2022

CLIMATE RESILIENCE PROJECTS FOR THE CAPE FEAR REGION

NCORR

RISE

Regions Innovating for Strong Economies and Environment

DPS

DEPARTMENT OF PUBLIC SAFETY

EQUAL HOUSING OPPORTUNITY

Contents

Land Acknowledgment

We wish to acknowledge and honor the Indigenous communities native to this region and recognize this vulnerability assessment covers communities and structures that are built on Indigenous homelands and resources. We recognize the Catawba, Lumbee, and Waccamaw Siouan 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.

North Carolina Office of Recovery and Resiliency (NCORR)

In the wake of Hurricane Florence in 2018, the State of North Carolina established the North Carolina Office of Recovery and Resiliency (NCORR) to lead the state's efforts to rebuild smarter and stronger. At that time, eastern North Carolina communities were still recovering from Hurricane Matthew, which occurred in 2016. NCORR manages nearly 1 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 to 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[1] website. NCORR is a division of the Department of Public Safety.

Regions Innovating for Strong Economies and Environment (RISE)

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. The RISE Regional Resilience Portfolio Program covers nine areas, depicted in
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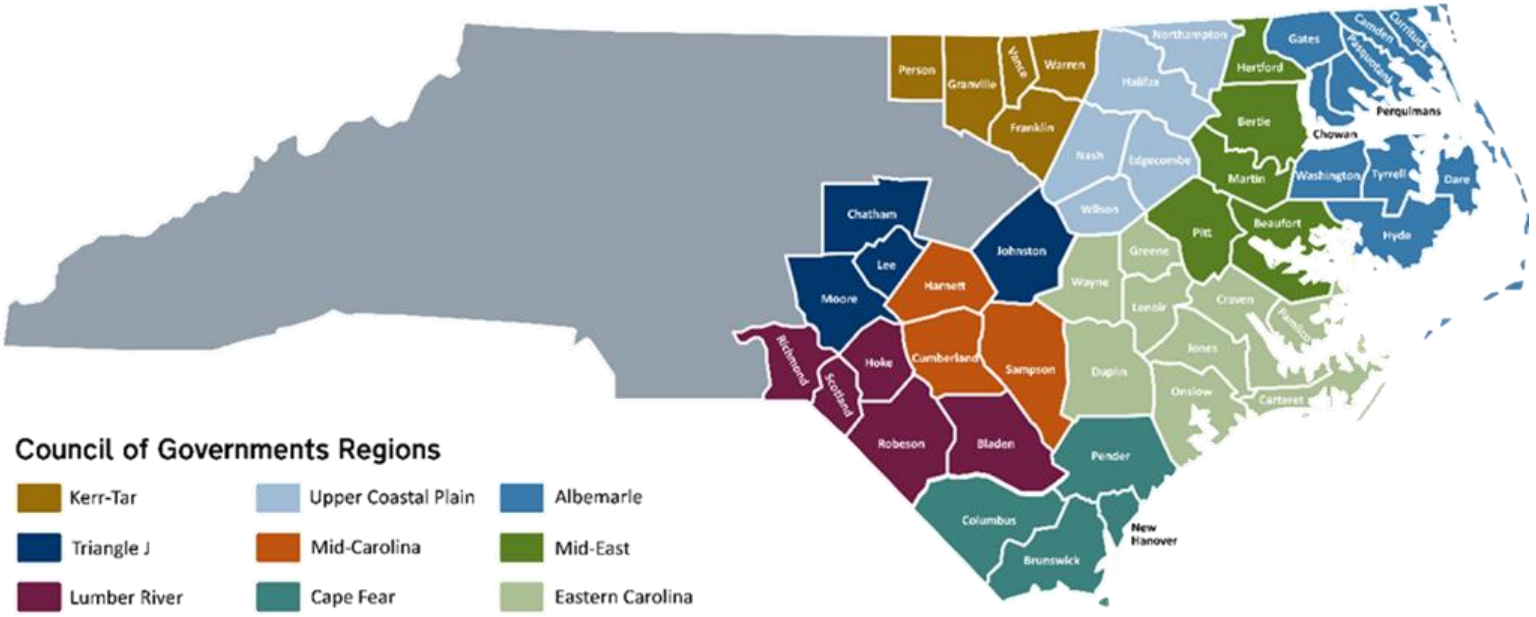
- Figure 1, which align with the North Carolina Council of Government Regions.
- Developing the *North Carolina Resilient Communities Guide*[2], a statewide resource that will provide tools, guidance, and opportunities for building community resilience.
- Hosting the Homegrown Leaders program, an NC Rural Center leadership training workshop, which operates in the eastern half of the state, and emphasizes resilience as a tool for community economic development.

RISE is funded by the U.S. Economic Development Administration and the HUD's CDBG-MIT funds, with in-kind support from NCORR and the North Carolina Rural Center. In addition, the Duke Energy Foundation committed $600,000 in grant funding to support the Regional Resilience Portfolio Program.

[1] https://www.rebuild.nc.gov/
[2] https://www.rebuild.nc.gov/resiliency/resilient-communities/rise/guidebook

Figure 1. RISE Councils of Government Regions



Letter of Support from the Regional Council of Governments

CAPE FEAR
COUNCIL OF GOVERNMENTS

Serving Local Government in:

Brunswick County
Bald Head Island
Belville
Boiling Spring Lakes
Bolivia
Calabash
Carolina Shores
Caswell Beach
Holden Beach
Leland
Navassa
Northwest
Oak Island
Ocean Isle Beach
Sandy Creek
Shallotte
Southport
St. James
Sunset Beach

Columbus County
Bolton
Brunswick
Cerro Gordo
Chadbourn
Fair Bluff
Lake Waccamaw
Sandyfield
Tabor City
Whiteville

New Hanover County
Carolina Beach
Kure Beach
Wilmington
Wrightsville Beach

Pender County
Atkinson
Burgaw
Surf City
Topsail Beach
Wallace

PROGRESS THROUGH COOPERATION

December 16, 2022

Dear reader,

Our Cape Fear region – encompassing Brunswick, Columbus, New Hanover, and Pender counties – is beloved by residents and visitors alike for our wonderful communities as well as our beautiful beaches, rivers, lakes, forests, and other natural features. However, our communities have seen firsthand how natural beauty can give way to floods, fires, and other tragic events. As a result, it is valuable to be thoughtful about how we as a region can be better prepared for living with the realities of natural disasters. Projects like the Regions Innovating for Strong Economies and Environment (RISE), coordinated by the North Carolina Office of Recovery and Resiliency (NCORR), provide opportunities for identifying potential action items that can allow us to better manage life alongside natural hazards.

I am thankful to NCORR, the North Carolina Rural Center, TetraTech, and local stakeholders for the work they have done in preparing this portfolio. I am particularly grateful that NCORR implemented the RISE program at a regional scale that coincides with Council of Government (COG) boundaries. COGs were established in the late 1960s and early 1970s to provide an opportunity for local governments with shared regional interests to work together across their individual borders, meaning that projects like RISE can leverage decades of coordination and collaboration to enhance regional outcomes.

As we look to the future of our region, I am hopeful that this project and other complimentary efforts can provide our southeastern North Carolina communities with an extra degree of preparedness that will serve residents and visitors well in the years to come.

Sincerely,

Allen Serkin
Executive Director

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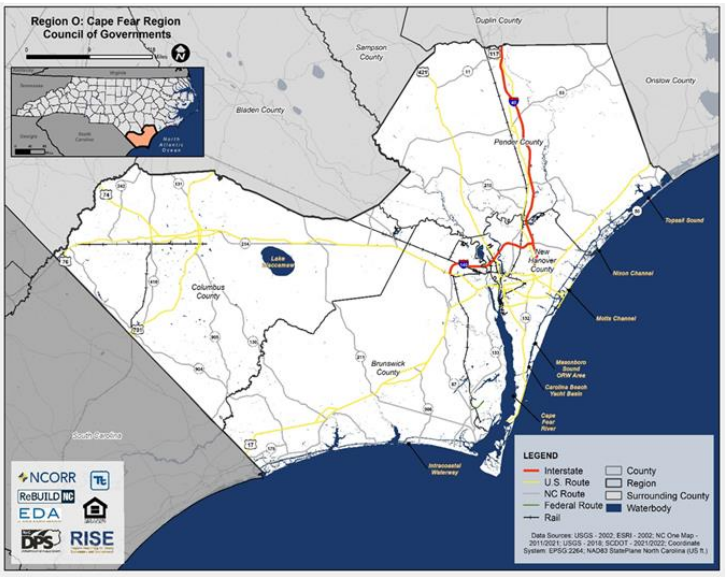
www.capefearcog.org

CAPE FEAR REGIONAL RESILIENCE PORTFOLIO

The RISE Cape Fear Regional Resilience Portfolio aims to advance the resilience of the Cape Fear Region. RISE Cape Fear is a partnership between NCORR, the North Carolina Rural Center, and the Cape Fear Council of Governments (COG). The project team is composed of an NCORR representative, COG representative, NC Rural Center facilitator, and a technical advisor. Facilitator Dr. Latoya Beatty supported community engagement and discussion at meetings, while Tetra Tech, Inc. provided technical assistance. The Cape Fear Region is composed of Columbus, Brunswick, New Hanover, and Pender Counties as shown in ***Figure 2***.

Figure 2. The Cape Fear Region



The Regional Resilience Portfolio Program is a two-part effort consisting of the *Climate Change and Natural Hazards Vulnerability Assessment for the Cape Fear Region*[3] 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 impact on the region. The ***Vulnerability Assessment Summary*** provides an overview the findings of this analysis.

The Regional Resilience Project Portfolio is a compilation of projects that will provide regional resilience benefits across the Cape Fear Region. These projects respond to critical issues highlighted in the vulnerability assessment and reflect local priorities identified during the planning process. The portfolio is composed of prioritized projects 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: Additional Projects for Consideration***.

Figure 3. Cape Fear Regional Resilience Program Process

[3] https://www.rebuild.nc.gov/media/2558/open

Planning Process

At the onset of the program, NCORR, Dr. Beatty, and the Cape Fear COG recruited local leaders from the region, representing issues and communities inside and outside government, to serve as a Stakeholder Partnership for the project. The Stakeholder Partnership met ten times 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 four-county region. Partnership membership spanned local government, community organizations, and companies, including:

- Brunswick County
- Cape Fear Area Rural Transportation Planning Organization (RPO)
- City of Whiteville
- Columbus Chamber of Commerce and Tourism
- Duke Energy
- Town of Leland
- NC Division of Emergency Management
- New Hanover County
- Pender County
- Smart Start of Pender County
- St. Philip African Methodist Episcopal Church
- Town of Surf City

Additionally, the project team solicited public input on vulnerabilities and potential solutions through online surveys, virtual meetings, and in-person meetings.

During the vulnerability assessment phase, the project team collaborated with the Stakeholder Partnership to identify top climate hazards and their historic and potential future impacts in the region. Two virtual public workshops were held in April 2022, providing an opportunity for members of the public to contribute to the identification of climate and natural hazards vulnerabilities that the region faces. In August 2022. Tetra Tech drafted the vulnerability assessment and responded to comments from the project team, Stakeholder Partnership, and public comment submissions.

During the project identification phase, the project team again collaborated with the Stakeholder Partnership to develop a long list of potential projects to build resilience to vulnerabilities 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 Stakeholder Partnership shortened the list of potential projects to 18 projects to present at two in-person public workshops in September 2022 in Leland. At the workshops, RISE staff solicited feedback from community members and local officials on the proposed project list, in addition to educating attendees about the Cape Fear 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 prioritize the projects through dot-preferencing. Facilitators captured ideas and discussions with flip boards and notecards. A summary of the results of the dot-preferencing activity is shown in ***Figure 4***. To view the public engagement report in its entirety please visit the Cape Fear Regional Resilience Portfolio[4] website.

Figure 4. Public Workshop Project Voting Results

[4] https://www.rebuild.nc.gov/resiliency/resilient-communities/rise/cape-fear

Project	Votes
Resilience hub	26
Supplemental flood zones	23
Publicly owned stormwater management maintence and retrofit	22
Socially vulerable populations disaster prep. general guide	21
Regional stormwater engineer circuit rider	20
Coastal stormwater management and erosion analysis	20
Cape Fear Council of Governments resilience planner	20
Land suitability analysis	20
Living shorelines new locations	19
Cape Fear online mapping tool	17
Grant writing workshop and support	14
Beach dune infilitration pilot project	13
Long-range flood buyout strategy	12
Subwatershed specific management policies	9
Increase CRS participation	9
Cost-share for privately-owned community stormwater retrofits	8
Mobile home retrofit study and pilot	7
Crosswalk existing project policies	5

After refining projects based on feedback, the project team used criteria approved by the Stakeholder Partnership to rank projects with a resilience scorecard. Complete scorecard ratings are available in

Appendix B: Resilience Score Card Ranking.

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
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 project team identified projects to include in the Regional Resilience Project Portfolio by incorporating resilience scorecard results, public workshop voting, the input of the Stakeholder Partnership, and the project team's subject matter expertise. The remaining projects that are not included in the portfolio are included in ***Appendix A: Additional Projects for Consideration*** for reference. The project team conducted additional, targeted outreach to state and local stakeholders to further research and refine each project. A final public comment period on the Project Portfolio was held in November 2022.

VULNERABILITY ASSESSMENT SUMMARY

The *Climate Change and Natural Hazards Vulnerability Assessment for the Cape Fear Region*[5] provides detailed insight regarding the susceptibility of the region to climate change and its population, assets, and resources. The Cape Fear Region has previously been impacted by a variety of hazards and will face increasing climatic hazards over the next several decades. Climate change and non-climate stressors create cascading impacts, which lead to new vulnerabilities in the region.

*Error! Reference source not found.*The following hazards pose a significant threat to the Cape Fear Region, based on scientific study, disaster history, and input from local leaders.

- Flood
- Hurricanes and Severe Storms
- Coastal Erosion
- Sea Level Rise
- Extreme Temperatures
- Drought
- Tornado
- Wildfire

Flood-related hazards are a focal concern to the region, based on the catastrophic impact of Hurricanes Matthew (2016) and Florence (2018). A summary of key findings from the assessment is available below.

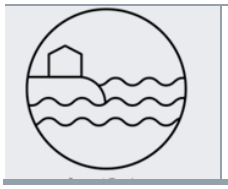
Flood

- Both coastal and inland communities are vulnerable to flooding. Coastal communities face cascading compounding hazards such as flooding, erosion, severe storms, and storm surge. Inland communities are more likely to face riverine flooding or have flooding exacerbated by failing infrastructure.

Hurricanes and Severe Storms

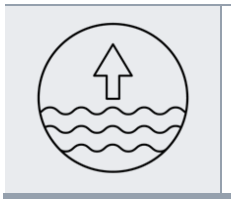
- The frequency and severity of hurricanes and severe storms are likely to increase over the course of the next 30 years. The increasing risk combined with the region's population being concentrated along the coastline will result in a larger percentage of the population being at risk of the impacts from hurricanes and severe storms.

