timeframe. Once established, the User Group will require regular meetings featuring programming and speakers.

Integration with Existing Plans, Programs, and Policies

This project will build off the success of existing CRS communities in the Albemarle Region. The project will also work with or partner with the existing Southeast North Carolina and Outer Banks User Groups.

This project will complement the proposed public outreach project for this portfolio which will develop flood-related outreach to be eligible for scoring in the CRS program.

Challenges/Obstacles

There are no foreseen challenges or obstacles.

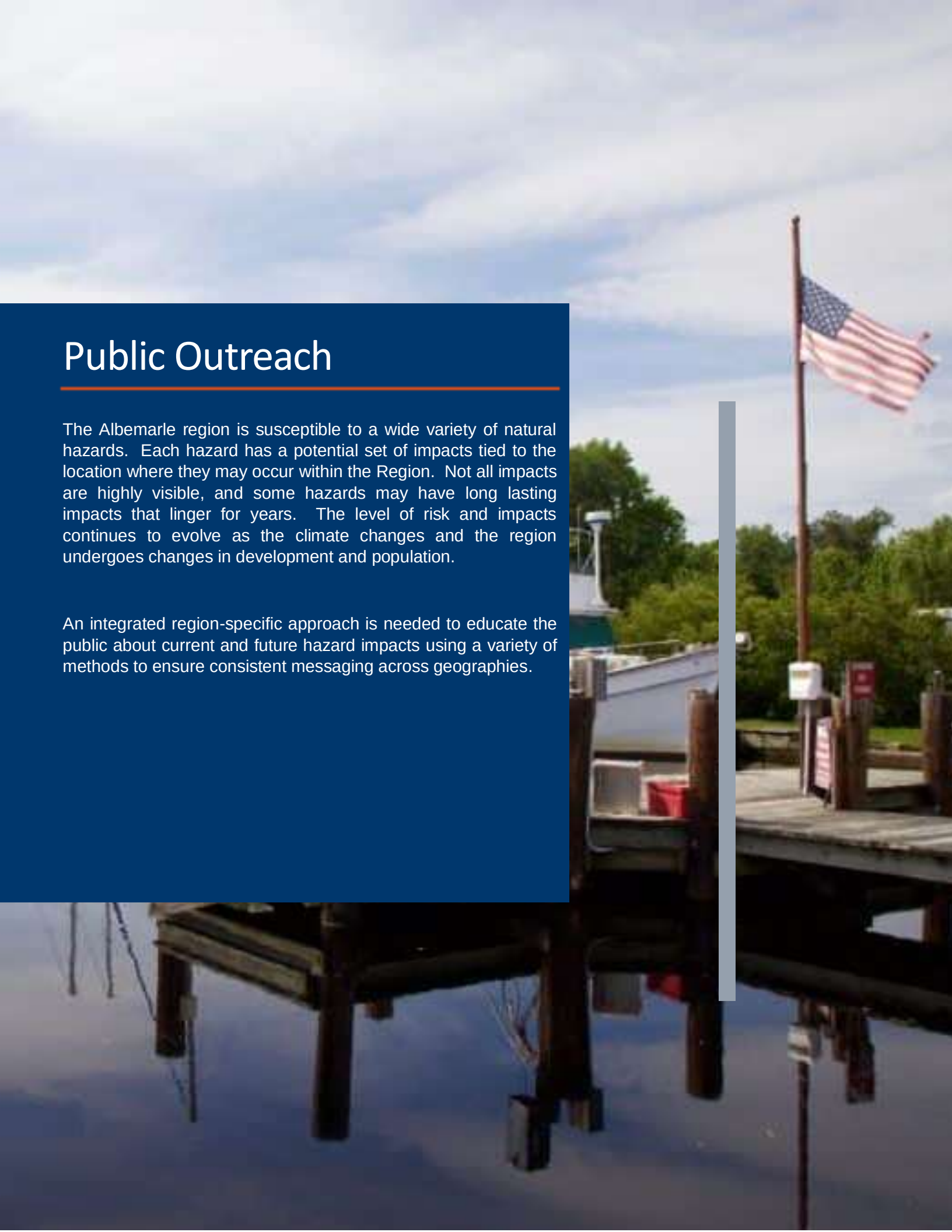
Legislative Challenges, Permitting, Zoning Requirements

There are no foreseen legislative challenges, permitting, or zoning requirements for this project.

Public Outreach

The Albemarle region is susceptible to a wide variety of natural hazards. Each hazard has a potential set of impacts tied to the location where they may occur within the Region. Not all impacts are highly visible, and some hazards may have long lasting impacts that linger for years. The level of risk and impacts continues to evolve as the climate changes and the region undergoes changes in development and population.

An integrated region-specific approach is needed to educate the public about current and future hazard impacts using a variety of methods to ensure consistent messaging across geographies.



PUBLIC OUTREACH

Problem

Obvious storm and weather impacts like wind and water damage, hazards can have long lasting and repetitive impacts, long recovery times, and cause a variety of cascading and lingering issues for communities. These cascading issues include substandard housing, food and water insecurity, and other public health threats. Increased awareness and public understanding of hazards, hazard impacts, the cascading effects of hazards on communities, and how to mitigate against these through their personal decisions is needed in order to increase the overall resilience of the Albemarle Region. Continued development, changing demographics, and ever-evolving climactic conditions have led to increased severity and frequency of disaster events and an evolving list of potential hazard impacts.

There are many different audience groups that will need to be educated through public outreach in order to increase resilience in the region. In addition to traditional audiences for public outreach like residents and business owners, the Albemarle Region has a strong tourism industry that attracts from around the country. Many visitors may not understand what to do before, during, and after a hazard event that occurs during their visit. Further, secondary homeowners may have similar knowledge limitations. The region has worked to make sure emergency management planning and notifications include visitors and secondary property owners, but hazard events that are localized, long-term, or have slow recovery times may not result in the same attention.

Socially vulnerable populations form a large portion of the Albemarle Region's permanent year-round population. These populations are especially at risk because of factors like socioeconomic status, household composition, minority status, or housing type and transportation. General outreach often misses connecting with these groups and lacks discussion of their unique risks to hazard events.

The mission of the Elizabeth City State University Emergency Management (ECSU EM) program is to provide a diverse pool of professionals with the skills required to maintain the safety of individuals, organizations, and communities from emergencies and disasters. The ECSU EM program is one of the many pre-existing organizations and outreach mechanisms in the region that can be used to maximize hazard outreach potential.

ECSU EM 2022

An integrated region-specific approach to current and future hazard impacts that targets diverse audiences using a variety of methods will ensure consistent messaging across geographies. This approach will have the largest reach.

Hazards Addressed

All Hazards: Drought, Erosion, Extreme Temperatures, Floods, Hurricanes, Severe Storms, Invasive Species, Water Quality Issues, Wildfires.

Sectors Addressed

The following sectors will be supported by this project:

- Social Vulnerability and Equity, Health, and Safety

- Housing, Critical Infrastructure, and Community Support Systems
- Economy
- Natural Environmental Systems
- Historical and Cultural Resources

Location/Service Area

Albemarle Region

Potential Impact

The Albemarle Region will develop a multi-faceted public outreach program, partnering with non-profit organizations, academia, and businesses, to organize and implement current and future hazard impact outreach.

Outreach will be developed to reach a variety of target audiences, including socially vulnerable populations. Target audiences are broken out from the populations that are considered "at risk" from the hazard or hazards of concern that the outreach is addressing. Target audiences will receive the same messaging as the general population but using different communication techniques that are specifically designed to reach and resonate with the target audience.

The program will work to expand beyond traditional hazard outreach pathways. The CRS User Group Project, identified in this portfolio, will convene local government staff to build education and outreach to communities. These projects share common goals and should be developed simultaneously as they each develop. Further, Elizabeth City State University's Emergency Management program may be available to assist with the development of educational materials, programming, and deployment. Museums in the region could be engaged and asked to partner in conducting outreach on past hazard events and potential future impacts.

Population(s) Served

This project will serve the entire population of the Albemarle Region including visitors, second home owners, and socially vulnerable populations.

Roles of Lead and Supporting Agencies

This project will establish an integrated, collaborative outreach effort between various academic groups, non-profit organizations, private businesses, and local governments.

Lead Implementer

The Albemarle Commission, in conjunction with the CRS User Group, will serve as the lead implementer. The Commission, along with participating local governments, can host a repository of outreach materials, in electronic form, on their respective websites. This repository will be organized according to the hazard type and the target audiences.

Supporting Agencies

Numerous federal, state, academic, environmental, and non-profit organizations will be contacted to ask for assistance in developing outreach materials, hosting outreach events, or leading trainings on hazard-related topics or outreach strategies.

Supporting agencies that showed interest during the planning process include:

- Elizabeth City State University's (ECSU) Department of Aviation and Emergency Management
- Tyrell County Community Development Corporation
- North Carolina Coastal Federation
- Albemarle Pamlico National Estuary Program
- Camden County Soil and Water District

- USDA NRCS Albemarle
- Camden County Soil and Water District

Additional partnerships may include:

- FEMA
- North Carolina Department of Public Safety and the NC Floodplain Management Program
- Soil and Water Conservation Districts
- American Red Cross
- County and local Offices of Emergency Management, Planning, and Building Inspections
- Museums
- Schools and youth organizations
- Environmental non-profits

Cost Estimate

The cost for the implementation of this project is estimated to be under $50,000 to establish outreach materials and $10,000 a year to train educators, develop a repository, and update materials as necessary.

Funding Sources

Funding to support the development of new outreach materials and the online repository may need to be supported through small grant opportunities.

Duke Energy Accelerator Grant. The RISE Region Resilience Portfolio Program will grant a total of $600,000 (or approximately $65,000 per region) for projects identified in the RISE program. Grant projects must be regional in scope. This funding can be used to secure additional finding from other sources. The deadline for this grant is spring 2023.

