Draft North Carolina Flood Resiliency Blueprint

March 1, 2024

This document serves as the **Draft North Carolina Flood Resiliency Blueprint**, representing the most significant statewide flood resiliency investment in North Carolina's history. The Blueprint is designed to bring together all flood-related resources and knowledge in the state into one unified platform. It will offer decision-makers at all levels a standardized methodology for flood planning, an online decision-support tool, and river basin-specific action strategies to address flooding in North Carolina communities. It will also allow the state to make targeted decisions about where to allocate resources for the most significant impact. The Blueprint will continue to be refined based on further stakeholder and community engagement, the pilot Neuse River Basin Flood Resiliency Action Strategy, the development and implementation of the Flood Resiliency Blueprint Tool, and on-the-ground project implementation.

The primary audiences for the Draft North Carolina Flood Resiliency Blueprint are intended to include the North Carolina General Assembly, state agencies, regional planning organizations, local governments, community leaders, academics, and other stakeholders interested in building flood resilience in the state of North Carolina.

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Definitions

A comprehensive list of definitions applicable to the North Carolina Flood Resiliency Blueprint is provided in Appendix A: Definitions Glossary.

Common Acronyms

1-D	One Dimensional
2-D	Two Dimensional
3-D	Three Dimensional
AI	Artificial Intelligence
CDC	Centers for Disease Control & Prevention
COG	Council of Government
DOI	Department of Insurance
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GICC	Geographic Information Coordinating Council
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HUC	Hydrologic Unit Code
IT	Information Technology
LASII	Local Assistance for Stormwater Infrastructure Investments
Lidar	Light Detecting and Ranging
ML	Machine Learning
NBS	Nature-Based Solutions
NC	North Carolina
NCDEQ	North Carolina Department of Environmental Quality
NCDOT	North Carolina Department of Transportation
NCEM	North Carolina Emergency Management
NCFMP	North Carolina Floodplain Mapping Program
NCORR	North Carolina Office of Recovery and Resiliency
PAG	Principal Advisory Group
PFRA	Probabilistic Flood Risk Analysis
QA/QC	Quality Assurance/Quality Control
RISE	Regions Innovating for Strong Economies and Environment
ROI	Return on Investment
SVI	Social Vulnerability Index
TAG	Technical Advisory Group
US	United States
USACE	US Army Corps of Engineers

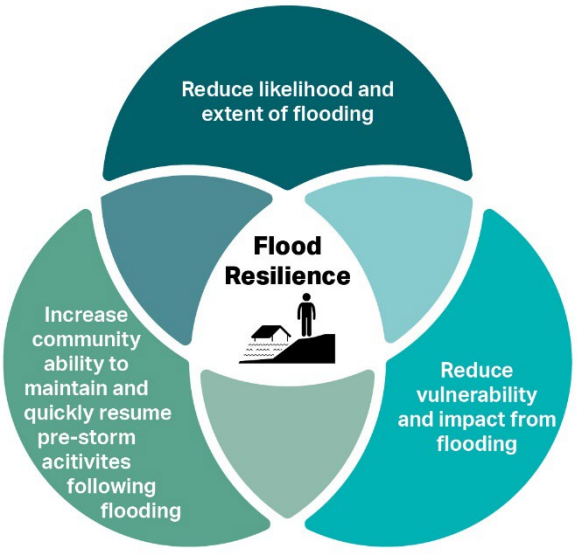
Executive Summary

Introduction

The North Carolina Flood Resiliency Blueprint is a first-of-its-kind program in the country and represents North Carolina's largest statewide flood mitigation investment. It is designed to bring together and build upon all the relevant existing resources and knowledge in the state to create one unified initiative to realize a more resilient North Carolina. The vision for this effort was developed through state legislation and extensive communication with state agencies, other states involved in robust flood mitigation and resiliency, communities on the frontlines of flood events, academics, nonprofits, climate and flood resiliency experts, legislators, and other stakeholders.