Coastal Erosion



- Several areas of the coastline in the region have lost at least three feet of shoreline over the past several decades. This rate of erosion is anticipated to continue.
- Areas along the coastline of New Hanover and Pender Counties have experienced upwards of five feet of erosion over the past several decades.

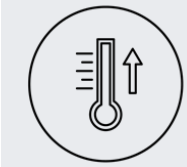
Sea Level Rise



- Sea level rise will have extensive impacts on the region as the majority of the population is concentrated in coastal areas, along with housing, critical infrastructure, and tourist attractions. Sea level rise will have cascading impacts on various sectors.
- The region will need to conduct long-range plans to identify suitable areas outside of the coast for continued development to accommodate the region's projected population growth.

[5] https://www.rebuild.nc.gov/media/2558/open

Extreme Temperature



- The number of high heat days is likely to increase in the region. Socially vulnerable populations face a disproportionate risk of extreme temperatures. Within the region, 21% of the total population is elderly; senior citizens have a higher rate of illness and death related to high heat. Fifteen percent of the population is economically disadvantaged; these households face financial burdens to cool their homes.

Drought

- The region has previously experienced extended periods of drought, which are likely to become more frequent as temperatures rise and high heat days increase in frequency.

Tornado

- Climate change is warming the atmosphere in the region, meaning storms have the potential to be more intense and occur more often.

Wildfire

- Increasing frequency and severity of wildfires will lead to increased damage to natural systems and potential damage to structures.
- Projected increases in wildfire risks and associated emissions can have harmful impacts on health.

The region's vulnerability to natural hazards is compounded by non-climate stressors. Non-climate stressors are conditions or changes unrelated to the climate that can exacerbate hazards (United States Global Change Research Program n.d.). In North Carolina, the greatest non-climate stressors are population growth, aging infrastructure, socioeconomic disparity, physical attacks, cyber security, rural-urban divide, and public health threats (Kunkel 2020). Local recovery and resilience plans, along with RISE stakeholders, identified the following additional challenges in the Cape Fear Region:

- Increases in population and aging population
- Changes in land use, including loss of green space, habitats, and natural functions of floodplains, and increase in impervious surfaces
- Age of regional infrastructure, particularly roads and stormwater systems
- Cost to repair septic and well systems
- Lack of broadband connectivity
- Local codes and policies which encourage redevelopment in hazard-prone areas
- Poor condition of regional infrastructure, particularly roads and stormwater systems
- Slow recovery process following a hazardous event

Together, climate hazards, non-climate stressors, and regional challenges create specific vulnerabilities for socially vulnerable populations, housing, critical infrastructure, the economy, and natural resources. These vulnerabilities are highlighted below.

Social Vulnerability

- The region's elderly population accounts for approximately 20% of the total regional population. This is a vulnerable population that has a disproportionate risk of natural hazards in comparison to the overall population. Resilience solutions must incorporate considerations for vulnerable populations, such as including solutions that benefit those with limited mobility or financial constraints.
- Lack of access to broadband (high-speed internet) in rural areas throughout Columbus and Pender Counties poses barriers to public outreach, including emergency notifications.
- Inland communities have a greater presence of socially vulnerable areas, and therefore, impacts of a single hazard are exacerbated. These communities experience some of the same hazards as coastal communities, but they are impacted differently, requiring tailored solutions.

Housing, Critical Infrastructure, and Community Support Systems

- Limited safe and affordable housing options throughout the region increases recovery time post-disaster and exacerbate pre-existing disparities and social vulnerabilities. Disasters are felt more severely in communities that are already facing challenges with accessing safe and affordable housing.
- Roadway infrastructure throughout the region is vulnerable to multiple hazards. Past flooding and hurricane events have resulted in extended closures and put the population at risk when evacuation routes are inaccessible.
- Increased urbanization and impervious surface contribute to additional flooding and stormwater runoff. Aging infrastructure throughout the region will need to be replaced or retrofitted. Currently, the region's infrastructure does not have the capability of handling today's stormwater amounts or those amounts anticipated with climate change and increased development. Failing infrastructure impacts a community's ability to transport goods and services and can leave individuals isolated during emergencies.

Economy

- Tourism accounts for a significant sector of the regional economy. Flooding, hurricanes, erosion, and sea level rise threaten the beaches and other natural resources that are tourist attractions.

Natural and Historic Resources

- Projected population increases will increase development pressures in suburban and rural areas and therefore decrease the amount of green space available to absorb rainwater and result in increased flooding

To explore individual communities and neighborhoods in the region and examine the data, please visit the web map that accompanies the assessment: Cape Fear Region - Resilience Portfolio Web Map (arcgis.com).

Due to the past and current hazards impacting the region, there are several ongoing initiatives to help with reducing risk and build resilience. Existing initiatives were reviewed to determine opportunities to

build upon these efforts, fill gaps, and avoid duplication. Notable strengths and advantages in the region include the following:

- The 2020 North Carolina Science Report developed by the North Carolina Department of Environmental Quality equips local leaders with the information necessary to make data-informed decisions when faced with addressing the impacts of climate change.
- Each county within the region has a FEMA-approved, locally adopted hazard mitigation plan, which includes a list of actions identified to reduce or eliminate the county's risk to natural hazards.
- Brunswick, New Hanover, and Brunswick Counties have local land use plans as required by the Coastal Area Management Act (CAMA), which provide a roadmap for managing growth in coastal areas, protecting natural resources, compatible economic development, and natural hazard risk reduction.
- The Hurricane Matthew Redevelopment Plans (2017) identify projects in the region to mitigate flood risk. The projects prioritized in the region include infrastructure projects, stream restoration, low-impact development, debris management, road closure tracking, rerouting, and retrofits to roads and bridges.
- The North Carolina Department of Transportation Multimodal Vulnerability Assessment on Strategic Transportation Corridors (2022) to include the portion of U.S. 74 from I-485 in Charlotte to the Port of Wilmington.
- The communities of Sunset Beach, Leland, Navassa, Topsail Beach, and Surf City are participating in the Department of Environmental Quality's Resilient Coastal Communities Program. Each has completed a resilience strategy.
- The City of Whiteville has partnered with the NC State University's Coastal Dynamics Design Lab to undertake a project titled "Floodprint" (2022). The project will establish flood mitigation projects in the community and identity implementation pathways, including funding.

SUMMARY OF PROPOSED PROJECTS

Project	Project Description
Name: Coastal Stormwater Management Tools **Hazards:** Floods, Hurricanes, Sea Level Rise, and Severe Storms **Recommended Lead Agency:** TBD **Estimated Cost:** Under $600K to develop all three; ongoing cost for outreach **Scale:** Coastal	**PROBLEM** Due to the intersection of development, tourism, and coastal environmental systems, many coastal communities have inadequate stormwater management systems, especially given future growth and changing coastal hazards. Stormwater management in ocean-facing communities is technically challenging and often costly. **SOLUTION** Local stakeholders have suggested multiple knowledge and guidance gaps that could be filled by regional or state resources. These include guidance on sizing stormwater infrastructure, resources on jointly addressing water quality and flooding, and legal analysis on local regulatory tools for guiding stormwater-wise development.
Name: Regional Stormwater Engineer Services **Hazards:** Floods, Hurricanes, and Severe Storms **Recommended Lead Agency:** Cape Fear Council of Governments **Estimated Cost:** Under $50K to start up, then self-sustaining through permitting fees **Scale:** Regional	**PROBLEM** Stormwater management challenges are prominent throughout the region. Population growth supports economic opportunity in the region, but new development can make flooding challenges worse. Managing the new development process is one the best opportunities to ensure that new development does not worsen stormwater problems, but many communities do not have an engineer on staff who can enforce local stormwater regulations. **SOLUTION** Create a regional contract mechanism for interested local jurisdictions to contract externally for stormwater engineering services, coordinated by a central organization, in this case, the Council of Governments.
Name: Outreach and Education for Stormwater Management Facilities on Private Property **Hazards:** Floods, Hurricanes, and Severe Storms	**PROBLEM** A significant portion of drainage and stormwater infrastructure are located on private property, sometimes with collective ownership on behalf of a subdivision. Problems with this infrastructure can lead to localized flooding on site or on neighborhood properties or roadways. Landowners may not be aware of their responsibility to ensure proper maintenance or may not have the resources to do so.

Project	Project Description
Recommended Lead Agency: TBD **Estimated Cost:** Under $50K to establish; $10-65K/year to operate **Scale:** Site-specific/regional	**SOLUTION** Establish an outreach program for private entities to provide education and awareness of stormwater management infrastructure. The program would include material on stormwater management basics, understanding landowner and permit-holder responsibilities, green infrastructure techniques and other retrofits, and financing strategies.
Name: Living Shorelines Site Analysis and Best Practices **Hazards:** Floods, Hurricanes, Sea Level Rise, Severe Storms, and Erosion **Recommended Lead Agency:** TBD **Estimated Cost:** $200,000 per locality **Scale:** Site-specific/Coastal	**PROBLEM** The region's beaches and shorelines are critical to the quality of life and economy of the region and state. These areas are also susceptible to erosion and damage from storm events. Many people recognize common defenses against erosion and storm damage as hard barriers like revetments and sea walls. However, these barriers are expensive to build and maintain, disrupt natural systems, and can displace the impact of wave energy and erosion onto nearby properties. **SOLUTION** Many coastal jurisdictions in Cape Fear are interested in implementing living shorelines, but do not have a clear pathway to identify the most suitable sites and installation. The proposed project would include a region-wide GIS-based analysis of strong site possibilities, overlaid with public ownership. It would also offer best practices and recommendations based on experiences of living shorelines experts in the state. Jurisdictions interested in participating in the project would be invited to connect with one another and be provided with technical assistance for grant applications for installation.
Name: Mitigating Risk to Manufactured Housing **Hazards:** All **Recommended Lead Agency:** TBD **Estimated Cost:** $100-200K; pilot project depends on scope **Scale:** Regional(study)/Site-specific(pilot)	**PROBLEM** Residents of mobile and manufactured housing (MHUs) endure disproportionately higher impacts from natural hazards. MHUs do not withstand severe weather as well as stick-built homes. Furthermore, they tend to be less energy efficient, exposing residents to higher risks of heat illness and energy cost burden. Compounding these issues, MHUs comprise a significant portion of the affordable housing available to low- and moderate-income (LMI) households, especially in inland areas. **SOLUTION** Conduct a study to examine the challenges and feasible solutions for hazard mitigation in diverse types of MHUs and MHU communities. Identify a solution to implement as a pilot project that may be replicated in other interested communities within the region.
Name: Regional Resilience Planner and Grant Writer	**PROBLEM** Local governments in the region would like to build long-term resilience but have limited capacity to pursue new opportunities or to hire a subject matter expert.

Project	Project Description
Hazards: All **Recommended Lead Agency:** Cape Fear Council of Governments **Estimated Cost:** $150K/year **Scale:** Regional	**SOLUTION** Create a regional position to provide resilience planning and grant writing assistance to local communities for resilience planning and grant writing.
Name: Resilience Hubs Support and Growth **Hazards:** All **Recommended Lead Agency:** TBD **Estimated Cost:** Survey and needs assessment likely to have cost under $100K; cost of upgrades and support depends on scope **Scale:** Regional/statewide	**PROBLEM** Building resilience, especially in our changing climate, is too large of a task for government to accomplish alone. Community based organizations and institutions play an essential role in supporting resilience day-to-day and in emergencies. Resilience hubs are a natural extension of this role. Resilience hubs are pre-existing community-based entities that provide community support before, during, and after disasters, in addition to their other programming. There are established resilience hubs throughout North Carolina, including at least one in the Cape Fear region. **SOLUTION** Better understand and support existing resilience hubs in the state and region. Examine ways to support existing hubs through technical assistance, direct funding, relationship-building, and direct upgrades. Elevate the effective work of hubs while exploring the possibility of new locations for resilience hubs.
Name: Flood Data **Hazards:** Floods, Hurricanes, Sea Level Rise, and Severe Storms **Recommended Lead Agency:** County Governments **Estimated Cost:** Will vary depending on scale **Scale:** Local/county/regional	**PROBLEM** During recent major storm events (e.g., Hurricanes Florence and Matthew) extreme flooding occurred outside of the FEMA Special Flood Hazard Area (SFHA) or 'mapped floodplain'. As hazards, such as flooding and hurricanes, evolve over the course of the next several decades it will be helpful to understand where flooding occurs outside the floodplain. **SOLUTION** Create a dataset on historic flooding that occurs outside the FEMA-mapped SFHA. Utilize historic water marks from past flood events and local knowledge about areas of frequent flooding. The project could also include the development and/or refinement of existing projections of future floodplain in the region based on climate data.

Coastal Stormwater Management Tools

Stormwater management challenges in the Cape Fear Region concern local leaders. Flooding throughout the region has been exacerbated in some areas due to undersized stormwater infrastructure or deferred maintenance. Stormwater management facilities constructed prior to modern stormwater management regulations may not have the proper facilities in place or these facilities may not be able to manage the volume of runoff presently.

Particularly in coastal areas combined hazards such as sea level rise and storm surge will quickly overwhelm stormwater management infrastructure and result in additional flooding. Coastal hazards are anticipated to increase over the next several decades as hurricanes become stronger and more frequent and sea levels rise. This increase in coastal hazards necessitates conducting an analysis to determine the current location and capacity of existing infrastructure, identifying areas of concern, and developing recommendations for retrofits and upgrades to accommodate larger volumes of stormwater runoff.

COASTAL STORMWATER MANAGEMENT TOOLS

Description

Coastal communities face stormwater management challenges that range from aging and deterioration of existing infrastructure to erosion, high groundwater, and sea level rise. Population growth is projected to continue in coastal communities resulting in an increase in impervious surface from development and additional stormwater management challenges. Additionally, the intensity of hurricanes and severe storms is projected to increase. The combination of these factors will compound stormwater management challenges and worsen conditions for infrastructure that is not designed to manage current and future conditions.

The project consists of developing three key resources.

1. *Guidance on sizing stormwater infrastructure.* Currently, standards for stormwater infrastructure rely on 10- to 20-year-old precipitation data, meaning the data exclude the record-breaking rainfall events experienced in Hurricanes Matthew and Florence. Infrastructure built today on outdated data is immediately undersized. The state is funding an update to these data, but it will not be complete for several years. There is an urgent need to provide guidance on how to use available data to ensure stormwater infrastructure meets current and future demands anticipated over the lifetime of the infrastructure.

2. *Techniques to address water quality and quantity*. The state and federal government have spent decades building programs to improve degraded water quality through stormwater management techniques. These programs reduce nonpoint source pollution and have traditionally targeted water quality, not water quantity. This part of the project focuses on identifying techniques and approaches that utilize green infrastructure and nature-based solutions to encourage co-beneficial projects that address water quantity and quality, while providing environmental enhancements. Additionally, nature-based solutions aid in addressing drivers of climate change and provide benefits such as carbon sequestration.

3. *Legal analysis and model ordinance for reducing local flood impacts from new development.* Communities are concerned that new development will worsen local stormwater runoff and create flooding problems nearby. Local governments are interested in maximizing known techniques for on-site stormwater management in new developments but require additional guidance on the legal provisions in North Carolina under current statute. This part of the project would provide authoritative guidance on local

land use law and stormwater management regulations. It would also provide model language for development codes as a guide for jurisdictions to develop local codes and regulations.