Since 2002, the Albemarle Pamlico National Estuary Program (APNEP) has supported over 40 outdoor education-conservation initiatives at schools and non-formal education centers throughout the region. This has included professional development opportunities for teachers. Training educators on how to communicate region-specific hazard impacts allows for greater reach and for information to reach the region's school children.

APNEP 2022

The North Carolina Environmental Enhancement Grant (EEG) Program provides grants to nonprofits, academic institutions, and government entities for wetland restoration, land acquisition, stormwater remediation, stream stabilization, and buffer installations. Additionally, the program funds research, planning, education, construction, remediation, and restoration. The program prioritizes projects that take place in or focus on benefiting underserved or overburdened communities. Because outreach and education are eligible activities, this grant might be a good match for the project.

Benefits Provided

Physical Benefits

Mitigation measures taken by property owners to protect homes and businesses are likely to occur throughout the Albemarle Region.

Socioeconomic Benefits

This project will provide educational awareness that will allow residents and businesses in the Albemarle Region to make informed decisions, allowing for the development of resilient communities and economies.

Environmental Benefits

Environmental education will be a major component of this project and focus on the encouragement of protection and enhancement of environmental systems that reduce natural hazard risk.

Equitable Outcomes

The Albemarle Region is home to many socially vulnerable populations that are at higher risk to the impacts of natural hazards and climate change.

Steps for Implementation

Phase 1: Project Kick-Off - In Phase 1, the Albemarle Commission will reach out to counties and municipalities in the Albemarle Region that may be interested in participating in this project to determine the level of interest and schedule a kickoff meeting.

Phase 2: Develop Outreach Goals and Audiences - In Phase 2, the group should identify outreach needs, specific audiences, and goals. It may be helpful to work with the CRS User Group who will also be conducting outreach to stakeholders in the region.

Phase 3: Identify How the Messaging to Specific Audiences May Occur - In Phase 3, the group should identify how messages should be conveyed to the audiences (through social media, workshops, videos, etc.).

Phase 4: Develop Messaging - In Phase 4, stakeholders will work together to develop messaging for the targeted audiences, topics, and delivery mechanism.

Phase 5: Develop Repository - In Phase 5, the Albemarle Commission will organize an outreach collaboration system and establish an online repository for outreach materials. Where possible, outreach materials in this repository will be in a template form that could be customized by the local government or organization.

Phase 6: Conduct Outreach - In Phase 6, outreach will be performed by local governments, academia, non-profits, and community-based organizations. Implemented outreach actions will be recorded as part of the database to identify and help to address potential outreach gaps in terms of targeted audiences and outreach topics. The Commission will work with groups like the Albemarle Pamlico Estuary Program and Elizabeth City State University's (ECSU) Department of Aviation and Emergency Management to develop and host workshops for educators, and facilitators, and to introduce new hazard-related information and outreach techniques. Promotion of these outreach materials and strategies will be led by the Commission and supporting agencies.

Implementation Timeframe

This project has a short implementation timeframe. Once established, the project will require ongoing maintenance for continual improvement of outreach materials and the continued offering of workshops and trainings.

Integration with Existing Plans, Programs, and Policies

This project will complement existing outreach programs in the Albemarle Region, including existing CRS programs. Flood-related outreach will be designed with scoring in the Community Rating System (CRS) in mind. This project could be integrated into local government planning documents such as Comprehensive Plans, Land Use Plans, Hazard Mitigation Plans, and Emergency Operations Plans.

This project will work with existing programs that currently conduct outreach such as emergency management groups and non-profits. The project will also seek to utilize non-traditional hazard outreach pathways such as the Homegrown Leaders program from the NC Rural Center, environmental education, and museum staff.

Challenges/Obstacles

The success of this project relies on the cooperation and enthusiasm of participants. This enthusiasm may be difficult to build and nurture under “blue sky” conditions without a disaster event that displays the importance of this effort. Outreach that is eligible for credit in the CRS program will provide an added incentive to shift to the outreach developed by this project.

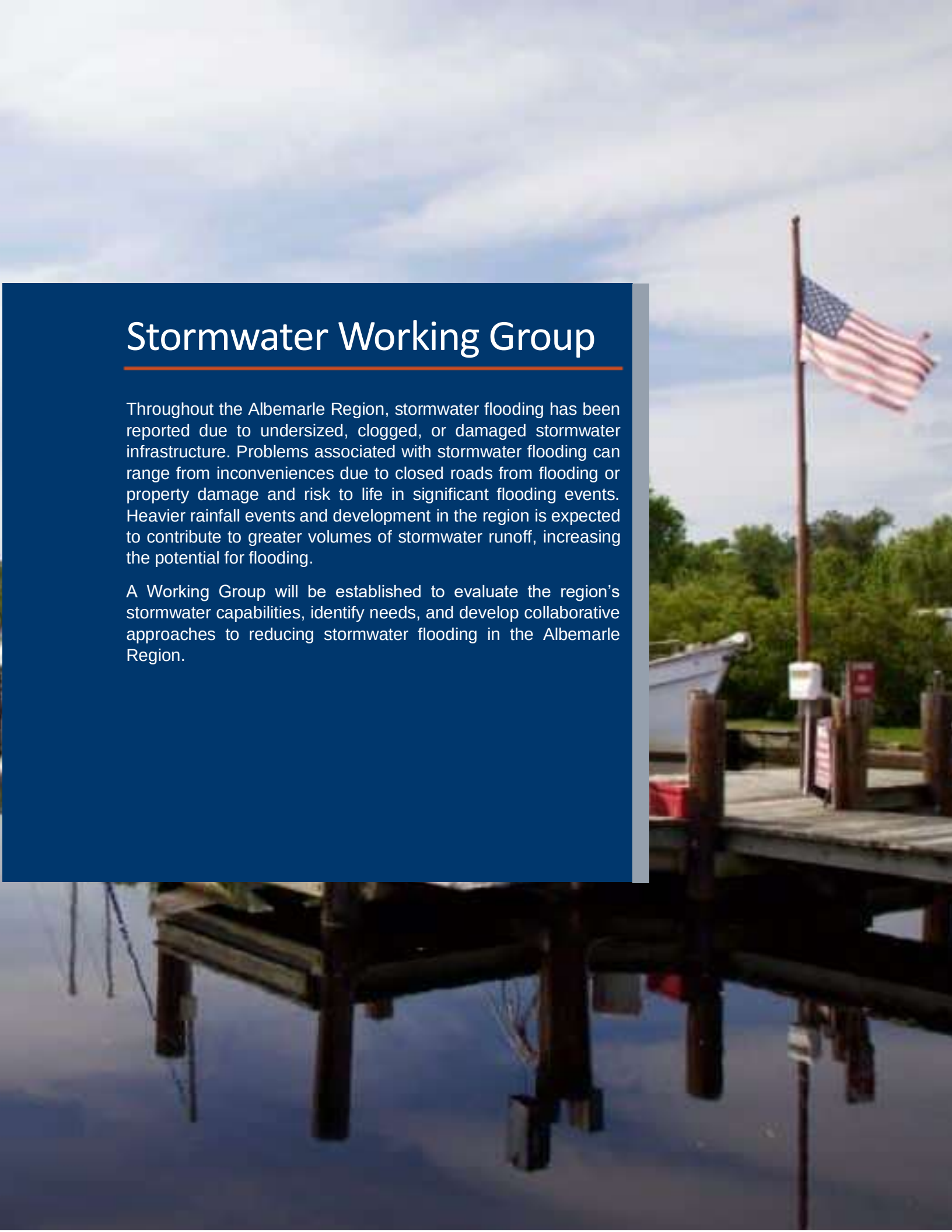
Legislative Challenges, Permitting, Zoning Requirements

There are no foreseen legislative challenges, permitting, or zoning requirements for this project.

Stormwater Working Group

Throughout the Albemarle Region, stormwater flooding has been reported due to undersized, clogged, or damaged stormwater infrastructure. Problems associated with stormwater flooding can range from inconveniences due to closed roads from flooding or property damage and risk to life in significant flooding events. Heavier rainfall events and development in the region is expected to contribute to greater volumes of stormwater runoff, increasing the potential for flooding.

A Working Group will be established to evaluate the region's stormwater capabilities, identify needs, and develop collaborative approaches to reducing stormwater flooding in the Albemarle Region.



STORMWATER WORKING GROUP

Problem

Flooding is one of the most visible hazards in the Albemarle Region. While the region garners a great deal of attention for coastal flooding, localized stormwater related flooding is occurring at an equal frequency. Problems from localized stormwater flooding can range from inconveniences due to closed roads to property damage.

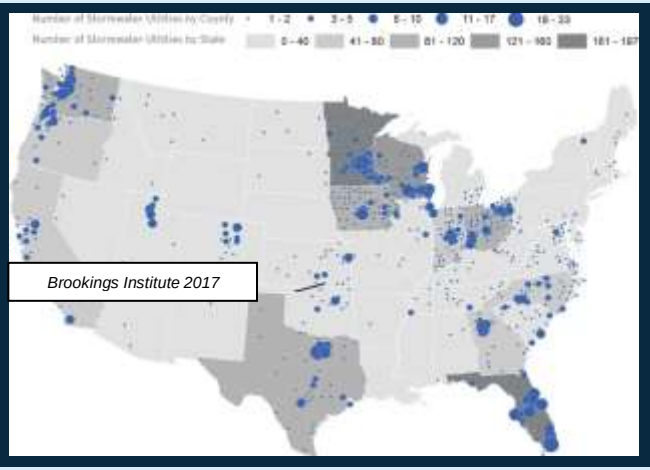
Construction of stormwater systems often takes place on a piece-by-piece basis over an extended period. Management of these systems is difficult and fragmented. As development has occurred and infrastructure aged, some stormwater systems become overwhelmed and lack the carrying capacity necessary to handle increased runoff.