The Blueprint provides a statewide flood planning framework and decision-support tool that enables state, tribal, regional, and local entities and their stakeholders to identify, prioritize, and direct resources to implement effective flood resilience strategies based on the best available science and understanding of likely future conditions. The Blueprint serves as the backbone of North Carolina's flood planning process and will help increase community resiliency to flooding. By investing in a more flood-resilient state now, North Carolina will protect and improve the lives and livelihoods of North Carolinians, secure and build upon its thriving economy, expand tourism, support agriculture, forestry, and other working land businesses, fortify transportation infrastructure, protect critical aspects of the military mission, and steward natural resources.

Within the last ten years, major hurricanes, tropical storms, and other severe rain events have highlighted a flood-risk crisis that threatens North Carolina's communities, businesses, and people. Since 1977, North Carolina has received federal aid for 29 major flooding events. Hurricanes Matthew and Florence in 2016 and 2018 caused $27 billion in damage and resulted in 76 storm-related fatalities across the state. As of April 2020, the state and federal governments have spent over $3.5 billion as a result of these two storms alone, and recovery needs continue to exist for communities.[1] The current flood risk experienced by communities is expected to be heightened as storm events and rainfall increase in frequency and intensity and the state's population continues to grow, highlighting the need for enhanced community flood resilience (ES-Figure 1).

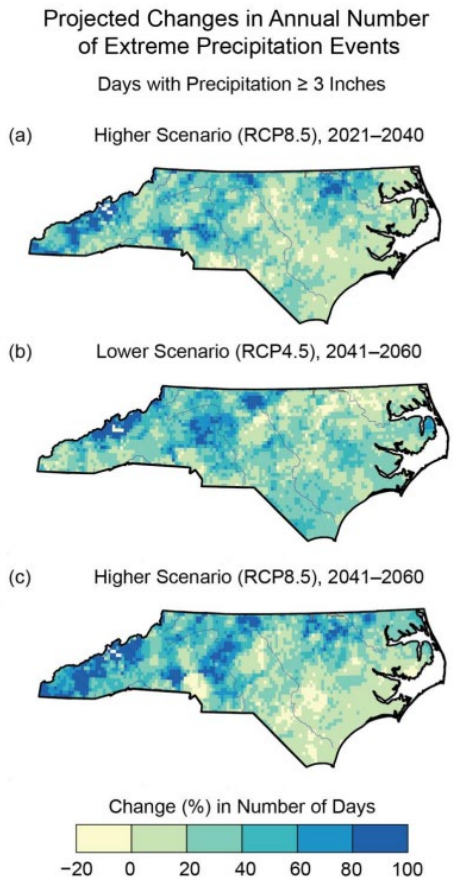


ES-Figure 1. Flood Resilience

Many jurisdictions face challenges related to current levels of flooding, even as the state continues to grow, attracting new businesses and

[1] "HUD Approves NC Plan for Spending Hurricane Florence Recovery Funds," NC Department of Public Safety, April 30, 2020, https://www.ncdps.gov/news/press-releases/2020/04/30/hud-approves-nc-plan-spending-hurricane-florence-recovery-funds-0.

residents. While North Carolina's growing economy and population are an overall positive trend for many communities, this growth is often accompanied by an increase in the amount of impervious surface area that reduces the ground's ability to absorb rainwater, increasing water flow into rivers, and worsening local and downstream flooding. The state's growth has also led to structures and infrastructure being built within areas that are beginning to experience flooding beyond historical patterns or that may be susceptible to flooding in the future.



ES-Figure 2. Changes in Precipitation

In highlighting the current flood risk that threatens North Carolina, it is important to consider the role of a changing climate, including increases in rainfall and sea level rise, and its potential to worsen the crisis. North Carolina is expected to experience further amplification of flood risk, partly attributed to rising precipitation levels and heightened flooding intensity (see ES-Figure 2).[2] While all North Carolinians will experience these effects in the future, resource-limited communities are disproportionately located in flood-prone areas, meaning these communities may bear a greater share of the increased flood risk.[3]