Hazards Addressed

- Floods, Hurricanes, Sea Level Rise, and Severe Storms

Location/Service Area

- Coastal communities

Population(s) Served

This project will benefit those individuals residing in coastal communities and neighborhoods.

Sectors Addressed

The following sectors will be supported by this project:

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

Physical Benefits

- Reduction in localized stormwater flooding, including potential reduction of impacts to homes, businesses, and roadways

Socioeconomic Benefits

- Reduction in inconveniences of localized flooding
- Maintaining access to businesses
- Communities that participate in the Community Rating System (CRS) may be able to obtain additional credits to reduce residents' flood insurance rates by adopting higher standards
- Reduction of impacts to emergency response during disasters
- Cost savings from implementing co-beneficial projects, such as nature-based solutions

Environmental Benefits

- Encouragement of co-beneficial projects throughout the region to improve water quality
- Creation and enhancement of wildlife habitat through the implementation of nature-based solutions and green infrastructure

Equitable Outcomes

Although most communities of higher social vulnerability are located in inland communities, these stormwater management tools will serve coastal communities including socially vulnerable residents in these coastal communities.

Roles of Lead and Supporting Agencies

This project will require the lead agency to serve as the primary developer of each of the three resources. Supporting agencies will provide subject matter expertise to inform the development of the resources and review draft materials to provide feedback and guidance.

Lead Implementer

The project will be led by an organization with coastal management, resilience, and stormwater management expertise. This organization could be a state agency, nonprofit, or other type of partner.

Supporting Agencies

All county and local municipal governments will be invited to partner on the project and be consulted to determine areas in need of these resources. Agencies with subject matter expertise include:

- State agencies: NC Department of Transportation (NCDOT), NC Department of Environmental Quality (DEQ), NC Emergency Management (NCEM) Floodplain

Management Program, and NC Wildlife Resources Commission (representatives from the Green Growth Toolbox)
- Academia: NC Sea Grant, NC State Climate Office, UNC School of Government, NCSU Stormwater Engineering Group, and NC Water Resources Research Institute (WRRI)
- Environmental nonprofits such as The Nature Conservancy (TNC) and NC Coastal Federation (NCCF).
- Soil and water conservation districts

Cost Estimate

Each of these resources is estimated to cost under $200K to develop. The budget for outreach should be included in the cost estimate; this could range from $10K to $50K for materials and staff time, depending on format and intensity of the outreach.

Funding Sources

There are multiple sources of funding available from state, federal, and private sources. Below is a list of several sources that are relevant to resiliency and water:

- FEMA's Building Resilient Infrastructure and Communities (BRIC)[6] grant supports hazard mitigation grants that reduce risk. The capability- and capacity-building category of funding permits project scoping activities which allow for the development of mitigation strategies including data gathering, feasibility studies, engineering design, outreach, conducting hydrologic and hydraulic studies, and grant application development for implementation.
- NC Sea Grant's Community Collaborative Research Grant Program[7] provides support for activities which support the goals of NC Sea Grant and WRRI such as building resilient communities and expanding research opportunities. This program prioritizes projects that incorporate diversity, equity, inclusion, justice, and accessibility. The program boosts collaborative partnerships and requires project teams to be led by one scientific expert and one local knowledge expert.
- The North Carolina Land and Water Fund (NCLWF)[8] serves to improve water quality and sustain ecological diversity by funding projects to acquire lands, restore the habitat for fish, wildlife, and other species, and enhance the filtering of stormwater runoff to reduce pollutants from entering water supplies. NCLWF can consider funding innovative stormwater projects that demonstrate a novel and untried method to water quality at the project site and how it would contribute to achieving NCLWF's goal of advancing stormwater-management practices for water quality.
- The North Carolina Environmental Enhancement Grant (EEG) Program[9] 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.
- DWR's Water Resources Development Grant (WRDG) Program[10] provides funding to local jurisdictions to complete projects for stream restoration, water management, water-

[6] https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply
[7] https://ncseagrant.ncsu.edu/funding-opps/grants/other-opps/community-collaborative-research-grant-program/
[8] https://nclwf.nc.gov/apply/project-eligibility
[9] https://ncdoj.gov/protecting-the-environment/eeg/
[10] https://deq.nc.gov/media/31983/open

based recreation, and preliminary feasibility or engineering studies.

- NC DEQ's 319(h) Grant Program provides funding to reduce nonpoint source pollution. The funding is provided through EPA and North Carolina typically receives $1 million annually for competitive funding. Funds may be used to conduct watershed restoration projects such as stormwater and agricultural best management practices (BMPs) and restoration of stream channels. Section 319 grant projects must be used to help restore waterbodies that are (1) currently impaired by nonpoint source pollution and (2) in areas with approved watershed restoration plans. There are three approved watershed restoration plans in the Cape Fear Region with strategies and actions that align with this project which cover the Lockwoods Folly, Greenfield Lake, and Bradley and Hewletts Creeks Watersheds.[11]
- NC DEQ's 205(j) Water Quality Management Planning Grant[12] provides approximately $150,000 annually to North Carolina communities for water quality planning which may include identifying the cause and extend of water quality problems, developing watershed restoration plans, mapping stormwater infrastructure, and conducting engineering designs for BMPs.
- NC DEQ Division of Water Infrastructure's American Rescue Plan Act (ARPA) Asset Inventory and Assessment (AIA) Grant[13] program financial support for asset inventory, including assessing the condition of critical assets for wet utilities including drinking water, central sewer, and stormwater infrastructure.
- NC DEQ's ARPA Local Assistance for Stormwater Infrastructure Investments (LASII) Funding Program[14] provides funding for construction and planning projects that will improve or create infrastructure for controlling stormwater quantity and quality.

Steps for Implementation

The common steps to develop each resource as listed below:

1. Scope the resource. Determine the target audience and the content to be included.
2. Conduct a needs assessment with the target audience. Techniques include surveying, conversations with audience, and focus groups. A report detailing conclusions from the assessment will inform the development of the resources produced for the project. The report should include recommendations for the format, content, and outreach techniques for the resources.
3. Develop the resource with proper expertise. Collaborate with supporting organizations to inform each resources using the best available data and proven best practices.
4. Review or beta-test the resource with a select group within the target audience.
5. Develop outreach materials to support dissemination and knowledge transfer. Examples include educational modules, webinars, presentations, etc. Opportunities to conduct outreach in pre-existing forums, such as conferences, should be maximized.
6. Publish and socialize the final resources.

[11] https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=c2461274b3ff4009a8c405c4bddeb3aa
[12] https://deq.nc.gov/about/divisions/water-resources/water-planning/nonpoint-source-planning/205j-wq-management-planning-grant#overview
[13] https://deq.nc.gov/about/divisions/water-infrastructure/i-need-funding/asset-and-inventory-assessment-grants
[14] https://deq.nc.gov/about/divisions/water-infrastructure/stormwater-funding-program

Guidance on Sizing Stormwater Infrastructure

Data available from the North Carolina State Climate Office will inform the recommendations on future climate conditions to guide specifications for designing stormwater system capacity, including what present-day storm the systems should be designed to (i.e., 10-year, 15-year, etc.) that will still account for future protections as well as sea level rise projections for coastal areas.

Techniques to Address Water Quality and Water Quantity

The lead agency will conduct research of local, state, national, and international resources that provide recommendations for the integration of water quality and water quantity management. This research may include identifying academic research, reviewing case studies of completed projects, and reviewing planning documents such as hazard mitigation, watershed management, and green infrastructure plans.

Legal Analysis and Model Ordinance for Reducing Local Flood Impacts from New Development

The legal analysis and model ordinance should be developed with input from state and local representatives, stormwater experts, and attorneys. The lead agency will conduct research of existing model ordinances from other communities. The project should include thorough legal review to ensure consistency with state law and policy.

Implementation Timeframe

Developing the resources is anticipated to 6-18 months after funding has been obtained and the capacity to complete the effort has been established. This timeframe can fluctuate depending on the depth of the resource and capacity of the lead organization. Time should be reserved for pilot versions and draft review by members of the target audience. Outreach can start immediately after the resource has been prepared and can continue indefinitely if the resource continues to be current. Updates may be needed as new data and techniques become available or new legislation is enacted.

Integration with Existing Plans, Programs, and Policies

There are a variety of existing plans, programs, and policies to address costal stormwater management challenges in the region. These existing initiatives provide an opportunity for integration with the proposed Coastal Stormwater Management Tools. For example, NCORR is funding the development of the NC Division of Mitigation Services (DMS) Natural Infrastructure Flood Mitigation Program (NIFMP), including formation of an advisory board; establishing program goals, objectives and performance metrics; creating a watershed planning strategy to integrate projects into current DMS watershed planning activities; integrating NIFMP development into current flood mitigation practices within North Carolina; and modeling to quantify effectiveness of various nature-based solution restoration practices.

Guidance on Sizing Stormwater Infrastructure

DEQ produces a Stormwater Design Manual[15] that provides minimum design criteria. This manual is updated periodically and provides an opportunity for this project to inform future updates and provide the best available data for establishing minimum design criteria.

Techniques to Address Water Quality and Water Quantity

EPA's Storm Smart Cities: Integrating Green Infrastructure into Local Hazard Mitigation Plans[16] is an example of combining water quality and flood concerns in the context of hazard mitigation planning. These principles are represented in the regions hazard mitigation plans (e.g., Southeastern North Carolina Regional

[15] https://deq.nc.gov/about/divisions/energy-mineral-and-land-resources/stormwater/stormwater-program/stormwater-design

[16] https://www.epa.gov/sites/default/files/2018-04/documents/storm_smart_cities_508_final_document_3_26_18.pdf

Hazard Mitigation Plan 2021 and Bladen-Columbus-Robeson Regional Hazard Mitigation Plan). These plans call for analyzing stormwater hotspots and identifying innovative solutions.

Legal Analysis and Model Ordinance for Reducing Local Flood Impacts from New Development

The project will complement the North Carolina Model Flood Damage Prevention Ordinance[17], which provides model language for reducing flood risk. The resource developed through the project will serve to enhance the available data and legal understanding of flood risk and regulations in North Carolina.

Pender County's 2011 report, Implementing Low Impact Development in Pender County[18], provides a local example of legal analysis on how development techniques can mimic the pre-development hydrology of a site, thereby reducing runoff to other properties. Other resources with guidance on local policy options include NC Forest Service and Duke University's Regulatory Strategies to Incorporate Green Infrastructure for North Carolina[19] (undated) and NC Cooperative Extension's Low Impact Development: A Guidebook for North Carolina[20].

Challenges/Obstacles

Some residents or elected officials may perceive stormwater management as a hindrance to new development. It is important that each of the resources and outreach materials articulate the value of managing stormwater to avoid flooding and environmental harm for current and future residents. This context for each of the resources may contribute to breaking down the perception that stormwater regulations are bad for development and therefore bad for the community.

On the other hand, communities may wish to undertake stormwater projects that use future-oriented sizing recommendations or that combine water quantity with water quality considerations but have trouble finding contractors familiar with these techniques. Local governments rely upon private sector contractors to get stormwater projects done, and so it is important that the audience for the resources include the many contractors that conduct work on behalf of communities.

Legislative Challenges, Permitting, and Zoning Requirements

The model ordinance will need to comply with existing minimum stormwater management requirements and ordinances at the state and local levels. It will also need to adhere to the legal authorities provided to local government by the state government. By completing the legal analysis component of this project, challenges with existing legislation can be identified and resolved.

[17] https://www.ncdps.gov/document/instructions-using-model-flood-damage-prevention-ordinance
[18] https://www.nccoast.org/uploads/documents/About%20us/Pelican%20Awards/Implementing%20LID%20in%20Pender%20County.pdf
[19] https://ncforestservice.gov/Urban/pdf/GreenInfrastructureNC.pdf
[20] https://www.uni-groupusa.org/PDF/NC_LID_Guidebook.pdf

Regional Stormwater Engineer Services

Stormwater flooding is a significant concern for communities in the Cape Fear region. Many stakeholders are worried about the impact that new development may have on stormwater flooding given the region's rapid growth. This growth can contribute to localized flooding if increases in impervious surfaces are not offset by stormwater management techniques.

It is the local government's role to ensure that new development is designed to meet current local stormwater standards. However, many local governments in the Cape Fear region do not have a stormwater engineer on staff to enforce existing local standards.

This project will create a mechanism for regional procurement of stormwater engineer services on an as-needed basis. The Council of Government (COG) would serve as a regional administrator to manage the administrative aspects while local governments would be able to secure engineering services to review development applications for stormwater compliance.

REGIONAL STORMWATER ENGINEER SERVICES

Description

The Cape Fear Region faces significant stormwater management challenges that are exacerbated due to rapid population growth and development. Some jurisdictions in the region have enhanced their local planning and zoning standards to address the impact of growth on stormwater runoff. However, not all jurisdictions have an engineer on staff to enforce local standards during permit review and enforcement.

The project would enable participating communities to access stormwater engineering services without the expense of employing a full-time engineer. The model of contracting for basic town services is familiar to many communities in the region as an economical alternative to hiring a full-time employee. In this proposal, the COG would work with an engineering firm to provide these services on a contract basis; dependent upon the need and demand this project may be expanded in the future to employ a full-time engineer to provide the same regional services. Participating communities would contribute to the project by paying a fee to access the services. This fee may be supported through development fees associated with stormwater permits.

Hazards Addressed

Flood, severe storm, sea level rise in ocean-facing communities

Location/Service Area

Regional

Population(s) Served

This project will serve all participating jurisdictions within the Cape Fear Region.

Sectors Addressed

The following sectors will be supported by this project:

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

Physical Benefits

- Reduction in stormwater runoff from new developments due to enforcement of standards in the development review process

Socioeconomic Benefits

- Reduction in stormwater impacts to residents of new and neighboring existing developments
- Cost savings to participating local governments they would incur hiring a full-time engineer

Environmental Benefits

- Reduction in stormwater runoff will lead to improvements in water quality, which supports healthy ecosystems and habitats

Equitable Outcomes

Local governments experiencing capacity and capabilities challenges will benefit from this project; this project is critical for small and rural jurisdictions who may face challenges sustaining a full-time position.

Roles of Lead and Supporting Agencies

The lead implementer would be responsible for establishing the service agreements, including legal and procurement services.

Lead Implementer

The Cape Fear COG would administer the program. Responsibilities include setting a fee structure, implementing contracts with local jurisdictions, and coordinating contracting with a stormwater engineer or hiring an in-house engineer, depending on demand.

Supporting Agencies

None

Cost Estimate

This project requires a minimal cost for startup activities such as developing the contract language, staff time to establish the fee structure, and procuring the engineering services. Startup costs are estimated to be under $50,000. Once the structure has been established the cost of services would be funded directly by the local jurisdictions utilizing the services.

Funding Sources

Grant programs rarely support personnel costs that are not within direct support of implementing a specific project. Communities interested in participating in this project could utilize a stormwater utility fee or development fee to support the costs associated with contracting the engineering services.