Heavy rainfall events are becoming more common and intense resulting in frequent flooding of low-lying areas, even those not in special flood hazard areas (SFHA).

The Vulnerability Assessment for the region identified the following gaps in data and understanding:

- Better stormwater modeling tied to anticipated development is needed to determine future stormwater management needs.
- Mapping of stormwater/urban flooding locations is needed to identify problem areas within the region. This type of flooding is not included in FIRMs and is constantly changing due to clogging, failure, and repair of stormwater systems.
- Modeling is needed to better understand the potential extent and severity of combined riverine and coastal flooding.

A potential outcome of the working group may be stormwater utilities. Stormwater utilities are not uncommon in North Carolina. Expansion of the number and scale of stormwater utilities can provide more stable and consistent stormwater management, including maintenance and improvements to stormwater infrastructure, removing the burden on local governments.



Brookings Institute 2017

- Better climate projections for the future occurrence of coastal storms and hurricanes in the Albemarle Region is needed to inform the future frequency and severity of storm surge.
- Mapping of areas of anticipated future development would allow for a better understanding of changes in exposure to flooding, especially for location-specific flood risk like coastal and riverine flooding.

Hazards Addressed

Flood, Water Quality

Sectors Addressed

The following sectors will be supported by this project:

- Social Vulnerability and Equity, Health, and Safety
- Housing, Critical Infrastructure, and Community Support System

Location/Service Area
Albemarle Region

Potential Impact

Creation of a stormwater working group would provide a support network for local governments working to address stormwater management and flooding in their communities. Working group members could work together to better understand stormwater management related needs in the region and develop best practices to address them. The working group would allow participants the opportunity to share information and funding sources to strengthen their programs.

Population(s) Served
This project will support local governments in managing stormwater infrastructure. Through improved stormwater management, vulnerable populations in low-lying areas may be impacted less frequently.

Roles of Lead and Supporting Agencies

Lead Implementer
The Albemarle Commission will serve as the lead implementer.

Supporting Agencies
Supporting agencies in this project will include all interested county and municipal agencies responsible for stormwater management and maintenance (the partners), non-profit organizations that can provide outreach support, and academic organizations that can provide data. State agencies such as the North Carolina Department of Environmental Quality could provide support for planning.

The Working Group can connect with groups such as the North Carolina Coastal Federation to discuss low impact stormwater solutions to stormwater runoff. Projects involving wetlands restoration, natural infiltration techniques, and permeable pavement can reduce runoff and the necessary carrying capacity needs of stormwater infrastructure.

North Carolina Coastal Federation 2022

Cost Estimate
The cost for the implementation of this project is estimated to be low (under $5,000) and primarily focused on securing meeting spaces and staff time for participating officials.

Funding Sources
It is anticipated that the costs associated with hosting meetings of the working group and staff time for participants will be absorbed by operating budgets. Outcomes from the working group such as stormwater infrastructure improvements, identified equipment needs, or development of regional stormwater utilities are likely to be grant eligible through private, state, or federal sources, depending on the identified actions.

Benefits Provided

Physical Benefits
Identified improvements in stormwater management programs including infrastructure design, expansion of carrying capacity, and regular maintenance is likely to reduce the frequency and severity of stormwater flooding.

Socioeconomic Benefits

This project will increase the capacity of stormwater management programs which may reduce the damages caused by stormwater flooding. Damages avoided will include damages to stormwater infrastructure, roadways, buildings, and cars. The project will also result in a reduction in interruptions caused by stormwater flooding including roadway and business closures, emergency access issues, and lost wages.

Environmental Benefits

Improved management of stormwater systems may also result in improved water quality.

Equitable Outcomes

The Albemarle Region is home to numerous socially vulnerable populations. Many of these populations reside in low-lying areas susceptible to flooding where there is limited investment in stormwater infrastructure.

Steps for Implementation

Phase 1: Stakeholder Interest and Assessment - In Phase 1, the Albemarle Commission will invite county and municipal departments, stakeholders, and other potential project partners to participate in an interest meeting on stormwater and flooding needs. During this meeting, the working group will assess and identify common needs across organizations. The working group will identify the current stormwater capabilities of participants including:

- Are existing stormwater programs in place?
- Do the programs include management plans and regulations?
- Have areas of frequent flooding been identified?
- Is stormwater infrastructure inventoried and mapped?

The Working Group will use this information to identify what is working well in the region, what improvements are needed, and areas to develop partnerships and work across jurisdictional lines when possible.

Phase 2: Develop Mission and Goals - In Phase 2, the Working Group will use information collected during Phase 1 to develop a mission statement and goals for the Working Group. Based on these goals, a schedule for the frequency of meetings will be established.

Phase 3: Access & Review Existing Plans, Policies, and Studies - In Phase 3, participating jurisdictions will inventory their plans, policies, and studies relating to stormwater management and submit copies if available to the Albemarle Commission. If possible, the Commission will create a website or shared drive where this information can be stored and accessed by all communities.

Phase 4: Review Gaps Identified in Vulnerability Analysis - In Phase 4, the Working Group will review the gaps in data and understanding identified in the vulnerability analysis:

- Better stormwater modeling tied to anticipated development is needed to determine future stormwater management needs.
- Mapping of stormwater/urban flooding locations is needed to identify problem areas within the region. This type of flooding is not included in FIRMs and is constantly changing due to clogging, failure, and repair of stormwater systems.
- Modeling is needed to better understand the potential extent and severity of combined riverine and coastal flooding.
- Better climate projections for the future occurrence of coastal storms and hurricanes in the Albemarle Region is needed to inform the future frequency and severity of storm surge.
- Mapping of areas of anticipated future development would allow for a better understanding of changes in exposure to flooding, especially for location-specific flood risk like coastal and riverine flooding.

The Albemarle Commission will facilitate a meeting with participants to discuss how these gaps might be addressed.

Phase 5: Explore Strategies and Potential Projects - In Phase 5, the Working Group will explore stormwater strategies that will help accomplish the goals identified in Phase 2. This could range from physical projects to research, to template documents that assist local governments with their stormwater management needs. Opportunities for partnership or to work at regional levels will be identified.

Phase 6: Peer-to-Peer Network - In Phase 6, the Commission and participants will continue to meet and utilize this peer-to-peer network to help improve the management of stormwater in their jurisdictions and the region.

Phase 7: Long-term projects - In Phase 7, the Commission and participants can explore long-term implementation projects.

Implementation Timeframe

This project has a short timeframe. The informational meeting can take place once the Albemarle Commission has coordinated with potential government and stakeholder representatives.

Integration with Existing Plans, Programs, and Policies

Information collected and projects identified through the Stormwater Working Group can be incorporated into capital improvement planning, hazard mitigation planning, stormwater management plans, watershed management, and ordinances.

This project will complement several of the proposed projects in this portfolio including:

- Albemarle Specific Natural Hazards Outreach
- Develop County-Wide Stormwater/Watershed Master Plans
- Harmful Algal Bloom (HAB) Prevention and Identification

The project will increase collaboration between stormwater managers and academic and non-profit organizations that have expertise in future conditions, stormwater management best practices, and those that can help identify problem areas, particularly in locations with historically underserved populations.

Challenges/Obstacles

The size of the region, as well as varying needs, may make organizing and sustaining involvement difficult.

Legislative Challenges, Permitting, Zoning Requirements

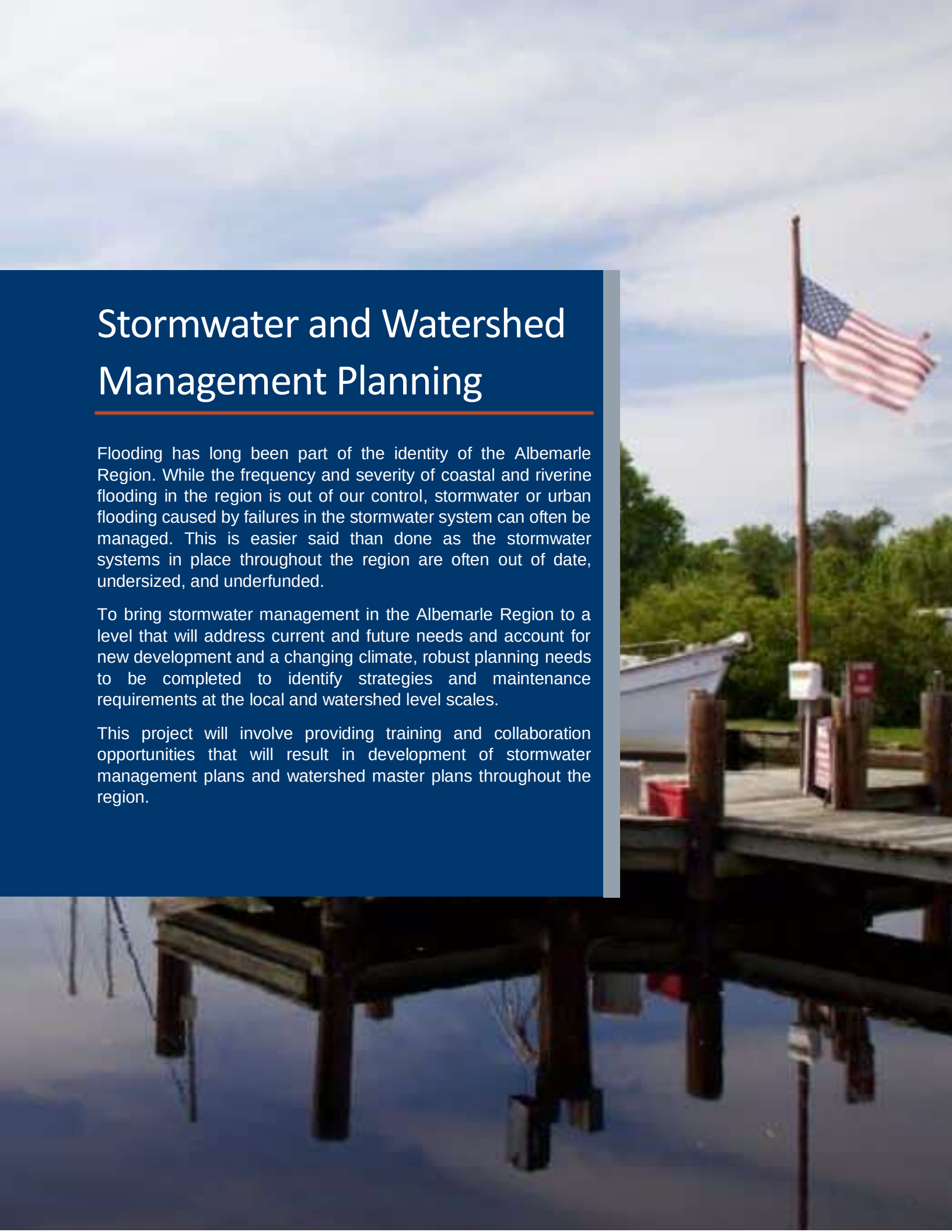
There are no legislative, permitting, or zoning requirement challenges at this time.