To better equip the state and its communities to manage current and future flood risk, the North Carolina General Assembly passed Section 5.9(c) of Session Law 2021-180 in 2021, which directed the North Carolina Department of Environmental Quality (NCDEQ) to develop a Flood Resiliency Blueprint (Blueprint).[4] The General Assembly provided additional guidance on the Blueprint's development in 2022 in Section 22 of Session Law 2022-75.[5]

The Blueprint planning framework and the decision-support tool are not envisioned as a static set of plans or tools but rather as a dynamic process incorporating new information as it becomes available. The effort will provide multi-scale flood modeling for future conditions, scenario exploration systems, guidance documents, and an iterative and interactive online planning tool to increase decision-makers' ability to understand flood risk and prioritize and implement flood resilience actions to protect communities, economies, and the environment. It will help to link and build on existing data, strategies, projects, plans, and efforts underway by local, state, and federal entities, academia, businesses, and nonprofits, as well as capitalize on lessons learned from existing programs in peer states.

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[2] "North Carolina Climate Science Report," North Carolina Institute for Climate Studies, June 2020, https://ncics.org/programs/nccsr/.

[3] Alireza Ermagun, Virginia Smith, and Fatemeh Janatabadi, "High Urban Flood Risk and No Shelter Access Disproportionally Impacts Vulnerable Communities in the USA," *Communications Earth & Environment* 5, no. 1 (January 2, 2024), https://doi.org/10.1038/s43247-023-01165-x.

[4] 2021 Appropriations Act, SL 2021-180, https://ncfloodblueprint.com/documents/SL2021-180.pdf.

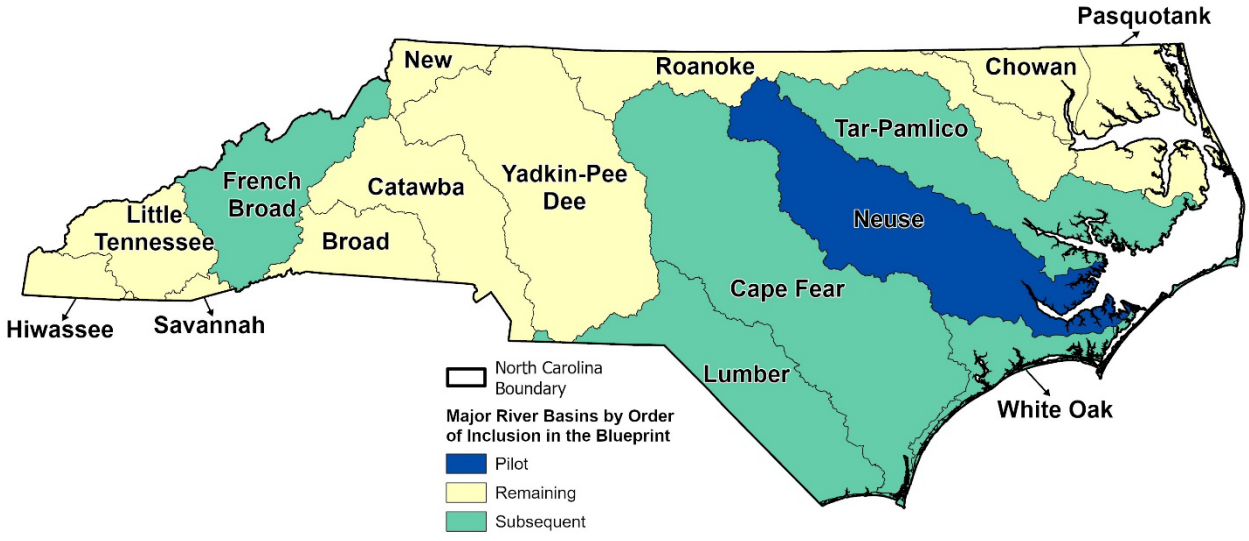
[5] Regulatory Reform Act of 2022, SL 2022-75, https://ncfloodblueprint.com/documents/SL2022-75.pdf.