Steps for Implementation

The recommended steps to implement the project are listed below:

1. Secure funding to cover startup costs and set up the program.
2. Consult with communities and current staff members to determine how third-party engineering services could be most effective.
3. Develop COG-local government contract mechanism and proposed fee structure for services.
4. Enroll local governments in the program.
5. Procure a stormwater engineering services.
6. Administer program.

Implementation Timeframe

Once startup funding is secured the procurement process may begin and an engineer or firm will be selected and onboarded. This process could take up to one year.

Integration with Existing Plans, Programs, and Policies

This project will assist local governments with enforce existing ordinances that protect current and future residents from flooding and water quality problems. Additionally, the project will and empower communities to consider the implementation of new standards which may be beyond the technical capabilities of current staff to enforce.

For example, the Bradley and Hewletts Creeks Water Quality Recovery Plan[21] lists actions focused on implementing and enforcing existing stormwater management requirements for new developments and redevelopment projects. The Lockwood Folly's River Fecal Coliform TMDL Implementation Plan calls for reducing stormwater runoff from new and existing development.[22] The Southeastern North Carolina Regional Hazard Mitigation Plan[23] has actions to maintain stormwater ordinances and ensure compatibility with EPA Phase II National Pollutant Discharge Elimination Systems (NPDES) requirements.

[21] https://files.nc.gov/ncdeq/Water%20Quality/Planning/NPU/319/WatershedMGTPlans_9element/BradleyHewletts_ws_plan%202012_August.pdf
[22] https://deq.nc.gov/media/4561/download
[23] https://em.nhcgov.com/wp-content/uploads/2021/06/20210107_SENC_RHMP_FINAL-1.pdf

Challenges/Obstacles

Securing startup funding for this service may be challenging, because it is not a typical capital or planning project. Additionally, communities may face challenges paying the fee for the service. If a community opts to establish a stormwater utility fee or development fee to offset the costs of the services, they may face opposition by community members. Developers are less likely to oppose development fees if the fee is part of the costs associated with the required reviews for new development.

To overcome these challenges, additional awareness may need to be brought to the attention of community members to understand the issues related to stormwater water and permit review and how the fee would be beneficial to the entirety of the community.

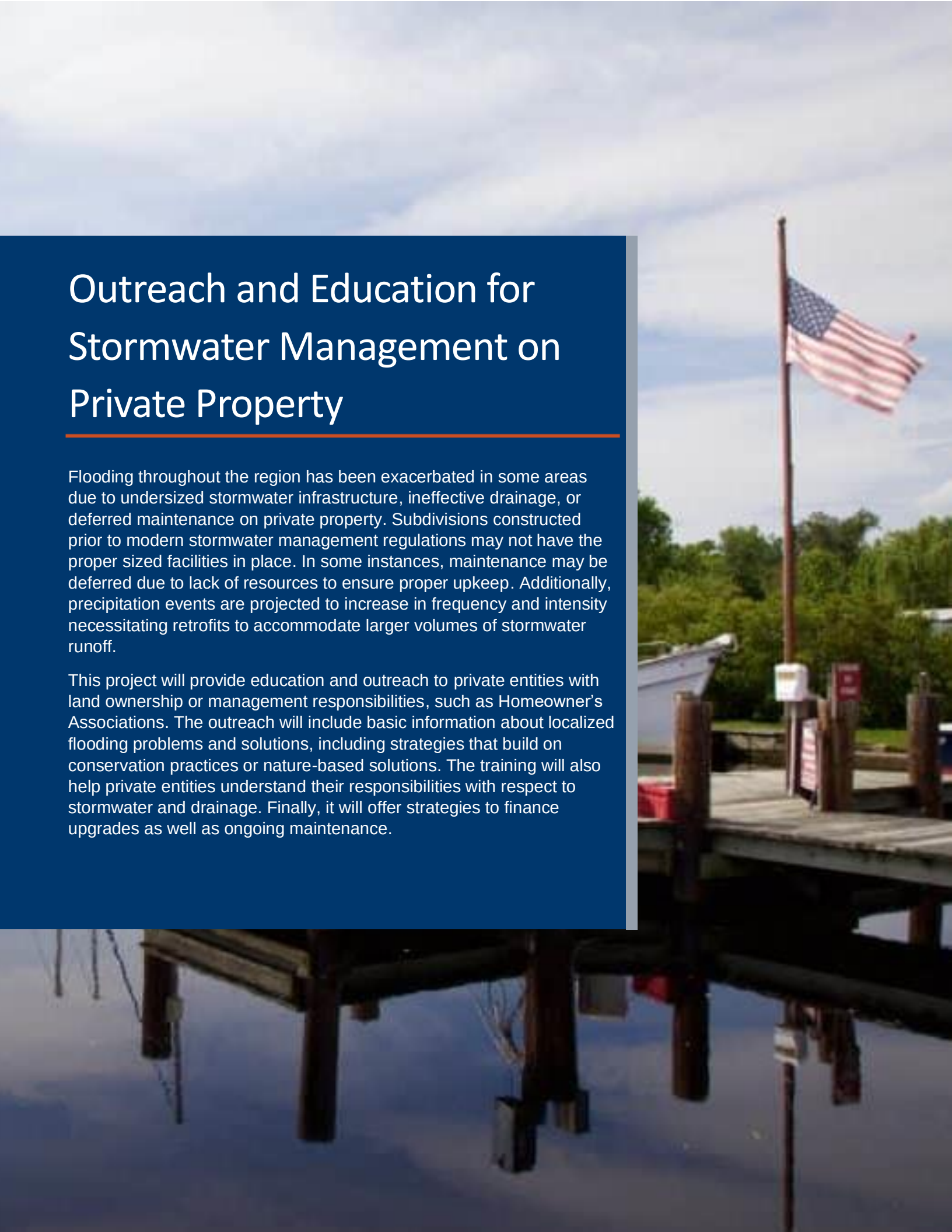
Legislative Challenges, Permitting, and Zoning Requirements

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

Outreach and Education for Stormwater Management on Private Property

Flooding throughout the region has been exacerbated in some areas due to undersized stormwater infrastructure, ineffective drainage, or deferred maintenance on private property. Subdivisions constructed prior to modern stormwater management regulations may not have the proper sized facilities in place. In some instances, maintenance may be deferred due to lack of resources to ensure proper upkeep. Additionally, precipitation events are projected to increase in frequency and intensity necessitating retrofits to accommodate larger volumes of stormwater runoff.

This project will provide education and outreach to private entities with land ownership or management responsibilities, such as Homeowner's Associations. The outreach will include basic information about localized flooding problems and solutions, including strategies that build on conservation practices or nature-based solutions. The training will also help private entities understand their responsibilities with respect to stormwater and drainage. Finally, it will offer strategies to finance upgrades as well as ongoing maintenance.



OUTREACH AND EDUCATION FOR STORMWATER MANAGEMENT ON PRIVATE PROPERTY

Description

Stormwater management facilities on public property are maintained by the state or county/local government. Facilities on private property, such as Homeowner's Associations (HOAs), faith-based organizations, and business, are the responsibility of these landowners. Infrastructure on private property is a concern because the responsible private entities may not be aware of their responsibilities, may not have funding to perform regular maintenance, the private entities may be inactive, or the private entities may not understand the function of the stormwater management facility.

The proposed project will provide education, outreach, and informational resources to support private entities that own stormwater management facilities. The targeted audience is any private landowner with stormwater management responsibilities, such as HOAs, businesses, and faith-based organizations.

The outreach effort has two objectives:

1. *Equip private entities with knowledge about stormwater management functions and responsibilities*. This education and outreach module could take multiple formats, such as a webinar series, in-person training, or printed materials. Education on stormwater management facilities and responsibilities would include several interrelated topics such as a basic overview of stormwater and management techniques, education on the consequences of untreated runoff, and responsibilities for managing stormwater facilities. Priority will be given to highlighting green infrastructure and nature-based solutions due to their co-benefits, cost effectiveness, and ability to reduce climate change drivers. Finally, the module would cover techniques for management, retrofit, and upgrades, with a particular emphasis on strategies that incorporate green infrastructure, nature-based solutions, recreation options, and environmental benefits.
2. *Connect private entities with financing strategies for assessments, maintenance, retrofits, or upgrades*. The financing strategy will consist of research to identify sources funding for private entities, financial techniques for raising capital to make investments, and analyzing the level of income needed to adequately maintain facilities in the long term.

Hazards Addressed

Flood, Hurricane, and Severe Storm

Location/Service Area

Regional

Populations Served

This project has the potential to benefit a large percentage of the population by providing resources for areas and places frequented by residents, such as businesses and faith-based organizations. In addition, this project will provide direct benefits to those residents residing in communities, such as HOAs, who participate in the project.

Sectors Addressed

The following sectors will be supported by this project:

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

Physical Benefits

- Reduction in localized stormwater flooding, including potential reduction of impacts to homes, businesses, and roadways

Socioeconomic Benefits

- Reduction in inconveniences of localized flooding
- Access to businesses and neighborhoods maintained
- Emergency response times unaffected
- Cost savings from implementing co-beneficial projects, such as nature-based solutions

Environmental Benefits

- Encouragement of co-beneficial projects throughout the region to improve water quality
- Creation and enhancement of wildlife habitat through the implementation of nature-based solutions and green infrastructure

Equitable Outcomes

There are no anticipated adverse impacts on socially vulnerable populations. The distribution of direct benefits depends on the private entities that participate in the program.

Roles of Lead and Supporting Agencies

The lead agency or agencies would develop the curriculum and execute the outreach. Supporting agencies may include subject matter experts and funding entities that would be able to assist with outreach, technical assistance, and supporting the implementation of upgrades and retrofits.

Lead Implementer

A state agency, nonprofit, or unit of local government such as the soil and water conservation district could all serve as the lead implementer.

Supporting Agencies

County and municipal governments, along with soil and water conservation districts, will be invited to participate in workshops, contribute curriculum material, and target areas or entities for outreach. Agencies with expertise on stormwater and outreach include:

- State: DEQ
- Academia: NCSU Cooperative Extension and UNC Environmental Finance Center
- Soil and Water Conservation Districts

Cost Estimate

The cost for the implementation of this project is estimated to be low but can vary greatly depending upon the scale and scope of outreach efforts. Curriculum development may be in the range of $20,000 to $40,000, depending on the sophistication and level of depth. Staff time to execute the outreach could be minimal, if the format is a webinar series, for example, or it could be more

substantial, requiring half the effort of a full-time employee. Cost of materials and possible in-person events similarly could range from $5,000 to $15,000 per year. Additional expenses may include printing and material distribution, venue fees for in-person meetings (e.g., renting the space, equipment, etc.), third-party contractor support, staff travel expenses for in-person meetings, etc. In total, operations could range from $10,000 to $65,000, depending on the format and frequency of training events.

Funding Sources

- NC DEQ's 319 Grant Program provides funding to reduce nonpoint source pollution. The funding is provided through EPA and North Carolina typically receives $1 million annually for competitive funding. Funds may be used to conduct watershed restoration projects such as stormwater and agricultural best management practices (BMPs) and restoration of stream channels. Section 319 grant projects must be used to help restore waterbodies that are (1) currently impaired by nonpoint source pollution and (2) in areas with approved watershed restoration plans. There are three approved watershed restoration plans in the Cape Fear Region with strategies and actions that align with this project which cover the Lockwoods Folly, Greenfield Lake, and Bradley and Hewletts Creeks Watersheds.[24]
- FEMA's Building Resilient Infrastructure and Communities (BRIC)[25] grant supports hazard mitigation grants that reduce risk. The capability- and capacity-building category of funding permits project scoping activities which allow for the development of mitigation strategies including data gathering, feasibility studies, engineering design, outreach, conducting hydrologic and hydraulic studies, and grant application development for implementation.
- The North Carolina Environmental Enhancement Grant (EEG) Program[26] 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.

Steps for Implementation

The recommended steps to implement the project are listed below:

1. The lead agency will coordinate with state and local governments and non-profits to identify existing outreach initiatives related to stormwater education for private property.
2. With the assistance of the state and local representatives, the lead agency will identify areas with prominent stormwater issues and determine where there is a need for and an interest in increased outreach and education.
3. The lead agency will develop education and outreach materials tailored to the local needs and concerns of these areas. This process includes defining d target audience and conducting a needs assessment to better understand the information needs of the target audience.

[24] https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=c2461274b3ff4009a8c405c4bddeb3aa

[25] https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply

[26] https://ncdoj.gov/protecting-the-environment/eeg/

4. The lead agency will collaborate with local, state, and federal agencies, academia, and environmental nonprofits to gather input on for outreach materials.
5. Once the workshops are healed the lead implemented will consult with the participating private entities to identify what their specific needs are.
6. The lead agency will conduct research based on the identified needs to identify applicable funding opportunities. The lead and supporting agencies will provide technical assistance to interested private entities to learn more about the identified funding opportunities and pursue funding.

Implementation Timeframe

This project has a medium implementation timeframe. From the time the workshops are conducted and up to the development of curriculum materials, the identification of target areas or entities for outreach could take months to years.

Integration with Existing Plans, Programs, and Policies

The project will build on prior stormwater management planning efforts in the Cape Fear Region. The project could complement existing resources that encourage on-site stormwater management on private property, such as NC Coastal Federation's Smart Yards[27] guide for managing stormwater in one's backyard.

The Community Conservation Assistance Program (CCAP)[28] provides funding to homeowners, businesses, schools, parks, and public land owners for water quality projects that may have drainage or flood mitigation benefits. Outreach efforts could build upon efforts of the CCAP to reach private landowners interested in stormwater management activities.

The Bradley and Hewletts Creeks Water Quality Recovery Plan lists actions aimed at supporting educational programs for residents to better understand stormwater impacts; securing funding to install retrofits to reduce runoff and track reductions; identifying cost-effective retrofit opportunities across the community; and evaluating stormwater facilities on private properties.[29] The Lockwood Folly's River Fecal Coliform TMDL Implementation Plan calls for specifically focusing on organized groups of homeowners, such as HOAs, to provide education, outreach, and training in regards to reducing stormwater runoff.[30]

Challenges/Obstacles

The success of this project relies on cooperation and the enthusiasm of participants. Buy-in and guidance from local governments to identify potential participants is critical. Private entities may be uninterested in participating or require additional encouragement upfront as to why their participation is needed. Collaborating with existing programs and initiatives will aid in successfully reaching the targeted audience.

Legislative Challenges, Permitting, and Zoning Requirements

Recommendations must meet minimum standards and may require review and approval by state and local regulatory departments.

[27] https://www.nccoast.org/uploads/documents/Media%20Room/Special%20publications/SmartYardsGuide_8-14_issue.pdf
[28] https://www.ncagr.gov/SWC/costshareprograms/CCAP/index.html.
[29] https://files.nc.gov/ncdeq/Water%20Quality/Planning/NPU/319/WatershedMGTPlans_9element/BradleyHewletts_ws_plan%202012_August.pdf
[30] https://deq.nc.gov/media/4561/download

Living Shorelines Site Analysis and Best Practices

Cape Fear's extensive shoreline, beaches, and barrier islands increases the region's vulnerability to coastal hazards such as sea level rise, erosion, flooding, hurricanes, and severe storms. Cape Fear's shorelines have experienced upwards of three feet of erosion over the past several decades; erosion is anticipated to continue as coastal hazards continue to increase in frequency and intensity.