Stormwater and Watershed Management Planning

Flooding has long been part of the identity of the Albemarle Region. While the frequency and severity of coastal and riverine flooding in the region is out of our control, stormwater or urban flooding caused by failures in the stormwater system can often be managed. This is easier said than done as the stormwater systems in place throughout the region are often out of date, undersized, and underfunded.

To bring stormwater management in the Albemarle Region to a level that will address current and future needs and account for new development and a changing climate, robust planning needs to be completed to identify strategies and maintenance requirements at the local and watershed level scales.

This project will involve providing training and collaboration opportunities that will result in development of stormwater management plans and watershed master plans throughout the region.



STORMWATER AND WATERSHED MANAGEMENT PLANNING

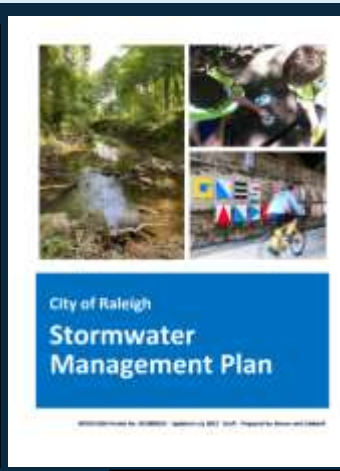
PROBLEM

Stormwater management presents a major obstacle in the Albemarle Region. There are numerous factors, both natural and man-made, that contribute to the difficulty of effective stormwater planning and the proper maintenance of stormwater systems. Actions that impact stormwater upstream in a watershed, such as increased development, will in turn impact the stormwater volume and speed of flow of water moving into downstream communities. Stormwater planning needs to be addressed beyond municipal and county boundaries and involves coordination and planning for entire watersheds.

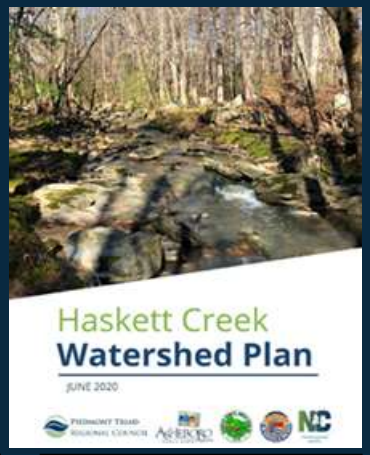
The region's high water table limits the ability to use certain stormwater detention and retention techniques to their maximum potential. Coastal storms can push storm surges inland, backing up natural conveyance systems and causing backflow in stormwater pipes. The slow and steady creep of sea level rise only exacerbates these issues. Increasing development and expansion of impervious surfaces cause higher rates of runoff. A changing climate has resulted in heavier and more intense rainfall events.

Existing stormwater infrastructure in the Albemarle Region, depending on when it was installed and how it was maintained, may be degraded and in need of replacement. Stormwater systems designed 50 or more years ago lack the carrying capacity to handle the volume of stormwater created by increasingly developed land and the modern frequency in the severity of rainstorms. Over time, stormwater capacity needs are only expected to increase.

A stormwater management plan can be used to improve water quality and reduce stormwater flooding based on jurisdictional boundaries. A watershed management plan considers watershed boundaries. These plans can work together to address stormwater quality and flooding issues.



City of Raleigh 2022



Piedmont Triad Regional Council 2022

Thorough and coordinated management of stormwater systems is needed throughout the region in order to address today's stormwater flooding concerns and prepare for tomorrow's conditions. Stormwater management plans need to be developed or updated to account for current infrastructure needs and include design specifications that consider anticipated changes in precipitation patterns that are likely to occur within the useful life of stormwater components. Proper maintenance strategies, including funding allocations and identification of responsible parties, must be part of stormwater management planning.

Hazards Addressed
Flood, Water Quality

Location/Service Area
Albemarle Region.

Potential Impact

All county and local municipal governments in the Albemarle Region will be invited to participate in workshops and be encouraged to develop and implement stormwater management and watershed master plans.

State agencies responsible for the review of plans and stormwater/watershed management will be encouraged to contribute to and participate in the workshops. Representatives of the Community Rating System (CRS program) will be invited to present methods of leveraging watershed master planning for points in the CRS program.

The North Carolina State Climate Office will be asked to present or contribute recommended guidance on future climate conditions that should be used to design stormwater system capacity requirements, including what present-day storm the systems should be designed to (10-year, 15-year, etc.) that will still account for future protections as well as sea level rise projections for coastal areas. It is expected that plans will be designed using data from the North Carolina Climate Risk Assessment and Resilience Plan.

Academia, environmental non-profit organizations, and soil and water conservation districts will be asked to partner with municipalities and counties to develop their plans, especially for watershed master plans that cross county borders.

Each municipality/county that develops and implements a stormwater management plan will also be strongly encouraged to develop a stormwater flooding reporting system. This system could be an online portal or a simple phone number that residents can use to report stormwater flooding and locations that need maintenance (debris clogs, broken or failing components, etc.). The reporting systems should connect directly to the responsible parties for the particular section of the stormwater system that is being reported on. Annual meetings of the responsible parties will be recommended to convene to discuss how maintenance of the system is proceeding if additional investment is needed and identify areas in need of an upgrade that should be included in the planning documents.

While the primary goal of this project is to reduce the occurrence of stormwater and urban flooding, a secondary benefit will be an improvement in water quality. Proper stormwater and watershed management will include proper treatment of runoff to prevent pollutants and nutrients from reaching local waterways.

Population(s) Served
This project will serve the entire population of the Albemarle Region.

Sectors Addressed
The following sectors will be supported by this project:

- Housing, Critical Infrastructure, and Community Support Systems
- Natural Environmental Systems

Roles of Lead and Supporting Agencies

This project will encourage the implementation of stormwater management and watershed master plans in the Albemarle Region through guidance and input from a variety of agencies and organizations.

Lead Implementer

The Albemarle Commission will serve as the lead implementer of the project and host workshops on the proper development of stormwater management plans for municipalities and counties. The Commission will also provide additional workshops on the development of watershed master plans. The Commission will host guidance materials and example model documents on its website.

Supporting Agencies

All county and local municipal governments in the Albemarle Region will be invited to participate in workshops and be encouraged to develop and implement stormwater management and watershed master plans.

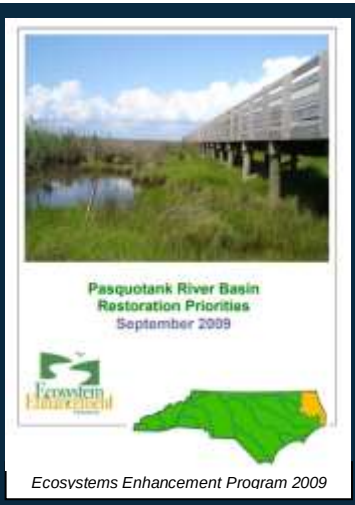
Agencies that will be asked to provide input and guidance on best practices for developing stormwater management and watershed master plans will include:

- State agencies responsible for review of plans and stormwater/watershed management
- Representatives of the CRS program
- North Carolina State Climate Office
- North Carolina Division of Mitigation Services
- North Carolina Department of Environmental Quality including the Division of Marine Fisheries
- Academia
- Environmental non-profit organizations
- Soil and Water Conservation Districts

Cost Estimate

The cost for the implementation of this project is estimated to be low (under $5,000) and mainly involves the costs of meetings and storing stormwater/watershed plan guidance, references, and sample plans on an online platform for easy access. Costs of stormwater infrastructure improvements identified by municipalities and counties are likely to be high.

The NC Division of Mitigation Services (DMS) is currently in the process of revising its River Basin Restoration Priority (RBRP) methodology and products. River Basin Restoration Priorities (RBRPs) are plans that DMS develops to identify priorities for the protection and enhancement of water quality, fisheries, wildlife habitat and recreational opportunities. The plans can be used to inform the development of watershed master plans that also consider reducing the impacts of flooding.



Ecosystems Enhancement Program 2009

Funding Sources

Funding for hosting workshops for the development of stormwater management and watershed master plans is anticipated to be provided by the Albemarle Commission.

Development of watershed plans could be jointly funded by groups of county and municipal governments with grant funding from the NC DEQ 205(j) Water Quality Management Planning Grant. Private and foundational funding may also be available from sources such as the Golden LEAF Foundation. The Duke Energy Accelerator Grant may also be an option. The RISE Region Resilience Portfolio Program will grant a total of $600,000 (or approximately $65,000 per region) for projects identified in the RISE program. Grant projects must be regional in scope. This funding can be used to secure additional finding from other sources. The deadline for this grant is spring 2023.