The Blueprint's unique nature and scope require its development to emphasize an adaptive learning and management approach that encourages flexibility to continuously leverage the expertise of relevant stakeholders, incorporate existing and ongoing flood resiliency efforts, and take advantage of technological advancements as they mature. Moreover, the Blueprint aims to identify and address gaps in ongoing flood resiliency efforts in the state, foster regional collaboration, and strengthen local programs by incorporating community and stakeholder knowledge as a primary foundation for its efforts.

The development of the Blueprint has been divided into phases. Phase I - Develop the Draft Blueprint began in late 2022 and included a focus on generating over two dozen documents and reports based on extensive research covering diverse topics related to flood resiliency and the successful development and implementation of the Blueprint. This foundational research and gap analysis, along with extensive stakeholder engagement, enabled the development of the Draft North Carolina Flood Resiliency Blueprint, a preliminary Draft Neuse River Basin Flood Resiliency Action Strategy (Neuse Action Strategy), and requirements for a Flood Resiliency Blueprint Tool (Blueprint Tool).

As their titles suggest and as directed by the General Assembly, the Preliminary Draft Neuse River Basin Action Strategy and the Draft North Carolina Flood Resiliency Blueprint are subject to change based on continuous engagement and feedback from stakeholders as well as new and refined key findings and recommendations that arise during Phase II of the Blueprint.

Phase II - Develop the Flood Resiliency Blueprint Tool launched in late 2023 to focus on developing the Blueprint Tool and refining the Draft Blueprint and Preliminary Draft Neuse Action Strategy. Local decision-makers and residents will have the opportunity to participate in several workshops in the Neuse River Basin to review and provide feedback on the preliminary draft action strategy. Further stakeholder engagement will be conducted to inform the development of the Blueprint Tool. Phase III - Apply to Targeted Basins Statewide is projected to begin in the spring of 2024 and will involve NCDEQ and coordinating stakeholders strategically implementing the Blueprint's planning framework and the Blueprint Tool across additional targeted river basins to develop River Basin Action Strategies (ES-Figure 3).