Implementing protective measures to preserve these natural areas is important as the region's economy is largely tied to coastal activities and resources such as tourism and recreation. Additionally, the region's population, property, and assets are concentrated in coastal areas and therefore there is greater exposure to coastal hazards.

To combat these challenges, several communities have installed living shorelines as a nature-based solution to provide protection against hazards, while maintaining the natural characteristics of an area, and creating habitat. Installing living shorelines is a long-term solution that more cost-effective than structural shoreline protection solutions. Additionally, living shorelines reduce erosion while restoring and/or maintaining the shoreline's natural system. Living shorelines serve to alleviate flooding, improve water quality, reduce erosion, and attract wildlife.

LIVING SHORELINE SITE ANALYSIS AND BEST PRACTICES

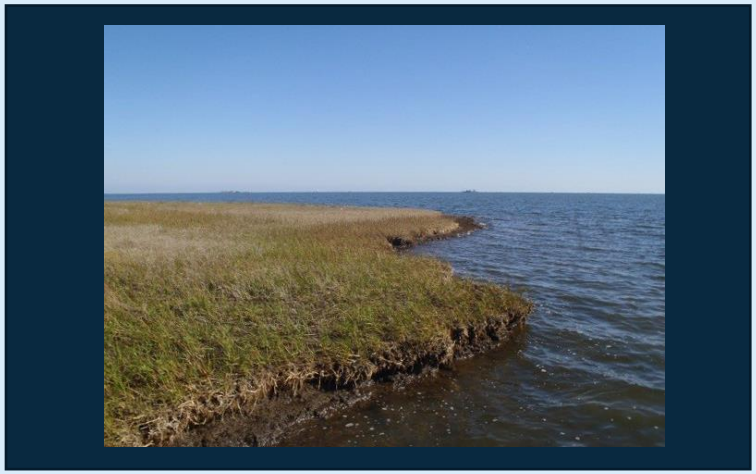
Description

While rates of erosion and accretion fluctuate in specific areas throughout the region, erosion is a threat to coastal natural resources and the economy that depends on them. It is also a threat to development at the ocean front, which includes residences and institutional and commercial uses. Storm events are projected to increase in frequency and intensity for the Cape Fear Region, which could lead to an increase in shoreline erosion rates.

In the Cape Fear region, local officials have expressed interest in implementing living shorelines as a resilience measure with multiple benefits. Living shorelines are "a protected, stabilized coastal edge made of natural materials such as plants, sand, or rock," as opposed to riprap, bulkheads, seawalls, or other hard structures (NOAA Fisheries n.d.). Living shorelines are a nature-based strategy that protects against coastal hazards while also improving coastal water quality and providing habitat that supports fisheries and coastal ecosystems.

The purpose of this project is to make living shoreline installation more accessible to local governments and other leaders that wish to install them in the Cape Fear region. Maximizing the value of living shorelines and ensuring their success depends on location and technique. This project has three components:

1. *Mapping analysis*. A mapping effort that identifies potential locations for installing living shorelines on public lands in the Cape Fear region. The mapping analysis will bring into focus the geophysical and environmental factors that make living shorelines most successful, overlaid with publicly owned property that will benefit local jurisdictions.
2. *Best management practices portfolio.* Compile a portfolio of verified successful techniques and practices for installing living shorelines. This portfolio will be developed for primary use by local governments and provide best practices regarding planning, design, financing, installation, and maintenance. In-state case studies will serve as the basis for the portfolio.
3. *Living shoreline installation*. Identify local partner to support and implement the installation of one or more living shorelines in a new location which serves the community, such as a public park.



Hazards Addressed

Floods, Hurricanes, Sea Level Rise, Severe Storms, and Erosion

Location/Service Area

Communities with estuarine shorelines with a focus on areas projected to experience upwards of six feet of erosion in the next

30 years. These areas include Carolina Beach, Bald Head Island, Ocean Isle Beach, and Wrightsville Beach (U.S. Geological Survey n.d.).[31]

Population(s) Served

This project will benefit individuals who live in and visit coastal areas, as well as the businesses and employees who rely on coastal tourism, recreation, and resources.

Sectors Addressed

The following sectors will be supported by this project:

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

Physical Benefits

- Reduced coastal erosion
- Protection of assets, such as structures and infrastructure, behind living shorelines
- Restores natural functions of coastal areas and reduces flood risk

Socioeconomic Benefits

- Reduced cost of shoreline protection and post-disaster recovery; living shorelines may reduce recovery costs as they are more cost effective to repair than gray infrastructure
- Aesthetic value of living shorelines supports coastal tourism
- Habitat value of living shorelines supports fisheries

Environmental Benefits

- Protection and enhancement of the biodiversity of coastal ecosystems, including natural marsh
- Creation and enhancement of wildlife habitat
- Water quality improvement

Equitable Outcomes

While most communities of higher social vulnerability are located within inland areas, coastal industries supported by natural resources often employ workers from across the region. The environmental and aesthetic value of living shorelines supports coastal economies and their workers.

Roles of Lead and Supporting Agencies

The lead agency will facilitate the process and contract to develop the suitability mapping analysis. The best practices portfolio will be developed using in-kind staff expertise; if the organization does not have this expertise in-house, a third-party contractor may need to be hired. The lead agency must be committed to close engagement with local governments throughout the process. Individual jurisdictions or other community-oriented landowners and managers would ultimately lead the installation of living shorelines.

Lead Implementer

The project will be led by an organization with coastal management, resilience, and living shoreline expertise. This organization could be a state agency, nonprofit, or other type of partner.

Supporting Agencies

State, local, nonprofit, and private entities throughout the state have expertise in living shorelines. Agencies with expertise on living shorelines include:

- Federal: NOAA, USACE, EPA, and FEMA

[31] For more information, see the *Climate Change and Natural Hazards Vulnerability Assessment for the Cape Fear Region* (p. 57).

- State: DEQ Division of Costal Management (DCM) and Division Water Resources (DWR), and NC Division of Marine Fisheries
- Environmental nonprofits like NCCF and TNC
- Local governments with living shorelines experience
- Academic experts and cooperative extension such as NC Sea Grant

Cost Estimate

The cost of the mapping and suitability analysis depends on whether new data will need to be acquired. Best practices and recommendations resources, including cost of outreach, is estimated around $150K. This estimate includes necessary costs for staff time of personnel conducting research and outreach, printing and distribution of materials, workshops to socialize the resources, and associated fees for workshops such as venue fees, equipment rental, and staff travel expenses.

NOAA estimates living shorelines installation to range from $1,000 to $5,000 per linear foot (NOAA Fisheries n.d.). The actual costs for the implementation of a new living shoreline are dependent upon site conditions, the type of materials utilized, and the scale of the living shoreline. Maintenance costs tend to be low, compared with hard infrastructure maintenance. Permitting for living shorelines is estimated to range from $250 - $475 (DCM 2022).

Funding Sources

- DEQ's 319 Grant Program provides funding to reduce nonpoint source pollution. The funding is provided through EPA and North Carolina typically receives $1 million annually for competitive funding. Funds may be used to conduct watershed restoration projects such as stormwater and agricultural BMPs and restoration of stream channels. Section 319 grant projects must be used to help restore waterbodies that are (1) currently impaired by nonpoint source pollution and (2) in areas with approved watershed restoration plans. There are three approved watershed restoration plans in the Cape Fear Region with strategies and actions that align with this project which cover the Lockwoods Folly, Greenfield Lake, and Bradley and Hewletts Creeks Watersheds.[32]
- The North Carolina Land and Water Fund (NCLWF)[33] serves to improve water quality and sustain ecological diversity by funding projects to acquire lands, restore the habitat for fish, wildlife, and other species, and enhance the filtering of stormwater runoff to reduce pollutants from entering water supplies.
- DWR's Water Resources Development Grant Program[34] provides funding to local jurisdictions to complete projects for stream restoration, water management, water-based recreation, and preliminary feasibility or engineering studies.
- The National Coastal Resilience Fund (NCRF)[35] is administered by the National Fish and Wildlife Foundation (NFWF) and supports planning, design, and restoration of natural and nature-based solutions to help protect coastal communities from the impacts of storms, floods, and other natural hazards. The program supports community capacity building and planning, site assessment and preliminary design, final design and permitting, and restoration implementation.

[32] https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=c2461274b3ff4009a8c405c4bddeb3aa
[33] https://nclwf.nc.gov/apply/project-eligibility
[34] https://deq.nc.gov/media/31983/open
[35] https://www.nfwf.org/national-coastal-resilience-fund-2022-request-proposals-closed

Steps for Implementation

The recommended steps to implement the project are listed below:

1. Distribute a survey to communities with estuarine shorelines to determine interest, knowledge gaps, and other needs relative to living shorelines. Jurisdictions interested in participating will form a working group to meet quarterly to provide input that will inform the project and receive updates.
2. The working group will participate in a basic needs assessment to ensure identify the most effective method for developing the mapping analysis and best practices portfolio to ensure it is beneficial for jurisdictions.

Mapping Analysis

3. Determine extent and data needs for mapping analysis and scope the cost. Depending on the lead implementer, a consultant may conduct the actual mapping and analysis. Conduct and ground-truth the mapping.

Best Practices Portfolio

3. Research best practices based on successful examples in North Carolina, grey literature, and academic research if necessary. Draft best practices document, review with the working group, and revise if needed.

4. Present results to the working group and explore interest in living shorelines projects. If there is interest, explore and develop a project proposal.
5. Post the mapping and best practices document to a website with high visibility among local governments. Ideally, the mapping analysis will be interactive.
6. Conduct outreach based on the two deliverables.

Implementation Timeframe

The development of mapping and a best practices document can likely be completed in under two years, possibly faster depending on the complexity of mapping. Actual implementation of living shorelines has a longer timeline, dependent upon securing funding, permit applications, design, and construction.

Integration with Existing Plans, Programs, and Policies

Living shorelines are often included in planning initiatives as a potential action or strategy to reduce risk. For example, the 9-Element Watershed Restoration Plan for Greenfield Lake calls for identifying BMPs, such as living shorelines, which are suitable for reducing non-point source pollution and assessment the efficacy of each identified BMP for future implementation.[36]

DCM developed a living shorelines strategy through 2026. The strategy focuses on training and outreach, research and monitoring, regulations, and coordination and implementation. The 2016 accomplishments report addresses efforts towards outreach, public awareness, financial incentives, and short- and long-term actions to advance the use of living shorelines. Additionally, DCM has previously hosted a series of workshops to provide training to property owners, contractors, landscaping professionals, and realtors.

Multiple mapping efforts have been completed and provide a foundation to build upon. DCM has completed a digital estuarine

[36] https://files.nc.gov/ncdeq/Water%20Quality/Planning/NPU/319/WatershedMGTPlans_9element/Greenfield%20Lake%202019%209-pt%20watershed%20plan%208-19-2016%20%28002%29.docx

shoreline map[37], which identifies five different types of shorelines. This effort will continue to include analyzing regional shoreline development trends and the distribution of coastal structures. Under the Coastal Resilience network, TNC in collaboration with multiple partners, developed the Living Shoreline Explorer[38] to provide the best available science and local data to visualize the potential suitability of living shorelines in coastal communities.

Additionally, NCORR is funding the development of the DMS Natural Infrastructure Flood Mitigation Program (NIFMP), which serves as a direct opportunity for integration of the proposed project. The NIFMP includes modeling to quantify effectiveness of various nature-based solution restoration practices.

Challenges/Obstacles

The success of this project requires the long-term involvement of several stakeholders across multiple sectors. Municipalities and organizations that are currently involved in other planning efforts may not be able to give this project the attention required to see it to fruition. Recognizing this challenge, the project proposes convening the working group of participating jurisdictions only on a quarterly basis.

In addition to maintaining buy-in long-term, challenges related to available data financing may arise. This project description identifies several organizations with subject matter expertise, who will not only be able to contribute towards the implementation of the project, but also provide guidance on data availability and gaps.

Additionally, fundings sources have been preliminary identified, but ensuring capacity to pursue funding (e.g., tracking timelines, preparing applications, managing awarded funds) could present additional challenges, especially in communities with low capacity.

In light of these potential challenges, it is recommended that an organization with subject matter expertise co-lead the project with a participating local jurisdiction.

Legislative Challenges, Permitting, and Zoning Requirements

A federal and state permit are required for the construction of living shorelines in North Carolina. The federal permit is issued by USACE, and the state permit is issued by DCM.

The scale of the proposed living shorelines will result in the need for a major permit. DCM's streamlined process for permitting averages 75 – 90 days for major permits (NC DEQ 2022). Major permits are utilized for activities that require other state or federal permits, cover more than 20 acres or for construction covering more than 60,000 sq. ft.

Major permits are reviewed by ten state and four federal agencies. A pre-filing meeting is required at least 360 days prior to submitting a certification. The goal of having all regulatory and resource agency representatives at the table is to discuss permits, identify foreseeable obstacles and eliminate unnecessary environmental impacts for the course of the given project. These meetings are designed for complex projects that may need local, state, and federal review.

[37] https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=f5e463a929ed430095e0a17ff803e156

[38] https://maps.coastalresilience.org/northcarolina/

Mitigating Risk to Manufactured Housing

Residents of mobile and manufactured housing (herein referred to as “manufactured housing units” or MHUs) endure some of the worst impacts of natural hazards. MHUs are less structurally sound than stick-built homes, and therefore do not withstand wind or wind-driven rain as well. Furthermore, they tend to be less energy efficient than stick-built homes, exposing residents to higher risks of heat illness and energy cost burden.

Compounding these issues, MHUs comprise a significant portion of affordable housing options for low- and moderate-income (LMI) households. LMI households are at additional risk to harms of natural hazards and climate change because it is more financially difficult to prepare, recover, and adapt.

Within the Cape Fear Region, there are 48,922 MHUs and 146 mobile home parks. Approximately 15 percent of the MHUs in the region are located within the regulatory floodplain.

The mitigation options available for MHUs and mobile home parks differ in some cases from the options available to stick-built homes. The proposed strategy will compile available mitigation strategies and identify gaps. It will also support, if desired, a pilot project to implement mitigation techniques at a particular site or jurisdiction.

MITIGATING RISK TO MANUFACTURED HOUSING

Description

MHUs are less resilient to climate hazards as compared to traditional, stick-built homes.[39] They are more susceptible to wind damage, typically cannot be rebuilt after flooding, and are not as energy efficient, exposing residents to hazards of high heat and energy cost burden. The cost of repairing MHUs after disasters often exceeds the home's tax value. However, MHUs are generally more affordable than stick-built homes. Many of the socially vulnerable populations in the region reside in MHUs, although residents in manufactured housing are by no means limited to the socially vulnerable.

Further complicating the issue, in mobile home parks, the land is typically owned by a single entity, and residents rent the land from the owner. This arrangement limits the mitigation measures MHU residents may take to protect their homes. The hazard mitigation needs of mobile home communities are understudied and the options for building resilience are not as well understood as in stick-built housing and neighborhoods.