The NC DEQ Division of Water Infrastructure was awarded approximately $82 million in American Rescue Plan Act funding for

stormwater projects through its competitive funding process from the newly-created Local Assistance for Stormwater Infrastructure Investments (LASII) program. Grants were available to local governments for projects to improve or create infrastructure for controlling stormwater quantity and quality. Construction grants and planning grants were available – stormwater construction grants were limited to $5 million per applicant per grant cycle and stormwater planning grants were limited to $400,000 per applicant per grant cycle. Applications for Fall 2022 funding round were due September 30, 2022. Spring 2023 applications are due May 1, 2023.

Benefits Provided

Physical Benefits

As stormwater management and watershed master plans are used to implement capital improvements, stormwater infrastructure systems will be strengthened throughout the region, leading to reduced flooding.

Socioeconomic Benefits

This project will encourage improved flooding resilience in the Albemarle Region through proper stormwater management. This should result in reductions in road closures due to flooding and necessary repairs, maintaining access to businesses and neighborhoods and keeping emergency response times low.

Watershed plans have already been developed by numerous coastal communities and land management groups in North Carolina (including Hyde County and the Mattamuskeet Drainage Association within the Albemarle Region).

Environmental Benefits

As stormwater infrastructure improvements are made, proper treatment of stormwater will result in improvements in water quality through the reduction of non-point source pollution and nutrient loading.

Equitable Outcomes

The Albemarle Region is home to numerous socially vulnerable populations and many of these populations are located in areas that have received low funding support for stormwater infrastructure. With stormwater management and watershed master plans likely to result in long-term stormwater management and infrastructure improvements, areas with historically low investment in stormwater infrastructure will be prioritized.

Steps for Implementation

Phase 1: Workshops - In Phase 1, the Albemarle Commission will coordinate with the Stormwater Working Group (project identified through this effort), state and federal agencies, academia, and environmental non-profits to gather input on best management practices. The Stormwater Working Group can assist the Albemarle Commissioner in identifying the specific needs, training, and outreach needed to support development of watershed plans within the region. Once specific topics have been identified and speakers are secured, the Commission will invite municipal and county governments to workshops. The workshop schedules, number of workshops, and topic areas will be determined by the level of interest.

Potential topics may include:

- What is a Watershed Plan and how to Develop a Watershed Plan.
- Potential protective criteria recommendations for the Chowan River and Albemarle Sound from the Nutrient Criteria Development Plan (NCPD) Scientific Advisory Council (SAC) to reduce nutrient loading of waterways that contribute to eutrophication and Harmful Algal Blooms (HABs).
- Recommendations for on-site wastewater treatment systems (septic) that reduce impacts on water quality.
- Encouragement of green infrastructure techniques and habitat restoration to increase natural infiltration, utilizing guidance

from documents like the Coastal Federation's Action Plan for Nature-Based Stormwater Strategies.

- Mapping of areas where future development is anticipated to allow better understanding of potential downstream increases in runoff and associated water quality issues.
- Anticipated needs for increasing the capacity of stormwater systems due to increases in heavy rainfall events and higher runoff due to the development.
- Considerations for the impact of sea level rise on stormwater outfalls, wetlands retreat, and migration of saltwater interfaces.

Phase 2: Stormwater and Watershed Planning- In Phase 2, the Albemarle Commission will work with state and federal agencies, academia, and environmental non-profits to offer education and outreach to interested municipal and county governments who wish to pursue development of watershed level plans. EPA has resources that may be helpful in the development of outreach and education include, "A Quick Guide to Developing Watershed Plans to Restore and Protect Our Waters" and "Handbook for Developing Watershed Plans to Restore and Protect Our Waters". Development of region-specific outlines, template language, project costs, and even budgeting for implementation may also be helpful in assisting local governments with the development of watershed plans. Identification of grants that can assist local governments in paying for watershed plans and subsequent infrastructure installation will also remove barriers to implementation.

Phase 3: Development of a Resource Repository – The Albemarle Commission could develop an online Resources Repository for Watershed Planning where all the workshops, webinars, templates, and guidance for local governments can "live".

Phase 4: Development of Watershed Plans - *The* Albemarle Commission, along with other State and non-profit partners, could assist interested local governments with watershed planning.

Implementation Timeframe

This project has a short implementation timeframe. The scheduling of workshops will be based on the availability of speakers and the interest of participants.

Integration with Existing Plans, Programs, and Policies

This project will build on prior stormwater management planning efforts in the Albemarle Region. The project will complement the proposed stormwater working group project as well as the CRS Working Group. Watershed master plans can be counted toward points for the CRS program.

The project will increase collaboration between counties, municipalities, and academic and non-profit organizations that undertake flood related outreach and habitat restoration.

Challenges/Obstacles

The size of the region, as well as varying needs, may make organizing and sustaining involvement difficult.

Legislative Challenges, Permitting, Zoning Requirements

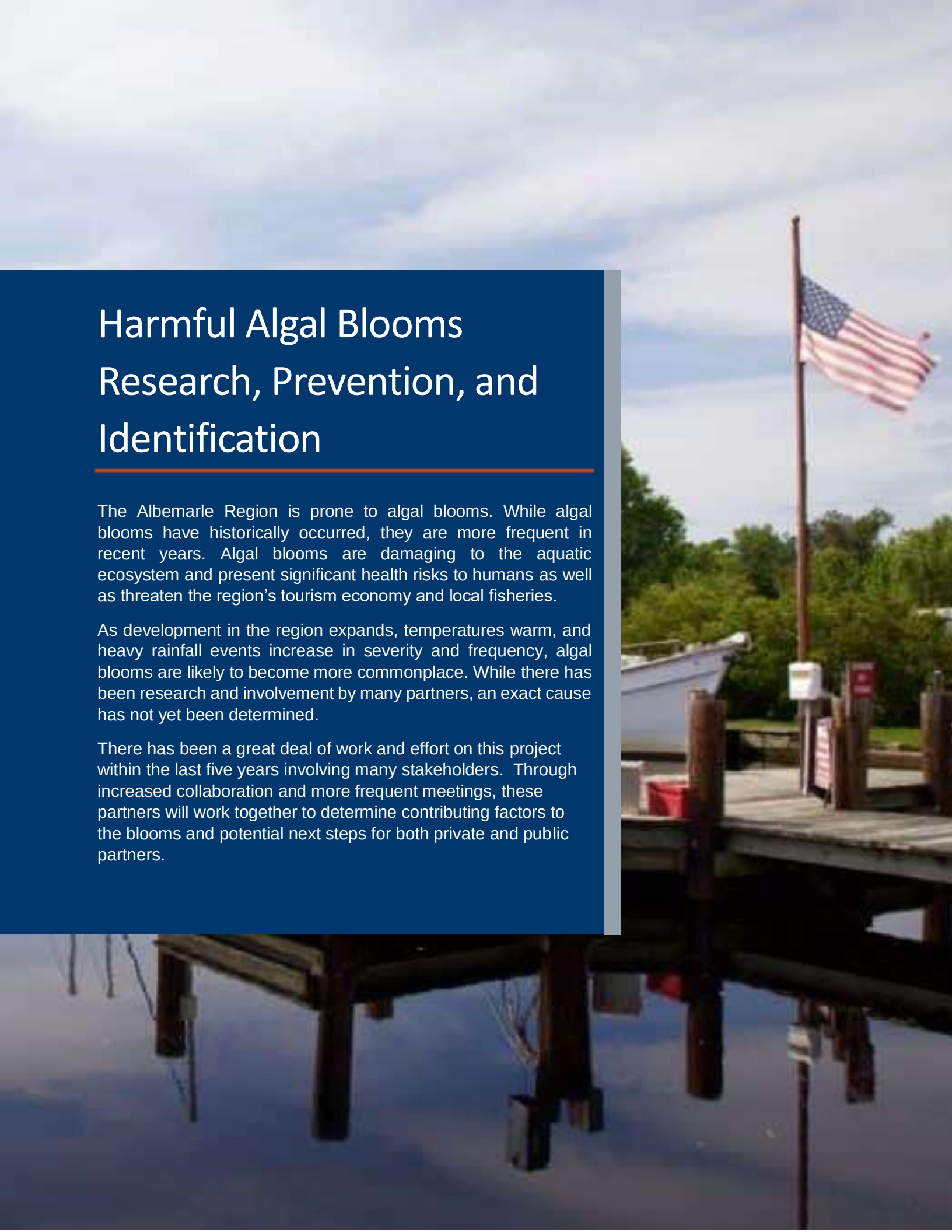
There are no legislative, permitting, or zoning requirement challenges at this time.

Harmful Algal Blooms Research, Prevention, and Identification

The Albemarle Region is prone to algal blooms. While algal blooms have historically occurred, they are more frequent in recent years. Algal blooms are damaging to the aquatic ecosystem and present significant health risks to humans as well as threaten the region's tourism economy and local fisheries.

As development in the region expands, temperatures warm, and heavy rainfall events increase in severity and frequency, algal blooms are likely to become more commonplace. While there has been research and involvement by many partners, an exact cause has not yet been determined.

There has been a great deal of work and effort on this project within the last five years involving many stakeholders. Through increased collaboration and more frequent meetings, these partners will work together to determine contributing factors to the blooms and potential next steps for both private and public partners.



HARMFUL ALGAL BLOOMS RESEARCH, PREVENTION, AND IDENTIFICATION

Problem

The Albemarle Region is dominated by freshwater rivers and streams and brackish coastal waters. Contamination of these waterbodies can damage ecosystems, threaten fisheries, and negatively impact recreation and tourism. Algae blooms, especially those dominated by cyanobacteria (also known as blue-green algae), can occur when eutrophication occurs, resulting in rapid growth and reproduction of algae in what is commonly referred to as a "bloom." When waterbodies are inundated by water runoff with high levels of naturally occurring and manmade nutrients, the waterbodies become more vulnerable to algal blooms.