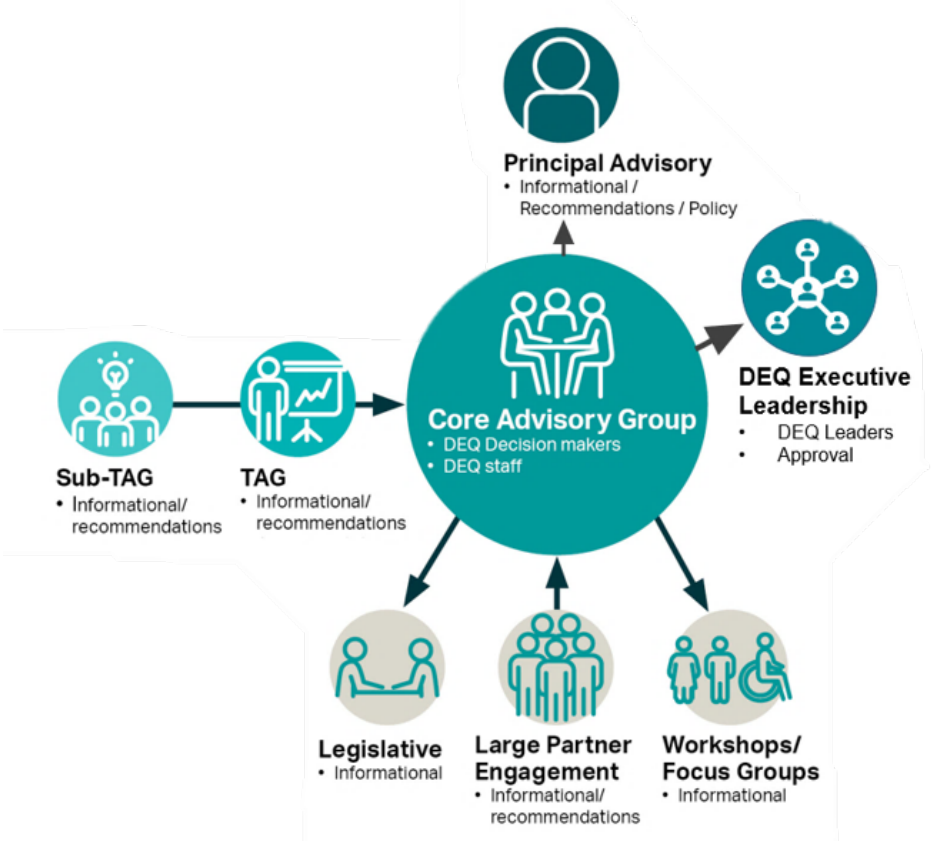


ES-Figure 3. North Carolina Major River Basins by Order of Inclusion in Blueprint

In addition to the Blueprint's initial funding, which is being used to develop the Blueprint and priority River Basin Action Strategies, the General Assembly appropriated $96 million for the implementation of flood resiliency projects. Session Law 2021-180 authorized, set the requirements, and allocated the funds to NCDEQ, while Session Law 2022-43 amended the requirements. NCDEQ is developing the spending strategy for these funds and will implement on-the-ground projects in parallel to the continued development of the tool and action strategies.

As Phase I ends, stakeholder engagement will continue to play a critical role in the Blueprint's development process. From the beginning, it was recognized that input from external stakeholders would be critical to the success of the Blueprint (ES-Figure 4). Every step of the development process included feedback and collaboration from a diverse set of stakeholders. NCDEQ took the proactive step of involving outside entities in crafting a work plan for Phase I. The work plan was informed by several one-on-one meetings and workshops that brought together NCDEQ staff, flood resiliency experts, key stakeholders, and potential Blueprint end-users from various sectors. These included other state agencies, academic institutions, local government representatives, and nonprofits.

At the outset of Phase I, NCDEQ engaged more than 150 subject matter experts and key stakeholders to participate across six Technical Advisory Groups (TAGs), a Neuse Regional Advisory Group, and a Principal Advisory Group (PAG). These groups served as the foundation for stakeholder involvement by providing valuable input on each component of Phase I across seven rounds of TAG and Neuse Regional Advisory Group meetings, as well as five PAG meetings. In addition, NCDEQ hosted 13 open house-style public meetings and workshops with local and regional decision-makers.



ES-Figure 4. Blueprint's Phase I Stakeholder Engagement Design

The stakeholder groups and NCDEQ worked together to create and review foundational documents during Phase I that were divided into four tasks covering Stakeholder Outreach/Facilitation, Gap Analysis, Recommendations, and Decision Framework, and the drafts of the North Carolina Flood Resiliency Blueprint and Preliminary Draft Neuse River Basin Flood Resiliency Action Strategy.

With Phase I ending, Phase II already underway, and Phase III on the horizon, it is essential to take stock of the progress made, the relationships built, and the next steps the Blueprint will take to realize North Carolina's vision and increase community resiliency to flooding.

Recommendations

No element of the Blueprint (e.g., documents, tool, program, staff) is intended to add any regulatory steps or authorities. It is also not intended to replace or usurp any federal, state, or local plans, projects, or authorities. The Blueprint is meant to link and enhance existing flood resilience efforts and provide new tools for decision makers. Participation is completely voluntary.

The Draft North Carolina Flood Resiliency Blueprint includes three primary sections: a River Basin Action Strategy Development Process with a Planning Workflow, Case Studies, and Blueprint Recommendations that directly apply to the program's long-term vision for increasing statewide flood resiliency. The Workflow is a multi-step process that the state and communities will be able to use to develop and implement River Basin Action Strategies (ES-Figure 5). Case Studies are used to demonstrate the Workflow implementation, highlighting the adaptability built into the Workflow that assists the Blueprint in addressing the unique flooding challenges and distinct goals of each participating community and region within a river basin. In addition, a set of recommendations for Blueprint program implementation covering diverse topics is proposed, informed by the supporting research and documentation from Phase I. These are intended to guide Blueprint development through Phases II, III, and beyond, as well as guide flood resiliency project implementation and support long-term program success. The Draft Blueprint and related documents provide a clear direction for how the Blueprint can serve as the central platform for flood resiliency planning and implementation at the state, regional, and local levels to achieve a more resilient North Carolina.