This project has two phases:

1. *Study*. Using quantitative and qualitative data, a study will evaluate the vulnerability of MHUs and options for mitigation. It will identify whether there are policy or funding gaps that need to be addressed through local, state, or federal government. This study could be conducted region-wide but would be suitable for a more targeted study in a portion of the region, especially inland areas, with more socially vulnerable populations.
2. *Pilot project*. Implement a pilot project to improve the resilience of MHUs at a particular site or within a particular community. The selection of the pilot site and the mitigation techniques will depend on owner interest, findings of the study, funding availability, and partners buy-in and support.

Hazards Addressed

All

Location/Service Area

The study could focus region-wide, or it could be narrowed to a particular jurisdiction if there is an interested partner community. Throughout the region, concentrations of MHUs are located in the following areas:

- Brunswick County: Winnabow, unincorporated areas of the County, and along the coastline
- Columbus County: Equally dispersed throughout the County
- New Hanover County: Along the coastline
- Pender County: Burgaw and along the coastline

Population(s) Served

This project will benefit individuals residing in MHUs.

[39] The U.S. Department of Housing and Urban Development defines a mobile home as a prefabricated detached structure, typically used as permanent dwelling, which remains in one place permanently or semi-permanently. The structure is designed without a permanent foundation on a chassis and connected to utilities on-site. A factory-built home prior to June 15, 1976, is a mobile home and one built after June 15, 1976, is a manufactured home. Manufactured homes are required to be constructed to higher standards.

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
- Natural Environmental Systems

Physical Benefits

- Reduction in hazard impacts on MHUs

Socioeconomic Benefits

- Reduction in costly repairs or life disruptions for residents living in MHUs

Environmental Benefits

- If mitigation techniques address stormwater issues, the solutions may provide improvements to water quality and habitat, especially if nature-based solutions are used

Equitable Outcomes

The project will provide direct benefits to socially vulnerable populations and a high-risk housing sector.

Roles of Lead and Supporting Agencies

The two phases of the project may have the same or different lead implementer. For the study, the lead implementer will need to conduct qualitative and quantitative research, which may include interviews and fieldwork. The lead implementer will also be responsible for conducting the study, facilitating reviews, and publishing.

For the pilot project, the lead implementer will need to serve as a project manager, overseeing the development of the project concept and implementation. This may require engaging residents, writing grant applications, procuring engineering, design, general contractors, or new housing units.

Lead Implementer

A state agency such as NCORR may serve as the lead implementer of the project for the study phase. The lead implementer for the pilot project will be determined based on the project but could be a state agency, a mobile home park owner, a municipality, a nonprofit, or another type of organization.

Supporting Agencies

If the study and pilot project are narrowed down to one or more particular jurisdictions, those jurisdictions will be key supporting agencies. Other subject matter experts include:

- State: North Carolina Housing Coalition, NCEM, NC Housing Finance Agency, and NC Manufactured Housing Board

Cost Estimate

The study phase of this cost is anticipated around $100,000–$200,000, depending on whether work is completed by an intern, by agency staff, or by an outside entity. The cost of the pilot project depends entirely on the scope of the pilot.

Funding Sources

- The North Carolina Land and Water Fund (NCLWF)[40] serves to improve water quality and sustain ecological diversity by funding projects to acquire lands, restore the habitat for fish, wildlife, and other species, and enhance the filtering of stormwater runoff to reduce pollutants from entering water supplies. NCLWF can consider funding innovative stormwater projects that demonstrate a novel

[40] https://nclwf.nc.gov/apply/project-eligibility

and untried method to water quality at the project site and how it would contribute to achieving NCLWF's goal of advancing stormwater-management practices for water quality.

- The North Carolina Environmental Enhancement Grant Program[41] 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.
- NC Sea Grant's Community Collaborative Research Grant Program[42] provides support for activities which support the goals of NC Sea Grant and WRRI such as building resilient communities and expanding research opportunities. This program prioritizes projects that incorporate diversity, equity, inclusion, justice, and accessibility. The program boosts collaborative partnerships and requires project teams to be led by one scientific expert and one local knowledge expert.
- All three of FEMA's Hazard Mitigation Assistance Programs[43] (Hazard Mitigation Grant Program [HMGP], Flood Mitigation Assistance [FMA], and BRIC) provide funding that would support a potential pilot project related to reduction of risk from a natural hazard, with FMA requiring that hazard to be flood. The capability- and capacity-building category in the BRIC program permits project scoping activities which allow for the development of mitigation strategies including data gathering, feasibility studies, engineering design, outreach, conducting hydrologic and hydraulic studies, and grant application development for implementation.

Steps for Implementation

The recommended steps to implement the project are listed below:

Study

1. Survey local governments for interest in partnership; determine one or more focus areas
2. Scope the study, including key research questions and data sources.
3. Conduct the study, with input from housing and mitigation experts.
4. Discuss findings with partner local governments.

Pilot Project

1. Scan partner jurisdictions for potential projects based on opportunities identified in study findings.
2. Explore one or more promising leads for a retrofit
3. If appropriate, scope the project and proceed to securing funding, design, and engineering.
4. Construct/implement project.

Implementation Timeframe

Once personnel and funding have been secured, the study can be conducted in a year or less. The pilot project implementation timeline depends on the scope of the project, but a multi-year timeline should be expected.

[41] https://ncdoj.gov/protecting-the-environment/eeg/
[42] https://ncseagrant.ncsu.edu/funding-opps/grants/other-opps/community-collaborative-research-grant-program/
[43] https://www.fema.gov/grants/mitigation

Integration with Existing Plans, Programs, and Policies

Due to hazard impacts and mitigation for MHUs being understudied there are limited examples of existing plans, programs, or policies for integration of this project. Most existing initiatives focus on direct retrofits for the MHU structure itself, such as elevation, rather than identifying opportunities to for comprehensive mitigation for several MHUs or a MHU community.

FEMA published a guide[44] in 2009 detailing methods to protect MHUs from floods and other hazards. The dated and limited information available for initiatives to identify best practices for reducing risk at a holistic level for MHUs exemplifies the need for additional research, analysis, and implementation of mitigative measures.

The Garden City Mobile Home Park Acquisition project[45] is an out-of-state example of implementing community-based mitigation measures in a mobile home park. The project consisted of acquiring land from the mobile home park, providing relocation services and financial assistance to displaced residents, and implementing a stream restoration project to alleviate flooding on the property.

Challenges/Obstacles

Local leaders, faced with the enormity of the challenge of flooding in their communities, may not see a value in singling out manufactured housing. Engaging local governments should include messaging that the mitigation options for MHUs deserve special consideration, given their unique construction, differences from stick-built housing, and the challenges of making any repairs or retrofits cost-reasonable.

Legislative Challenges, Permitting, and Zoning Requirements

In North Carolina, MHUs must be constructed in accordance with HUD federal standards and installed in accordance with North Carolina regulations. Federal regulations include the following:

- Part 3280 - Manufactured Home Construction and Safety Standards
- Part 3282 - Manufactured Home Procedural and Enforcement Regulations
- Part 3285 - Model Manufactured Home Installation Standards
- Part 3286 - Manufactured Home Installation Program

The only statewide regulation is the 2019 State of North Carolina Regulations for Manufactured Homes[46]. In addition to these regulations and standards, local jurisdictions may enforce additional restrictions on MHUs such as floating zone districts, special use permits, buffers, and design requirements (UNC School of Government 2020).

The proposed pilot project will need to comply with the applicable federal, state, and local regulations.

[44] https://www.fema.gov/sites/default/files/2020-08/fema_p85.pdf
[45] https://www.times-news.com/news/local_news/county-gets-grant-to-relocate-occupants-of-trailers/article_7053551d-51e9-51f3-9191-5c3a96c3b5ec.html
[46] https://www.ncosfm.gov/manufactured-bldg/manufactured-homes

Regional Resilience Planner and Grant Writer

Throughout the Cape Fear Region, local governments face the challenge of addressing long-term resilience in their communities. In many smaller communities, local staff have serval duties and may not have the capacity or expertise to plan for long-term resilience. Unfortunately, the need for this work is increasing as evidenced by recent hurricanes and tropical storms that resulted in extreme damages. These natural hazards are likely to increase in frequency and intensity over the next thirty years.

Providing communities with greater support and technical assistance for planning and funding projects to build resilience would benefit the region. While communities may not have resources to sustain a position dedicated to this issue, a regional support person could provide services to multiple local governments.

This project provides a cost-effective way to serve communities and assist with securing funding to implement resilience focused projects. In addition, a planner with a regional service area can support cohesive efforts across municipalities and encourage replication of successful approaches.

REGIONAL RESILIENCE PLANNER AND GRANT WRITER

Description

Within the region there is consensus that long-term solutions are needed to build resilience in the face of increasing risk of natural hazards. However, building the capacity to do so remains a major challenge. Local jurisdictions are saturated with duties to address day-to-day community challenges. Adding the task of long-range resilience planning will increase this burden. A regional expert could provide technical assistance on an ongoing basis to jurisdictions in the region. Activities that this position could conduct include:

- Assessing risks and vulnerabilities at a localized scale
- Developing strategies and individual project concepts that build resilience
- Providing grant writing support for funding opportunities
- Providing the region with connections to resilience experts within or outside the region
- Finding funding for and/or procuring up-to-date modeling and data on hazards for use by communities and their consultants in the region; this might reduce costs compared with procuring those models and data on an individual basis
- Supporting the integration and use of the Cape Fear regional vulnerability assessment in other planning and policy documents
- Consulting with regional, state, or national groups dedicated to advancing resilience resources
- Providing resilience guidance specific to the hazards and landscapes in the Cape Fear Region

Hazards Addressed

All

Location/Service Area

Regional

Population(s) Served

This project could serve all jurisdictions within the Cape Fear Region.

Sectors Addressed

All

Physical Benefits

- Long-term planning will contribute to conservation of critical natural resources and future compatibility of land uses

Socioeconomic Benefits

- Technical assistance provided to secure grant funding may lead to additional grants being utilized by the local jurisdiction resulting in a reduction in use of general funds. This benefit is timely given the infusion of federal funding opportunities created by the Infrastructure Investment and Jobs Act and the Inflation Reduction Act.
- Cost savings to local jurisdictions that will not have to hire a full-time resilience planner/grant writer

Environmental Benefits

- Projects identified by the resilience planner and/or funded through grant funds secured by the resilience planner may provide environmental benefits such as water quality improvement, creation and enhancement of wildlife habitat, etc.

Equitable Outcomes

Jurisdictions that have historically lacked the ability or capacity to apply for funding or devote staff time to implementing resilience projects will be able to successfully compete with larger jurisdictions and bring much-needed resources to their community. Smaller communities, which are often more rural and less affluent, are particularly likely to benefit from this additional capacity.

Roles of Lead and Supporting Agencies

The lead implementer would employ the regional resilience planner and grant writer. Additional agencies would support the capacity of this individual to serve jurisdictions in the region. If multiple COGs are interested in housing a resilience planner, an agency such as NC Association of Regional COGs may be able to support networking and relationship building among these entities.

Lead Implementer

The Cape Fear COG would be a suitable organization to host the proposed position. The COG currently provides planning and administration services for federal, state, and local programs across the region to fulfill its mission to, "provide regional solutions that improve the quality of life for those [they] serve'. The existing vision and purpose of the COG is ideal for housing this position. Additionally, the COG has existing strong relationships with jurisdictions in the region and deeply understands the challenges these jurisdictions face.

Supporting Agencies

There are several organizations in North Carolina that offer technical assistance to local governments on disaster and climate resilience. To support the success of these efforts, it is important that these organizations build a relationship with the planner. Some of these organizations include:

- State agencies: NCORR, NCEM, and NCDEQ Division of Coastal Management
- Academia: NC Sea Grant, NCSU Cooperative Extension, NC State Coastal Dynamics Design Lab, and State Climate Office
- Environmental nonprofits such as the Conservation Trust for North Carolina

Cost Estimate

According to the U.S. Bureau of Labor Statistics, the median salary for an urban or regional planner is $78,500 (Bureau of Labor Statistics 2022). In addition to the base salary, costs would also include providing benefits for a full-time staff member and any additional administrative overhead costs. In total, this project is estimated to have a cost of approximately $150,000 annually.

Funding Sources

Ideally, funding for this position would be provided by the state budget on a recurring basis. Currently, some of these functions may be filled by an allocation in the 2021 budget for COGs. Long-term sustainment of the proposed position would be supported through external funding sources, so services could be provided to interested communities at no cost.

Grant funding to support personnel costs is often limited. Grants are more widely available to support staff time to conduct the activities that may be completed by the planner rather than the total salary of the planner.

Steps for Implementation

Recommended steps to implement the project are listed below:

1. Consult with communities and current staff members to determine how a regional position could be most effective.
2. Advocate for or secure funding to accommodate a new position.
3. Develop a position description based on needs expressed by partners in step 1.

4. Recruit and hire a qualified candidate.

Implementation Timeframe

The timeframe for this project is dependent on finding a funding source. The lead implementer can concurrently conduct steps 1 – 3. Once a funding source is identified, funds are secured, and the position description has been established the lead implemented can begin their internal hiring process to establish and fill the position.