Algal blooms that cause adverse effects are known as Harmful Algal Blooms (HABs). When favorable environmental conditions exist, algae can reproduce rapidly and form blooms that appear as surface scums, water discoloration, or both. Blooms also cause major changes in water chemistry, including high pH and dramatic swings in dissolved oxygen. Lack of oxygen created by decomposing algal blooms sometimes results in fish kills and other aquatic life impacts.

Some algae, especially blue-green algae, can produce toxins. These toxins have been linked to adverse health effects in wildlife, domestic pets, and humans. The Division of Water Resources (DWR) currently tests samples for microcystin, one of the most common and well-studied algal toxins.

When public health concerns arise from algae blooms, local health departments and the N.C. Department of Health and Human Services determine an appropriate response with technical support from DWR. Common actions include swimming closures, contact advisories, and the issuance of public notifications. In addition to environmental and public health concerns, blooms can lead to economic losses due to increased drinking water treatment costs, decreased tourism and recreation, remediation efforts, fisheries losses, and decreased property values.

Harmful algal blooms, or HABs, can take on a variety of forms including discolored water or surface scums that can appear bright green, blue, red, or brown in color; floating or submerged clumps, flecks, or mats; or milky blue/white surface scum. Suspected algal blooms should be reported to the North Carolina Division of Water Resources using the Fish Kill/Algal Bloom Reporting App.

NC DEQ 2022

During the 2015 to 2022-timeframe, multiple occurrences of algal blooms in the Chowan River, Perquimans River, Little River, and Pasquotank River, and Albemarle Sound were documented. As temperatures warm, and increased heavy rainfall events combine with increased development, the frequency and duration of HABs may become more commonplace. Equal to the complexity of the problem are the number of efforts and organizations working to address this problem. While there has been a great deal of effort working on the blooms in the region, increased collaboration across interested stakeholders is needed to determine a cause of the blooms and what next steps are needed.

Hazards Addressed
Water Quality Issues

Sectors Addressed
The following sectors will be supported by this project:

- Social Vulnerability and Equity, Health, and Safety
- Economy
- Natural Environmental Systems

Location/Service Area
Albemarle Region

Potential Impact

If completed, this project will work to improve the water quality of rivers in the Region as well as the overall quality of life thereby protecting public health and recreational use of these waters. Partnerships will be strengthening through increased engagement and collaboration.

Population(s) Served
This project will serve the entire population of the Albemarle Region, including tourists, but focus on the Following target audiences:

- Populations living near waterbodies
- Tourists, ecotourism groups, and populations who use those waterbodies for recreation
- Commercial and recreational fishermen
- Populations that rely on surface water for their potable water supply.

Roles of Lead and Supporting Agencies

This project will establish a collaborative outreach effort between various environmental non-profits, state agencies, and academic institutions.

Lead Implementer
The Albemarle Commission in conjunction Albemarle Resource Conservation and Development will serve as the lead implementer at the beginning of the project and invite the supporting agencies to attend a workshop to discuss informational needs, data gaps, target audiences, and outreach strategies surrounding HABs in the Albemarle Region.

Supporting Agencies
Numerous federal, state, academic, environmental, and non-profit organizations will be contacted to ask for assistance in developing outreach materials and outreach strategies and conducting outreach.

Supporting agencies for this project include:

- Chowan Edenton Environmental Group
- Green Saves Green
- Municipal and County governments
- Tyrrell County Community Development Corporation
- Albemarle-Pamlico National Estuary Partnership
- North Carolina Sea Grant
- North Carolina Coastal Federation
- Soil and Water Conservation Districts

Additional cooperation will be requested, as a starting point, from the following groups:

- North Carolina Division of Water Resources
- North Carolina Department of Agriculture and Consumer Services
- North Carolina Department of Environmental Quality including the Division of Marine Fisheries
- North Carolina Department of Health and Human Services
- North Carolina Environmental Management Commission
- North Carolina Water Resources Research Institute

- National Oceanic and Atmospheric Administration (NOAA) Sea Grant
- United States Fish and Wildlife Service
- U.S. Geological Survey (USGS)
- Natural Resources Conservation Service
- Waterkeepers Carolina
- Science and Technologies for Phosphorus Sustainability (STEPS) Center
- Universities and colleges
- Schools and youth organizations

Cost Estimate

The cost for the implementation of this project is estimated to be low.

Funding Sources

There is no funding needed for the initial steps. Funding for next steps of this project will be identified by the stakeholder group. However, the Duke Energy Accelerator Grant may also be an option. The RISE Region Resilience Portfolio Program will grant a total of $600,000 (or approximately $65,000 per region) for projects identified in the RISE program. Grant projects must be regional in scope. This funding can be used to secure additional finding from other sources. The deadline for this grant is spring 2023.

Benefits Provided

Physical Benefits

Minor physical benefits are expected from this project.

Socioeconomic Benefits

Potential reduction in the frequency and severity of HAB events will benefit the tourism and fishing industries. Additionally, this project will aid in mitigating the health-related impacts by fostering better awareness and understanding of how to avoid, report, and track HABs.

Environmental Benefits

Generally efforts will increase awareness of the impacts to the environment with localized discussion on specific issues related to HABs.

Equitable outcomes

Many socially vulnerable populations rely on the health of the region's coastal ecosystems for their livelihoods including those in the hospitality industry at tourist destinations and those involved in commercial fisheries. This project will benefit work to improve ecosystem health and allow for safe food, water, and stable sources of income.

Academic organizations such as the Science and Technologies for Phosphorus Sustainability (STEPS) Center who conducts research on phosphorus, one of the nutrients that can contribute to HABs, will be asked to contribute up to date information on eutrophication and HAB reduction techniques that can be used in the Albemarle Region.

STEPS 2022

Steps for Implementation

There has been a great deal of work and effort on this project within the last five years involving many stakeholders.

The Chowan and Pasquotank River Basin Water Resources plans outlines relevant information specific to implementation of this project including various related initiatives, involved stakeholders, and funding. There are recommendations specific to algal blooms that support the project including:

- expanding education and outreach to improve digital bloom reporting;
- tracking health-related algal events including closures and advisories;
- developing/expanding local capacity to monitor for algal blooms and algal toxins; and
- coordinate and facilitate semi-annual meetings between state agencies, local agencies, and stakeholders to discuss water quality concerns.

The Albemarle Resources Conservation and Development Council (Albemarle RC&D) website also has a very succent summary of recent events and stakeholders, including minutes and presentation from recent actions and general outreach for residents.

Implementation for this project should support, not duplicate, efforts already underway.

Step 1: Meeting and Assessment: In Step 1, the Albemarle Commission, in conjunction with Albemarle RC&D and other key stakeholders, will invite supporting agencies, local governments, and other stakeholders to attend a meeting to discuss the current status of research and efforts by all the engaged groups and stakeholders. The goal of meeting will be to learn about all the status of recent efforts, informational needs, data gaps, target audiences, and outreach strategies surrounding HABs in the Albemarle Region. This meeting could mirror and update action since the last major meeting in the region, February 2020 (see minutes on the Albemarle RC&D website). The group should explore and determine next steps to work cooperativity to manage and address the algal bloom problem. This should include some type of outreach to the public. The group could consider setting up a more routine meeting schedule and determine when the group will meet again. It may be helpful if the group can determine a way to communicate the status of actions with the entire group after the initial meeting such as an email group or Teams Group.

Step 2: Meeting Follow Up and Next Steps. At the initial meeting, the group should have identified next steps. The Albemarle Commission and Albemarle RC&D should communicate regular updates and collect status on action items. These items could be posted on a website in a central location. Additionally, project leads could discuss and decide how to outreach updates not only to the stakeholder group, but local governments, their elected body, and any other important identified groups or parties. Project leads should host another meeting at the identified time.

Implementation Timeframe

This project has a short implementation timeframe. Convening of Phase 1, Meeting and Assessment should be able to be completed within the 2023 year.

Integration with Existing Plans, Programs, and Policies

Next steps actions, identified by the stakeholder group could be integrated into local government land use, comprehensive, hazard mitigation, stormwater, or similar planning efforts. Any updates in policy or findings should be integrated in the Chowan and Pasquotank River Basin Plans.

Challenges/Obstacles

The number and diversity of stakeholders involved and working on different aspects of this project makes it challenging to keep everyone informed and involved.

Legislative Challenges, Permitting, Zoning Requirements

There are no foreseen legislative challenges, permitting, or zoning requirements for this project.

APPENDIX A: OTHER RESILIENCE PROJECTS CONSIDERED BY THE RISE ALBEMARLE REGION

Project Name	Project Description	Lead Agency
Organization of Private Sector Emergency Response Partnership	**PROBLEM** Government disaster response following a large-scale event takes time, especially where outside resources need to be brought in. Storm damages to infrastructure, limitations in infrastructure, and the region's expansive sounds and waterways limit the speed of this response. **SOLUTION** Enhance relationships between faith-based organizations, non-profits, and businesses to allow for rapid deployment of goods to aid in recovery and supplement state or federal response and support agencies.	While a lead implementer has not yet been identified, a central faith-based organization, non-profit, or business will ultimately lead in identifying and inviting participants to join the group. The Albemarle Commission will assist in this identification effort.
Resilience Hub Network	**PROBLEM** In order to continue to have viable communities and economies in the Albemarle Region, Homeowners, farmers, and business owners need to be aware of the impacts of sea level rise, severe rainfall, and other hazard impacts and the potential mitigation measures they can take to protect lives and property. **SOLUTION** Create a network of resilience hubs (one for each county) that would offer information, guidance, and technical assistance to residents and business owners on hazards and mitigation options. Establish a peer-to-peer network to support resilience hubs.	Ongoing outreach and discussions are required to identify organizations that are currently involved with resilience hubs in the region.
Regional Home Elevation Program	**PROBLEM** Most home elevation grant programs (FEMA FMA, HMGP, etc.) require the homeowner to self-fund their elevation projects before being reimbursed once work is complete. Many homeowners, particularly socially vulnerable populations, do not have the budget to cover these upfront costs, essentially eliminating these programs as an avenue to protect their properties.	To Be Determined