The Draft Blueprint includes guidelines to ensure consistent practices and procedures statewide yet remains sufficiently flexible to account for different physiographic settings, development intensity, regional differences, and other types of variability. The Workflow is designed as a recurring cycle for each river basin, where each iterative planning cycle builds on the efforts of the previous planning cycle. The Workflow is adaptable and considers future conditions during project planning, implementation, and maintenance phases. The implementation of these projects is balanced between shovel-ready projects and longer-term action.

Steps 1 through 6 of the Blueprint's Workflow focus on flood risk and vulnerability assessments and identifying potential flood resilience actions through collaboration between state agencies, regional planning groups, and local communities. The Blueprint Tool supports the planning process throughout the Workflow. These steps culminate in a River Basin Action Strategy with a ranked collection of local and regional actions and potential funding sources. Action implementation commences in Step 7 of the Workflow, overseen by NCDEQ in collaboration with a local, state, or regional sponsor for on-the-ground execution of flood resiliency projects. Step 8, the final piece of the Blueprint's Workflow, ensures program and project accountability. Through the Blueprint Tool, users can understand flood risk for a particular area and access and share information from a dashboard

communicating metrics on spending, risk reduction, and milestone completion in a highly visual format.

ES-Figure 5. North Carolina Flood Resiliency Blueprint Workflow

This Workflow was designed to be a scalable framework for flood resiliency planning. While NCDEQ intends to use this to develop River Basin Action Strategies for all basins in the state, the fundamental steps can be utilized by decision-makers at all levels, even outside of NCDEQ's process.

The Blueprint draws upon a strong foundation of prior flood resiliency work in the state. Analysis during Phase I revealed more than 50 flood resiliency or flood reduction plans and programs across the state, in addition to federal efforts. NCDEQ developed the Blueprint Workflow to link, fill gaps, and build upon the existing plans and programs rather than replace them. As noted earlier, the increase in flood risk due to a variety of factors underscores the need for enhanced resiliency planning and project implementation based on future conditions modeling — a task the Blueprint is designed to accomplish.

Phase I of the Blueprint identified several gaps across North Carolina's current flood resilience planning, policy, and programming. The Draft Blueprint outlines recommendations to remedy these gaps as well as recommending what actions the State should take to implement the Blueprint and continuously improve it. Through a collaborative effort, TAG and PAG members, NCDEQ, and the consultant team drafted recommendations to provide actionable steps to implement the program as it moves into future phases of work. These recommendations span seven primary categories: Program Development, Tool Development, Characterizing Flooding, Workflow Implementation and River Basin Strategy Development, Project Ranking, Financing and Funding, and Pilot Project Implementation (ES-Table 1).

The Draft North Carolina Flood Resiliency Blueprint is the first significant step in achieving the legislature's long-term vision for the Blueprint, which is stated as "…the backbone of a State flood planning process that increases community resiliency to flooding, shall be a resource for riverine and stream management to reduce flooding, and should support the establishment and furtherance of local government stormwater maintenance programs" (S.L. 2021-180, Section 5.9(c)). The individual communities that make up each of North Carolina's 17 river basins have unique needs, a wealth of expertise, and a desire to find solutions to the challenges of flooding. As the state grapples with the impacts of future change and the likelihood of increased flooding, the Blueprint serves as a central decision-support and implementation platform for numerous resiliency efforts and guides stakeholders and communities toward more resilient futures. The Blueprint's tools and processes, which let science drive flood mitigation decisions, will ultimately assist decision-makers in making more informed choices for why, where, and how to deal with flooding in ways that support a more resilient and vibrant state.