Integration with Existing Plans, Programs, and Policies

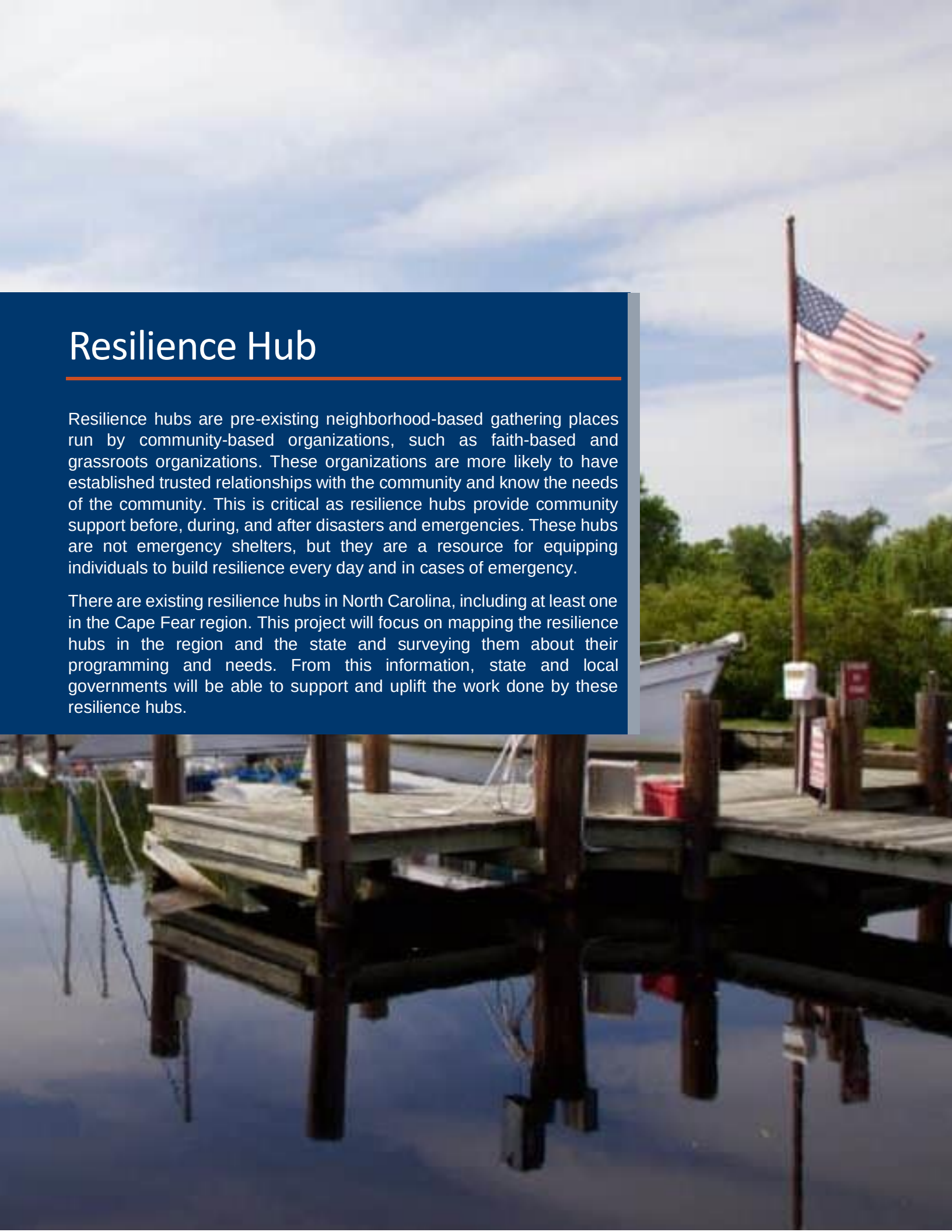
The purpose of this project is to uplift existing resilience focused plans, programs, and policies. This includes evaluating hazard mitigation plans, comprehensive plans, redevelopment plans, etc. to identify projects to build resilience in communities throughout the region. The position will support current regional goals and policies. This project will build off and support grant writing efforts underway by local and county governments such as efforts to implement projects identified through the NC Resilience Coastal Communities Program.

Challenges/Obstacles

Securing funding for this position will likely be the most significant challenge. Grant programs typically prefer to fund tangible deliverables, rather than personnel alone. If the position were grant funded, long-term funding would be needed to ensure the longevity of the position. The best way to overcome this challenge is to secure funding from the state budget; however, grant funding should still be pursued.

Legislative Challenges, Permitting, and Zoning Requirements

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



Resilience Hub

Resilience hubs are pre-existing neighborhood-based gathering places run by community-based organizations, such as faith-based and grassroots organizations. These organizations are more likely to have established trusted relationships with the community and know the needs of the community. This is critical as resilience hubs provide community support before, during, and after disasters and emergencies. These hubs are not emergency shelters, but they are a resource for equipping individuals to build resilience every day and in cases of emergency.

There are existing resilience hubs in North Carolina, including at least one in the Cape Fear region. This project will focus on mapping the resilience hubs in the region and the state and surveying them about their programming and needs. From this information, state and local governments will be able to support and uplift the work done by these resilience hubs.

RESILIENCE HUBS

Description

A resilience hub is designed to serve the immediate community and provide support and resources related to resilience to residents year-round. The resilience hub functions day-to-day, during an emergency or disaster, and during recovery. Resilience hubs are generally established in facilities that are known and trusted community gathering places, such as community centers and houses of worship. In addition to the physical aspects of the resilience hubs, hubs are often established and led by trusted community leaders and organizations with support and resources being provided by governmental organizations. Hubs provide ongoing programming and training that is tailored to the specific needs, culture, and values of the community.

This effort will focus on building support and boosting existing resilience hubs in the region. This project will prioritize the needs of existing hubs and community-based entities interested in becoming hubs. This may include providing dedicated funding, providing technical assistance to pursue grant funding, donating supplies, assisting with identifying resources, assisting with structure retrofits and upgrades such as backup power, and having professionals, such as healthcare and others, visit the hub and provide services.

While new locations for hubs may be identified, the project will focus largely on existing hubs. Within these hubs, networking can begin to foster peer-to-peer learning and knowledge exchange to replicate best practices and successes throughout the region and state. There are multiple networks of community-serving disaster-related organizations in the state which might be good starting points for this peer-learning. Governmental entities will support partnership building by identifying and connecting potential partners. Ongoing programming is critical to ensuring that hubs are continuously serving the community and equipping individuals and the community with the resources required to withstand disasters.

Hazards Addressed

All

Location/Service Area

Resilience hubs serve a neighborhood, town, or part of a county, although some hubs have a larger reach.

Population(s) Served

This project will directly serve those communities where a resilience hub is established. Resilience hubs focus on serving residents with the greatest needs, such as populations with higher social vulnerability.

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

Physical Benefits

- For resilience hubs that pursue facilities upgrades and retrofits, this will increase the level of protection and resilience of the services provided by the hub.
- Emergency supplies, such as sandbags, distributed by a resilience hub can add physical benefits to the individual households of residents who participate

Socioeconomic Benefits

- Resilience hubs support the human needs of individuals in the communities on an ongoing and emergency basis,

which is foundational to the wellbeing of community members

Environmental Benefits

- None anticipated

Equitable Outcomes

The goal of resilience hubs is to serve areas of increased social vulnerability and provide resources and supplies to vulnerable populations. The grassroots approach to establishing resilience hubs ensures that resources are directly received by the communities with the greatest need.

Roles of Lead and Supporting Agencies

There are multiple components of this proposed project, and the lead implementer could vary among the components. A lead agency is needed to build an understanding of resilience hubs in the region and state and develop and implement a survey to better understand their current programming and needs. From there, the lead implementer would work toward addressing needs and building capacity, working closely with hubs to ensure that communities' needs drive the process. The lead implementer may facilitate peer-to-peer learning among resilience hubs or may work with a supporting agency to take on some of this work. Finally, depending on interest, a lead agency might propose new locations for resilience hubs and programming to support them.

Lead Implementer

Ongoing outreach and discussions are required to identify organizations that are currently involved with resilience hubs in the region.

Supporting Agencies

Agencies with expertise and networks relevant to this project include:

- Community-based organizations (CBOs), especially those active in disaster and disaster recovery
- Groups that convene CBOs with roles in disaster and resilience, such as the North Carolina Inclusive Disaster Recovery Network and The Conservation Fund's Resourceful Communities
- Local emergency management agencies and local health and social services departments
- NCEM
- NC Department of Health and Human Services

Cost Estimate

The cost for the implementation of this project will vary widely based on the needs and concerns of the neighborhoods and communities where a new hub is established. For existing hubs, the cost may only include ongoing programming and annual operating cost for the facility. Other hubs may want to pursue facility upgrades, such as back-up power generators, solar panels, and other retrofits to ensure the building is hazard resistant. Below is an overview of potential costs to be expected for the project.

- Survey of current resilience hubs and needs assessment
- Ongoing peer-to-peer networking
- Support for ongoing programming (staff time and facility operations)
- Financial support for distribution of emergency supplies to residents in need
- Facility upgrades, ranging from elevating utilities and back-up generators to installing solar packs or microgrid development

Funding Sources

- All three of FEMA's Hazard Mitigation Assistance Programs[47] (HMGP, FMA, and BRIC) provide funding that would support facility retrofits to resilience hubs that increase the level of protection of the facility to natural hazards, with FMA requiring that hazard to be flood. The capability- and capacity-building category in the BRIC program permits partnership building activities which allow gap analyses, partner identification and partnership development, database and directory development, conducting a forum, etc.
- NC Sea Grant's Community Collaborative Research Grant Program[48] provides support for activities which support the goals of NC Sea Grant and WRRI such as building resilient communities and expanding research opportunities. This program prioritizes projects that incorporate diversity, equity, inclusion, justice, and accessibility. The program boosts collaborative partnerships and requires project teams to be led by one scientific expert and one local knowledge expert.
- NOAA's Environmental Literacy Program (ELP)[49] offers competitive grants that help communities build the environmental literacy necessary for resilience to extreme weather, climate change, and other environmental hazards.

Steps for Implementation

1. A lead implementer needs to be identified; an agency or organization with an interest in community resilience and experience liaising with government would be a good fit.
2. The definition of the term "resilience hub" varies. An initial conversation with resilience hub leaders and experts on resilience hubs can support a shared definition for the purposes of this project.
3. Conduct a needs assessment with existing resilience hubs and other community-based organizations that provide some relevant offerings. Conduct a separate needs assessment with local emergency management and social services departments to better understand what gaps might be filled by resilience hubs.
4. Explore strategies to strengthen existing hubs or help existing nonprofits transition to resilience hubs; build consensus around top priorities.
5. Pursue funding and other next steps to implement.
6. If needed and wanted, a peer-to-peer network can support resilience hubs, such as through regular calls and a listserv system. This exchange would help participants share updates and opportunities, successes, and challenges.

Implementation Timeframe

This project depends on finding a motivated lead implementer, which may or may not materialize. Once a lead implementer has been identified, the engagement, needs assessments, and strategy development could be completed in under a year. Pursuing the priority strategies will depend on their scope, but a timeframe of multiple years should be anticipated.

Integration with Existing Plans, Programs, and Policies

The project will build on the work of local governments, academic groups, community and faith-based organizations, and nonprofit organizations that undertake resilience-related outreach and implementation efforts. These groups include but are not limited to Men and Women United for Youth and Families, United Way of

[47] https://www.fema.gov/grants/mitigation
[48] https://ncseagrant.ncsu.edu/funding-opps/grants/other-opps/community-collaborative-research-grant-program/
[49] https://www.noaa.gov/office-education/elp/resilience-hub

Cape Fear, local Emergency Management departments, and Long-Term Recovery Committees.

The NC Climate Justice Collective's Resiliency Organizing Hubs[50] provide interactive, culturally relevant training in resilience-based organizing and serve as a space for building relationships and capacity. The Dawson Resiliency Hub in Scotland Neck, NC, is organized by A Better Chance A Better Community to provide food, encourage civic engagement, and conduct other community programming.

Additionally, extent work complete outside the state can also offer insight into shaping the project. The Urban Sustainability Director's Network[51] has developed a repository of resources for establishing and sustaining resilience hubs.

Challenges/Obstacles

The success of this project relies on the commitment and support of community-based entities. However, community-based organizations often face challenges due to a limited amount of time that may be devoted to an initiative, limited or no staff and reliance on volunteers, limited or no funding. Additionally, building governmental support and buy-in to assist the lead implementer in carrying out these tasks is also critically important and may serve as a challenge.

Legislative Challenges, Permitting, and Zoning Requirements

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

[50] https://www.ncclimatejustice.info/resiliency-organizing-hubs

[51] http://resilience-hub.org/

Flood Data

As flooding hazards continue to evolve and exceed historic events, the knowledge we use to plan and prepare for these events must change as well. Recent catastrophic flood events in the Cape Fear Region resulted in significant flooding in areas outside of the FEMA-mapped floodplain, which represents areas with the highest risk of flooding.

Using data from past historic events, such as high-water marks, provides insight into how flood levels are changing. This data combined with sea level rise projections can be used to develop supplemental flood zones to be used to make risk-informed decisions about development, investments, and more in the region.

FLOOD DATA

Description

Historic flooding in the region has extended beyond the current regulatory floodplain boundaries. As hazards continue to evolve and flooding is exacerbated, it is critical to develop a comprehensive understanding of where flood hazards exist in the region. This data will better equip local leaders with the knowledge to direct investments and accommodate growth in the region.

This project will be an effort to use historic flooding and future projections to develop a floodplain data layer to supplement existing floodplain data developed by FEMA and other entities. The primary objectives of this mapping exercise are to utilize field-collected, post-storm data of flood elevations from Hurricanes Florence and Matthew within the region to complete the following tasks:

- Develop a GIS dataset that captures the actual extent of flooding during Florence (the storm of record); additional local knowledge can be incorporated to capture areas outside the regulatory floodplain that flood on a frequent basis.
- If local leadership is interested, develop or refine an existing future floodplain data layer based on climate projections

The results of this mapping effort will equip local leaders with the knowledge and data to make risk-informed decisions regarding designated growth areas and public investment.

Hazards Addressed

Floods, Hurricanes, Sea Level Rise, and Severe Storms

Location/Service Area

Regional or County specific

Population(s) Served

This project may provide benefits to the entirety of the region by aiding in identifying flood hazard areas that impact evacuation routes, shelters, and other critical facilities. If the project is completed by a single local government, it may be replicated to be implemented by others within the region.

Sectors Addressed

The following sectors will be supported by this project:

- Housing, Critical Infrastructure, and Community Support Systems

Physical Benefits

- No direct physical benefits will be provided by this project. However, local leaders will be better equipped to make risk-informed decisions regarding new development and public investments.

Socioeconomic Benefits

- None anticipated

Environmental Benefits

- No direct environmental benefits will be provided by this project. However, the project will provide additional data and insight into where future flooding may occur and therefore inform future projects that may have environmental benefits.

Equitable Outcomes

None anticipated

Roles of Lead and Supporting Agencies

The lead agency will take on the responsibility of conducting the research and technical analysis to develop the data for the supplemental flood zone. Supporting agencies will be entities that may provide additional data to inform the development of the supplemental flood zone, such as known high water marks or climate projections. Supporting agencies also include those entities who will use the data within their communities.

Lead Implementer

Ongoing outreach and discussions are required to determine the agency best suited to lead this project.

Supporting Agencies

Potential supporting agencies:

- NCEM, specifically NC National Flood Insurance Program Coordinator's Office
- State agencies with relevant flood data and responsibilities, such as NCDOT and NCDEQ
- Local governments to ground truth data and utilize the final product to inform decisions within the community
- State Climate Office
- Climatologists and other flooding experts from universities
- Third party climate data providers such as First Street Foundation

Cost Estimate

The cost for this project will vary depending on the number of communities are interested in being included. Additional data points on the costs of similar projects in other communities will be included in the final portfolio.

Funding Sources

- All three of FEMA's Hazard Mitigation Assistance Programs[52] (HMGP, FMA, and BRIC) provide funding that would support research and data development for flood risk reduction. that increase the level of protection of the facility to natural hazards.
- NC Sea Grant's Community Collaborative Research Grant Program[53] provides support for activities which support the goals of NC Sea Grant and WRRI such as building resilient communities and expanding research opportunities. This program prioritizes projects that incorporate diversity, equity, inclusion, justice, and accessibility. The program boosts collaborative partnerships and requires project teams to be led by one scientific expert and one local knowledge expert.
- The North Carolina Environmental Enhancement Grant (EEG) Program[54] 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.
- DWR's Water Resources Development Grant (WRDG) Program[55] provides funding to local jurisdictions to complete projects for stream restoration, water management, water-based recreation, and preliminary feasibility or engineering studies.