Project Name	Project Description	Lead Agency
	SOLUTION Establish a regional program to provide the upfront costs for participation in elevation reimbursement programs. The program would provide funding for construction costs for home elevation for low-income property owners. Upon property owner reimbursement from FEMA, the funds would be restored to the program to support the next homeowner.	
Wetlands Mitigation Banks	**PROBLEM** Wetlands are at risk for loss throughout the Albemarle Region due to sea level rise, wetlands retreat, erosion, saltwater intrusion, and habitat degradation. Wetlands provide critical habitat, improve water quality, and provide flood protection and wave attenuation for adjacent areas.	North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS), the Coastal Federation, local governments, and landowners
	SOLUTION Utilize and expand existing wetland mitigation banks. Wetland mitigation banks are established through the restoration, creation, or enhancement of wetlands. When a mitigation bank is established, the landowner retains ownership and use of the property, while a conservation easement protects the wetlands from incompatible degrading activities.	
	PROBLEM Evacuation routes in coastal areas are degraded in many areas. Some roadways used as evacuation routes are undersized (not enough lanes) or low-lying. This presents risk of potential damage/failure of roadways during hazardous events, roadways being exposed to flooding, and the speed of evacuation being reduced by the maximum capacity of the roadway.	
Coastal Evacuation Route Upgrades	**SOLUTION** Conduct a transportation study to identify inadequacies. Undertake roadway widening, bridge replacement, and ferry upgrades to aid in the evacuation.	State-level coordination and approval are needed from NC DOT; Hyde County will take a lead role as a pilot county.
	PROBLEM The state does not conduct ambient water quality sampling in Currituck Sound, North Landing River, or the Northwest River watersheds.	
Water Quality Sampling Program	**SOLUTION** Establish a standard water quality sampling program to test for potential contaminants and harmful algal blooms. This would include using a numeric nutrient criterion to test for potential eutrophication issues.	Albemarle-Pamlico National Estuary Partnership
	PROBLEM Many stormwater systems in the Albemarle Region are undersized. Current standards for stormwater system construction are based on precipitation norms of the past and	

Project Name	Project Description	Lead Agency
	do not incorporate today or tomorrow's projected rainfall conditions. Undersized stormwater components lead to stormwater flooding and potential damage to roadways, adjacent properties, and the stormwater system.	
Stormwater Modeling	**SOLUTION** Develop a stormwater model that projects capacity needs based on anticipated changes in precipitation for the lifespan of the stormwater infrastructure. Utilize this model to establish regional stormwater system requirements for construction and guide the replacement/upkeep of current systems.	Would require the collaboration of NC State DOT, NCDEQ, and academia; Pasquotank County is willing to take a supporting role as a pilot.
	PROBLEM Inflow and infiltration (I&I) occur when rainwater or groundwater enters the wrong system – the sanitary wastewater system – and over burdens it. Groundwater (infiltration) seeps into sewer pipes through holes, cracks, joint failures, and faulty connections. Stormwater (inflow) rapidly flows into sewers via roof drain downspouts, foundation drains, storm drain cross-connections, and through holes in manhole covers. Groundwater tables are rising in the region. Stronger rainfall events and stormwater deficiencies can cause urban flooding to be more intense and last longer. Most I/I is caused by aging infrastructure that needs maintenance or replacement. In the Albemarle Region, wastewater treatment plants assume that I&I is a large problem as volume rates rise dramatically during and following a rainfall event. As I&I worsens, costs of wastewater treatment rise, and the potential for the release of untreated wastewater due to volume exceedance increases.	
Address I&I in Sewerage Lines	**SOLUTION** Develop a regional program to identify sources of I&I and establish a program to fund necessary repairs. Improvements and repairs could include locking lids, flood vents, and watertight systems.	Regional Sewer Utilities, Counties, Municipalities
	PROBLEM Numerous lift stations in the Albemarle Region are not elevated and could be impacted by flooding, resulting in potential damage and release of untreated water.	
Elevate Lift Stations	**SOLUTION** Survey the region's lift stations to determine current flood protection levels. Elevate flood-prone lift stations and waterproof components that are not able to be lifted.	Regional Sewer Utilities, Counties, Municipalities
	PROBLEM The North Carolina State Real Estate Commission requires sellers to tell buyers if the seller has "actual knowledge" of the property is subject to flood risk or being located in a federally designated flood area. This language is not specific enough to require a	

Project Name	Project Description	Lead Agency
	comprehensive assessment of past flooding or other hazard events. There also is no need to tell buyers whether they are required to have flood insurance.	
Hazard Disclosure	**SOLUTION** Establish a regional hazard disclosure policy and expand hazard disclosure to include discussion of a flood, erosion, and other hazards. A flood-focused hazard disclosure requirement has recently been proposed by the Biden administration on a national scale. It would require the disclosure of any previous flood damage, flood insurance claim, or requirement to have flood insurance. FEMA would enforce disclosure by requiring counties and municipalities that participate in the federal flood insurance program to have disclosure policies in effect, either through local or state laws.	North Carolina, State Real Estate Commission
	PROBLEM Pasquotank County has a high flood risk and a history of flooding damages. Specific flood issues have been identified at the Meadstown/Weeksville portion of the County and the Newland area, a flood study is needed. Given the low elevation of the County, sea level rise will result in increasing coastal flooding risk in the future.	
Address Flooding in Pasquotank County	**SOLUTION** Complete a flood study of Pasquotank County, develop a stormwater/flooding/ watershed master plan for Pasquotank County, and implement identified actions. Replicate the planning and implementation effort in other counties in the Albemarle Region.	Pasquotank County
	PROBLEM It is difficult to compete for national grants for resilience project funding.	
Creation of Regional Resiliency Funding Source	**SOLUTION** Develop a regional funding program to fund smaller projects in the Albemarle Region that would struggle to be competitive on a national scale.	Existing regional leaders such as the Albemarle Commission
	PROBLEM The Albemarle Region is impacted by poor air quality due to high temperatures and other air quality issues. Residents of the Albemarle Region have a high rate of asthma and are more prone to the impacts of poor air quality.	
Expand Air Quality Testing	**SOLUTION** Expand on the air quality sensor network being established by the Chowan Environmental Group to develop full coverage of the Albemarle Region.	Chowan Edenton Environmental Group

Project Name	Project Description	Lead Agency
	PROBLEM Navigable channels need to be maintained to allow for commercial and recreational boating, including ferry systems. Erosion of shorelines results in sediment being transferred into waterways and channels. Inland channels that are filled with sediment and debris contribute to flooding.	
Dredging of Inlets and Waterways	**SOLUTION** Conduct regular dredging of inlets and navigable waterways. Complete de-snagging and siltation removal of inland waterways that are flood concerns.	USACE, Soil and Water Conservation Districts; Hyde County would be interested in participating in work in connection with: Dredging inlets and Waterways - particularly Hatteras Inlet and Silver Lake Channel in Ocracoke and would take a leading role.
	PROBLEM Interoperable communications were identified in the General Assembly's Criminal Justice Information Network report of 1995 as a critical need for public safety agencies when responding to emergencies. The State is using the VIPER system of 800 MHz radios. To have coordinated communication, local agencies need to incorporate 800 MHz radios into their dispatch center consoles so they can communicate with State personnel and neighboring counties on the VIPER system. Not all county and local agencies have this capability yet due to costs. This results in limited emergency response coordination capabilities.	
VIPER Radio Expansion	**SOLUTION** Implement upgrades of communications systems to the VIPER system in local and county emergency response agencies that currently lack it to achieve interoperability.	North Carolina Department of Public Safety, county, and municipal emergency management departments. Hyde County has verbally committed to take a supporting role.
	PROBLEM Low-lying coastal farmlands are losing productivity due to regular flooding and saltwater intrusion. Wetlands are being lost due to erosion and sea level rise near the water’s edge in many locations.	
Convert Flood Prone Farmland to Wetlands	**SOLUTION** Conduct a survey of coastal farmers in the Albemarle Region to determine acreage of farmland that is regularly flooded/abandoned due to sea level rise. Establish conservation easements on impacted farmland in exchange for payments to landowners. Convert land located in easements to wetlands.	NC DEQ, NCSU, USDA
	PROBLEM The state of North Carolina does not have stringent testing requirements in place for harmful algal blooms and lacks ambient water quality standards for cyanobacteria or related cyanotoxins.	

Project Name	Project Description	Lead Agency
Ambient Water Quality Standard for Cyanobacteria and Cyanotoxins	**SOLUTION** Increase water quality testing for harmful algal blooms. Develop state water quality criteria for common cyanotoxins and adopt the 2019 EPA-recommended cyanotoxin ambient water-quality criteria for recreational use.	NC DEQ, NC DHHS, North Carolina Environmental Management Commission
	PROBLEM Monitoring of natural systems is needed to identify long-term changes from hazards such as erosion, wetlands retreat, saltwater intrusion, sea level rise, and invasive species. Hazard events that result in damages also need to be surveyed. Lack of this information results in a less thorough understanding of hazard impacts/problem areas and weakens potential grant applications.	
Establish Drone Monitoring Program	**SOLUTION** Establish an AUV monitoring program through the Elizabeth City State University Aviation Science Degree program. Use long-term aerial monitoring to establish baselines for the region's: beaches to monitor for erosion; wetlands to monitor for wetlands retreat; coastal forests and coastal agriculture to monitor for saltwater intrusion/ghost forests, and forests and other at-risk ecosystems to monitor for invasive species. Complete post-event surveys for storms, floods, severe erosion events, harmful algal blooms, and wildfires.	Elizabeth City State University
	PROBLEM Water management improvements are needed for Lake Phelps at Pettigrew State Park and canals leading out of the lake that is connected to the Scuppernong River. Flood issues are compounded by agricultural ditches and water management / hydrologic restoration at Pocosin Lakes National Wildlife Refuge. Flooding may be caused by a variety of factors including rainfall/climatic issues, storm-driven flooding, sea level rise, and poor drainage systems. Floodwaters block roadways and surround the St. Mary's Church outside of Crestville in eastern Washington County.	
Scuppernong River Flood Study	**SOLUTION** Complete a flood study to identify the causes of and methods of addressing flooding in Washington, Tyrrell, and Hyde Counties. Implement identified actions.	Soil and Water Conservation Districts

APPENDIX B: RESILIENCE SCORECARD

Category	Considerations	-1	0	1
Reduction in Risk	How many hazards are addressed? What is the probability the hazard(s) will occur?	One	More than 1	All Hazards
	Does the project protect life or property or both?	Neither	Life or Property	Both
	Does the project address current and future hazards?	Neither	Current or Future	Both
	Does the project reduce the risk at a regional scale?	No	Maybe	Yes
	Does the project reduce a non-climate stressor?	No	Maybe	Yes
Scale	Is the project regional?	No	Maybe	Yes
	Can the project be replicated?	No	Maybe	Yes
Cost	What is the range of cost? Low (Under $50K)? Medium ($50k-$1m)? High (Over $1m)?	High	Medium	Low
Benefits	Do benefits outweigh the costs?	No	Maybe	Yes
Timeframe	How long will it take to implement the project? Short: Less than 5 years. Medium: 5-15 years. Long: More than 15 years	Long	Medium	Short
Feasibility	Is the project technically and legally possible?	No	Maybe	Yes
	Will permitting be required?	Yes	Maybe	No
	Are project sponsors identified, engaged, and have the capacity to implement the project?	No	Identified but not committed	Identified and committed
	Is a funding source identified?	No	Yes, have to apply	Yes, in place
Socioeconomic	Does the project aid in building a strong economy?	No	Maybe	Yes

Category	Considerations	-1	0	1
	Does the project supports improving community infrastructure (e.g., road network)?	No	Maybe	Yes
Climate Justice and Equity	Does the project benefit areas with a high Social Vulnerability Index?	No	Maybe	Yes
	Does the project have a positive, qualitative impact on populations that identify as Black, Indigenous, or People of Color (BIPOC)?	No	Maybe	Yes
	Does the project improve health resources?	No	Maybe	Yes
Environmental Impacts	Does the project address drivers of climate change?	No	Maybe	Yes
	Does the project use nature-based solutions?	No	Maybe	Yes
	Does the project provide habitat restoration for threaten and endangered species?	No	Maybe	Yes
Public and Stakeholder Support	Is there strong support for the project? Was it ranked as a high priority by the stakeholder partnership?	Low	Medium	High

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
Reduction in Risk	How many hazards are addressed? What is the probability the hazard(s) will occur?	0	1	0	0	0	-1	-1	0	-1	1	1	-1	-1	-1	-1	1	-1	-1	0	1	0	-1	-1	0	-1	1
	Does the project protect life or property or both?	0	1	1	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	1	0	-1	0	1	1	1	1
	Does the project address current and future hazards?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
	Does the project reduce the risk at a	1	-1	-1	1	1	1	1	1	-1	1	0	1	-1	1	1	1	1	1	-1	-1	-1	1	1	0	0	1

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	regional scale?																										
	Does the project reduce a non-climate stressor?	-1	1	-1	-1	1	-1	1	1	-1	-1	-1	1	-1	-1	-1	1	-1	0	1	1	-1	-1	1	-1	-1	-1
Scale	Is the project regional?	1	1	1	0	1	1	1	1	-1	1	0	1	-1	-1	1	1	1	1	-1	1	1	1	1	1	0	1
	Can the project be replicated?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cost	What is the range of cost? Low (Under $50K)? Medium ($50k-$1m)? High	-1	1	-1	1	-1	0	-1	-1	-1	0	1	-1	0	1	1	-1	1	0	-1	0	-1	1	1	0	0	-1

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	(Over $1m)?																										
Benefits	Do benefits outweigh the costs?	1	1	1	1	1	-1	1	1	1	1	1	1	1	1	1	1	1	-1	1	0	1	-1	1	1	1	1
Timeframe	How long will it take to implement the project? Short: Less than 5 years. Medium: 5-15 years. Long: More than 15 years	1	1	0	1	-1	1	0	-1	0	1	1	0	0	1	1	1	1	1	0	0	-1	1	1	1	1	1
Feasibility	Is the project technically	1	1	1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	and legally possible?																										
	Will permitting be required?	1	1	-1	1	-1	1	1	-1	1	1	1	1	1	1	1	1	1	1	-1	1	-1	1	1	0	1	1
	Are project sponsors identified, engaged, and have the capacity to implement the project?	-1	0	0	0	1	1	0	0	0	1	0	1	1	1	1	-1	1	1	1	1	1	0	1	1	0	1
	Is a funding source identified?	-1	-1	0	1	0	0	0	0	0	1	1	-1	0	0	1	-1	1	0	0	0	0	1	1	1	0	1
Socioeconomic	Does the project aid in building	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	1	-1	-1	1	-1	1	-1	1	-1	-1	-1	1	-1	-1	-1

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	a strong economy?																										
	Does the project supports improving community infrastructure (e.g., road network)?	-1	-1	0	-1	1	-1	1	1	1	-1	-1	1	1	1	-1	1	-1	-1	0	0	-1	-1	-1	-1	1	-1
Climate Justice and Equity	Does the project benefit areas with a high Social Vulnerability Index?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Does the project have a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	positive, qualitative impact on populations that identify as Black, Indigenous, or People of Color (BIPOC)?																										
	Does the project improve health resources?	-1	1	-1	-1	-1	1	-1	-1	-1	1	-1	-1	-1	-1	1	-1	1	1	-1	-1	-1	1	-1	-1	-1	1
Environmental Impacts	Does the project address drivers of climate change?	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	Does the project use nature-based solutions?	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	0	0	0	-1	0	-1	1	-1	0	-1	0	-1
	Does the project provide habitat restoration for threaten and endangered species?	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	-1	-1	-1	1	-1	-1	-1	-1	-1	-1
Public and Stakeholder Support	Is there strong support for the project? Was it ranked as a high	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	-1	0	0	0	0	0	0	0	0	0

Category	Considerations	Regional Home Elevation Program	Private Sector Emergency Response Partnership	Wetlands Mitigation Banks	V Zone Requirements for the Coastal A Zone	Coastal Evacuation Route Upgrades	Water Quality Sampling Program	Stormwater Modeling	Address I&I in Sewerage Lines	Elevate Lift Stations	Public Outreach	Hazard Disclosure	Creation of Stormwater Utilities	Address flooding in Pasquotank County	Develop County-Wide Stormwater/Watershed Plans	HAB Education and Outreach	Creation of Regional Resiliency Funding Source	Agriculture Stormwater Control	Expand Air Quality Testing	Dredging of inlets and waterways	VIPER Radio Expansion	Convert flood-prone farmland to wetlands	Establish Ambient Water Quality Standard for	Regional Community Rating System Coordination/CRS	Establish Drone Monitoring Program	Scuppernong River Flood Study	Resilience Hub Network
	priority by the stakeholder partnership?																										
SCORE		**0**	**7**	**3**	**2**	**5**	**3**	**5**	**2**	**-2**	**9**	**5**	**7**	**4**	**9**	**11**	**7**	**11**	**3**	**2**	**4**	**0**	**4**	**11**	**4**	**4**	**8**

Priority	Scoring
Low Priority	<1
Medium Priority	1-3
Medium-High Priority	4-6
High Priority	>6

APPENDIX C: REFERENCES

Albemarle-Pamlico National Estuary Partnership. 2022. “Our Work.” Online address: https://apnep.nc.gov/our-work/outreach-and-engagement

Brookings Institute. 2017. “As flood risks intensify, stormwater utilities offer a more resilient solution.” Online address: https://www.brookings.edu/blog/the-avenue/2017/09/21/as-flood-risks-intensify-stormwater-utilities-offer-a-more-resilient-solution/

City of Raleigh. 2022. “Draft City of Raleigh Stormwater Management Plan.” Online address: https://cityofraleigh0drupal.blob.core.usgovcloudapi.net/drupal-prod/COR16/StormwaterManagementPlan2022.pdf

Elizabeth City State University (ECSU) Emergency Management program. 2022 Federal Emergency Management Agency (FEMA). 2022. “CRS User Groups.” Online address: https://crsresources.org/100-2/crs-users-groups/

North Carolina Coastal Federation. 2022. “Cleaner & More Productive Coastal Waters by Facilitating the use of Nature-Based Stormwater Strategies that Improve Water Quality and Reduce Flooding.” Online address: https://www.nccoast.org/protect-the-coast/stormwater/

North Carolina Department of Environmental Quality (NCDEQ). 2022. “Algal Blooms.” Online address: https://deq.nc.gov/about/divisions/water-resources/water-sciences/ecosystems-branch/algal-blooms

North Carolina Department of Environmental Quality (NCDEQ). 2022. “Watershed Planning Documents.” Online address: https://deq.nc.gov/about/divisions/mitigation-services/dms-planning/watershed-planning-documents

North Carolina Department of Environmental Quality. Ecosystems Enhancement Program. 2009. “Pasquotank River Basin Restoration Priorities, September 2009.” Online address: https://deq.nc.gov/media/8090/download

Piedmont Triad Regional Council. 2022. “Haskett Creek Watershed Master Plan.” Online address: https://www.ptrc.org/services/regional-planning/water-resources/ongoing-projects/haskett-creek-watershed-plan

Science and Technologies for Phosphorus Sustainability (STEPS). 2022. “Knowledge Transfer.” Online address: https://steps-center.org/knowledge-transfer/

Town of Nags Head. 2022. “Flood Information.” Online address: https://nagsheadnc.gov/213/Flood-Information