[52] https://www.fema.gov/grants/mitigation
[53] https://ncseagrant.ncsu.edu/funding-opps/grants/other-opps/community-collaborative-research-grant-program/
[54] https://ncdoj.gov/protecting-the-environment/eeg/
[55] https://deq.nc.gov/media/31983/open

- NC DEQ's 319(h) Grant Program provides funding to reduce nonpoint source pollution. The funding is provided through EPA and North Carolina typically receives $1 million annually for competitive funding. Funds may be used to conduct watershed restoration projects such as stormwater and agricultural best management practices (BMPs) and restoration of stream channels. Section 319 grant projects must be used to help restore waterbodies that are (1) currently impaired by nonpoint source pollution and (2) in areas with approved watershed restoration plans. There are three approved watershed restoration plans in the Cape Fear Region with strategies and actions that align with this project which cover the Lockwoods Folly, Greenfield Lake, and Bradley and Hewletts Creeks Watersheds.[56]

Steps for Implementation

1. With the assistance of the state and local representatives and subject matter experts, the lead agency will initiate the research and analysis to identify historic water marks and the extent of previous significant flooding in the region.
2. The lead agency will solicit feedback and comments from subject matter experts and local representatives to ground truth the preliminary results. Participatory mapping or citizen science techniques could be used.
3. Data available from the North Carolina State Climate Office will inform the inputs for future climate conditions to create a comprehensive flood zone consisting of historic flooding and projected flood levels.
4. Findings should be made publicly accessible with careful messaging about appropriate use.
5. Outreach will provide awareness of the availability of the data, the applicability, and how to use the data to build resilience within the community.

Implementation Timeframe

Implementation is estimated to take 2–5 years. This includes time to perform the research, develop the supplemental flood zone, and conduct outreach about the availability of the new data.

Integration with Existing Plans, Programs, and Policies

Similar efforts have been completed for the North Carolina Floodplain Mapping Program[57] Dare County, and Horry County, SC[58]. The NCEM Floodplain Mapping Program publishes an Advisory Flood Mitigation Map that provides a visualization of flood risk in non-regulated areas. Additionally, the mapping tool provides flood hazard information, risk assessments, and mitigation strategies. Horry County completed an analysis to develop regulated supplemental flood zones based on recorded, historic flood exposure.

NC DOT is using NCORR funds to support the Transportation Pooled Study, which will update the National Oceanic and Atmospheric Administration (NOAA) "Atlas 14" precipitation intensity, duration, and frequency estimates. This data is used by the public and private sectors to design everything from drainage for public highways and bridges to stormwater infrastructure for residential development. This updated data can be integrated into the tools developed from this project.

NCORR developing The Digital Resilience Clearinghouse will be a shared online resource for data, case studies, guidance, and funding resources. The target audience is local leaders, and the

[56] https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=c2461274b3ff4009a8c405c4bddeb3aa
[57] https://flood.nc.gov/advisoryflood/
[58] https://www.horrycounty.org/gis/flood/

intention is to put information about flooding and other risks into the hands of people in a position to use it in their community.

NC DEQ is supporting a study of the probable maximum amount of precipitation at a location for a given duration that is meteorologically possible (the “worst case” scenario for rain or snow). This updated data will support watershed and resilience planning by helping government and non-government entities plan for design, location, and relocation of water infrastructure—such as dams, culverts, and drainage networks—and ensure safety and functionality.

Challenges/Obstacles

Building local government and community buy-in may be challenging. Some stakeholders and community members may be concerned that depicting flood risk outside the regulated floodplain may impact property values. It will be critical to ensure that awareness and outreach about the project includes information on the importance of understanding actual risk.

Additional challenges that may arise for this project is the availability of data and gaps in data. If areas flood frequently but result in minimal or no damage these events are often not documented. This may result in the need to include anecdotal and qualitative data into the project. To tackle this challenge in Maryland, the Department of Natural Resources passed legislation for local communities to identify and document areas of nuisance flooding to establish a record of frequent, low-damage events. Tools such as MyCoast allow for real-time crowdsourcing to measure water levels, geocode locations, and more.

Legislative Challenges, Permitting, and Zoning Requirements

This project is informational only. There are no anticipated legislative, permitting, or zoning challenges.

APPENDIX A: ADDITIONAL PROJECTS FOR CONSIDERATION

Project Name	Project Description
Name: Beach Dune Infiltration Pilot Project **Hazards:** Floods, Hurricanes, Severe Storms, and Erosion **Estimated Cost:** Low **Scale:** Site-Specific/Coastal	**PROBLEM** The majority of the Cape Fear Region's population, property, and assets are concentrated along the coastline. Due to the concentration of people and resources, this increased the risk of coastal hazards, which is exacerbated by aging stormwater infrastructure. The region's coastal communities are vulnerable to sea level rise, flooding, severe storms, hurricanes, and erosion; all of which can result in greater damage due to deficiencies in stormwater infrastructure. **SOLUTION** Construct a pilot project to reduce stormwater runoff and protect water quality. Communities, such as Kure Beach, have utilized technology to capture stormwater runoff and then utilized sand to filter contaminants and pollutants from entering the ocean. Open-bottomed chambers are constructed beneath dunes to temporarily contain stormwater as it naturally filters through the sand.
Name: Cape Fear Online Mapping Tool **Hazards:** All **Estimated Cost:** Medium **Scale:** Regional	**PROBLEM** Due to the variety of hazards the region is susceptible to currently and over the next several decades it is critical to increase climate literacy within the region. With many incoming residents to the area, newcomers may be less familiar with flooding history. **SOLUTION** Create a region-specific website with consolidated resources to inform residents about hazards within the region, such as areas prone to flooding or areas with significant erosion. The website would also provide resources for small-scale mitigation measures a resident would be able to implement independently.
Name: Crosswalk of Existing Projects **Hazards:** All	**PROBLEM** There are a variety of existing plans and initiatives that address risk reduction and resiliency. Often a plan may be developed, but there is not a clear implementation pathway or local buy-in to bring the project to fruition.

Project Name	Project Description
Estimated Cost: Low **Scale:** Regional	**SOLUTION** Conduct an analysis of projects identified in previous planning documents to determine the most beneficial projects for communities to pursue. The analysis would be based on the technical feasibility of each project and the cost-effectiveness and benefits the project would provide to the community.
Increase CRS Participation **Name:** Increase CRS Participation **Hazards:** Flood, Hurricane, and Severe Storm **Estimated Cost:** Low **Scale:** Regional	**PROBLEM** The CRS program is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the NFIP. Through participation in CRS, flood insurance premium rates are discounted on a sliding scale based on the activities a community implements. All communities do not currently participate in the program. **SOLUTION** Promote and encourage participation in CRS. Activities may include providing education and technical assistance to communities not currently enrolled in CRS or providing support for participating communities to increase their rating and subsequently premium discount.
Name: Land Suitability Analysis **Hazards:** All **Estimated Cost:** Medium **Scale:** Regional	**PROBLEM** During post-disaster recovery, residents may be unable to find suitable locations to relocate. Additionally, the surge in the region's population necessitates an increase in further development. It will be critical to ensure new development is risk-informed and ensures people are not placed in harm's way. **SOLUTION** Conduct an analysis to identify areas in the region that are most suitable for new development based on susceptibility to hazards, proximity to existing public utilities, and other factors. The analysis would serve as a guide for siting for new development and relocation due to hazard impacts.
Name: Long-range Flood Buyout Strategy **Hazards:** Floods, Hurricanes, Severe Storms, and Erosion	**PROBLEM** During post-disaster recovery, residents may be reluctant to relocate due to a number of reasons. As a disaster survivor, these residents may often be faced with a multitude of immediate concerns and needs. Being proactive and conducting prior planning to develop a plan for post-disaster

Project Name	Project Description
Estimated Cost: Low **Scale:** Regional	relocation would help residents during this time. Additionally, pre-disaster buyouts often take an extended amount of time to complete and prior planning can aid in expediting the process. **SOLUTION** Conduct a planning effort to identify sustainable practices that would support the voluntary removal of vulnerable structures from hazard-prone areas and complements existing buyout programs.
Name: Publicly Owned Stormwater Management Maintenance and Retrofit **Hazards:** Floods, Hurricanes, and Severe Storms **Estimated Cost:** High **Scale:** Regional	**PROBLEM** Local governments within the region face capacity and capability challenges and have limited resources to properly maintain publicly owned stormwater management infrastructure. **SOLUTION** Develop a cost-share maintenance program to support regular maintenance of public stormwater throughout the region. All participating communities would contribute funding for the budget to implement the program.
Name: Socially Vulnerable Populations Disaster Preparedness Guide **Hazards: All** **Estimated Cost: Low** **Scale:** Regional	**PROBLEM** Approximately 21% of the region's population is over 65 years old and may have a higher risk of hazards due to limited mobility and finances. The region's economically disadvantaged population is approximately 15% and may face barriers to evacuating, heating/cooling their homes, and obtaining supplies during emergencies. **SOLUTION** Develop a disaster preparedness guide that addresses barriers socially vulnerable populations may face such as limited mobility and finances.
Name: Subwatershed-Specific Management Plans	**PROBLEM** Planning efforts are often conducted based on political boundaries. As a result, planning efforts are likely to be limited and not address the full scope of watershed issues, such as addressing the source of flooding and the upstream and downstream impacts.

Project Name	Project Description
Hazards: Floods, Hurricanes, and Severe Storms **Estimated Cost:** Medium **Scale:** Regional	**SOLUTION** Provide funding and training for local government to develop subwatershed-specific management plans that are designed to control the rate and volume of runoff.

APPENDIX B: RESILIENCE SCORE CARD RANKING

The following was used to assign a value to each response for the ranking criteria.

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 the 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, must apply	Yes, in place

Category	Considerations	-1	0	1
Socioeconomic	Does the project aid in building a strong economy?	No	Maybe	Yes
	Does the project support improve 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 threatened 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

		Publicly Owned Stormwater Management Maintenance and Retrofit Program	Regional Stormwater Engineer Circuit Rider	Cost-Share for Privately Owned Community Stormwater Retrofits	Supplemental Flood Zones	Subwatershed-Specific Management Plans	Cape Fear Council of Governments Resilience Planner	Coastal Stormwater Management and Erosion Analysis	Beach Dune Infiltration Pilot Project	Living Shorelines New Location(s)	Crosswalk Existing Project Proposals	Grant Writing Workshop and Support	Cape Fear Online Mapping Tool	Increase CRS Participation	Long-Range Flood Buyout Strategy	Socially Vulnerable Populations Disaster Preparedness Guide	Mobile Home Retrofit Study and Pilot Project	Resilience Hub	Land Suitability Analysis
Category	**Considerations**	**Program and Policy**						**Construction**				**Public Awareness and Messaging**			**Community Resilience**				
Reduction in Risk	How many hazards are addressed? What is the probability the hazard(s) will occur?	0	0	0	0	0	1	0	0	0	1	1	1	0	0	1	0	1	0
	Does the project protect life or property or both?	1	-1	1	-1	-1	-1	-1	1	1	-1	-1	-1	1	1	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	0	1	1	1
	Does the project reduce the risk at a regional scale?	1	1	0	1	1	1	1	-1	-1	1	1	1	1	1	-1	-1	-1	1
	Does the project reduce a non-climate stressor?	1	1	1	-1	0	1	1	-1	-1	0	0	-1	0	1	1	-1	1	1
Scale	Is the project regional?	1	1	1	1	1	1	1	-1	-1	1	1	1	1	1	1	-1	-1	1
	Can the project be replicated?	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
Cost	What is the range of cost? Low (Under $50K)? Medium ($50k-$1m)? High (Over $1m)?	-1	0	-1	0	0	0	0	1	1	1	1	0	1	1	1	0	1	0
Benefits	Do the benefits outweigh the costs?	0	1	0	1	1	1	1	1	1	1	1	1	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	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
Feasibility	Is the project technically and legally possible?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

		Publicly Owned Stormwater Management Maintenance and Retrofit Program	Regional Stormwater Engineer Circuit Rider	Cost-Share for Privately Owned Community Stormwater Retrofits	Supplemental Flood Zones	Subwatershed-Specific Management Plans	Cape Fear Council of Governments Resilience Planner	Coastal Stormwater Management and Erosion Analysis	Beach Dune Infiltration Pilot Project	Living Shorelines New Location(s)	Crosswalk Existing Project Proposals	Grant Writing Workshop and Support	Cape Fear Online Mapping Tool	Increase CRS Participation	Long-Range Flood Buyout Strategy	Socially Vulnerable Populations Disaster Preparedness Guide	Mobile Home Retrofit Study and Pilot Project	Resilience Hub	Land Suitability Analysis
	Will permitting be required?	-1	1	-1	1	1	1	1	-1	-1	1	1	1	1	1	1	-1	1	1
	Are project sponsors identified, engaged, and have the capacity to implement the project?	-1	0	-1	-1	-1	1	-1	0	0	0	1	-1	0	-1	-1	-1	0	-1
	Is a funding source identified?	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	0	-1	0	0	0	-1	0	-1
Socioeconomic	Does the project aid in building a strong economy?	0	0	-1	-1	-1	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	0
	Does the project support improve community infrastructure (e.g., road network)?	1	1	-1	-1	-1	-1	1	1	1	0	0	-1	-1	-1	-1	-1	-1	-1
Climate Justice and Equity	Does the project benefit areas with a high Social Vulnerability Index?	0	1	-1	0	-1	0	-1	-1	-1	0	0	-1	0	0	1	1	1	-1
	Does the project have a positive, qualitative impact on populations that identify as Black, Indigenous, or People of Color (BIPOC)?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
	Does the project improve health resources?	-1	-1	-1	-1	-1	0	-1	-1	-1	0	0	-1	-1	-1	1	-1	1	-1
Environmental Impacts	Does the project address drivers of climate change?	-1	-1	-1	-1	0	1	1	0	1	0	0	-1	0	-1	-1	-1	0	-1
	Does the project use nature-based solutions?	0	0	0	-1	0	0	1	1	1	-1	-1	-1	0	0	-1	1	-1	-1
	Does the project provide habitat restoration for threatened and endangered species?	-1	-1	-1	-1	0	0	-1	0	1	0	0	-1	-1	0	-1	-1	-1	0

		Publicly Owned Stormwater Management Maintenance and Retrofit Program	Regional Stormwater Engineer Circuit Rider	Cost-Share for Privately Owned Community Stormwater Retrofits	Supplemental Flood Zones	Subwatershed-Specific Management Plans	Cape Fear Council of Governments Resilience Planner	Coastal Stormwater Management and Erosion Analysis	Beach Dune Infiltration Pilot Project	Living Shorelines New Location(s)	Crosswalk Existing Project Proposals	Grant Writing Workshop and Support	Cape Fear Online Mapping Tool	Increase CRS Participation	Long-Range Flood Buyout Strategy	Socially Vulnerable Populations Disaster Preparedness Guide	Mobile Home Retrofit Study and Pilot Project	Resilience Hub	Land Suitability Analysis
Public and Stakeholder Support	Is there strong support for the project? Was it ranked as a high priority by the Stakeholder Partnership and community?	1	1	-1	1	-1	0	1	0	0	-1	0	0	-1	-1	1	-1	1	0
	TOTAL	**2**	**7**	**-4**	**-2**	**0**	**9**	**7**	**2**	**4**	**5**	**9**	**-2**	**5**	**5**	**7**	**-4**	**6**	**1**

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

APPENDIX C: REFERENCES

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