ES-Table 1. Recommendations to Implement the North Carolina Flood Resiliency Blueprint

Category	Recommendation
Program Development	• Integrate Other Flood Resiliency Strategies into the Blueprint's Planning Process and the Blueprint Tool
	• Create and Administer Stakeholder Engagement Programming
	• Build the Blueprint's Staffing Capacity
	• Integrate Lessons Learned from Peer State Programs into the Blueprint
	• Evaluate Options for a Blueprint Oversight Group
	• Create a Nature-Based Solutions Policy Digest
Tool Development	• Implement Lessons Learned from Existing Online Flood Mitigation Decision-Support Tools
	• Use the Best Available Data for the Flood Resiliency Blueprint Tool and Planning Process
	• Use Advanced Technologies Where Appropriate
	• Update Statewide Datasets Relevant to the Blueprint
Characterizing Flooding	• Partner with NCEM and NCDOT to Conduct 2-D Future Conditions Flood Modeling
	• Use a Two-Tiered Approach to Flood Modeling
	• Study the Benefits of Natural Assets for Flood Reduction, Flood Storage, and Flood Dispersion
Workflow Implementation & River Basin Strategy Development	• Implement a 5-Year Cycle for Action Strategies
	• Develop and Implement a Data Quality Review Process
	• Update Tool with Resiliency Action Plan Project Information Annually
	• Create River Basin Advisory Groups for Each River Basin
	• Conduct Basin-Specific Financial and Technical Capacity Needs Assessments
	• Provide Support to Under-Resourced Communities Throughout the Implementation of the Blueprint
Project Ranking	• Develop a Dynamic Resiliency Project Ranking Methodology
	• Incorporate Local Priorities into Project Ranking
Financing and Funding	• Integrate Identified Funding Sources
	• Develop a Compensation Program for the Agricultural Community Based on the Use of Farmland for Flood Storage and Reduction
	• Implement Multiple Finance and Organizational Approaches to Address Local Stormwater Programs
	• Provide Grant Opportunities to Establish Stormwater Programs
	• Incentivize Multipurpose and Multi-benefit Solutions
	• Coordinate State-Funded Projects Through the Flood Resiliency Blueprint
Pilot Project Implementation	• Complete Implementation of Stoney Creek Pilot Projects
	• Explore Agency Partnerships for Implementation
	• Implement Pilot Flood Resiliency Projects from River Basin Action Strategies

1 Introduction

Many North Carolina communities have experienced catastrophic flooding events in recent years, with some counties seeing multiple flooding disasters within the same year. Over the last ten years, major hurricanes, tropical storms, and other severe rain events have highlighted a flood-risk crisis that threatens North Carolina's communities, businesses, and people. Between 1977 and 2023, North Carolina received federal aid for 29 major flooding events. Hurricanes Matthew and Florence in 2016 and 2018 caused $27 billion in damage and resulted in 76 storm-related fatalities across the state. As of April 2020, the state had spent over $3.5 billion as a result of these two storms alone, and communities still face needs for recovery.[6] The current flood risk experienced by communities is expected to intensify as storm events and rainfall increase in frequency and intensity and the state's population keeps climbing— thereby highlighting the need for enhanced community flood resilience (Figure 1-1).

North Carolina continues to grow, attracting businesses and people looking to relocate or establish themselves in a thriving state. The state's population increased from 9,535,483 in 2010 to 10,439,388 in 2020, marking a 9.5 percent increase in the last decade, and is projected to reach 11.6 million by 2030.[7] While North Carolina's growing economy and population are an overall positive trend for many communities, this growth is often accompanied by an increase in the amount of impervious surface area. Increasing impervious surface area reduces the ground's ability to absorb rainwater, which in turn decreases infiltration and can cause higher volumes and speeds of water entering waterways, ultimately exacerbating the frequency and severity of flooding. The state's growth has also led to structures and infrastructure being built in areas that are beginning to experience flooding beyond historical patterns. There has also been increased construction in areas that may not have historically experienced flooding, but where current models project the risk of flooding will increase in coming years.

Figure 1-1. Flood Resilience

There are many types and sources of flooding that have negative impacts on human safety, homes and businesses, rural lands, infrastructure, and the environment. These sources of flooding may occur independently but often happen concurrently with each other. In addition to major riverine, coastal, and flash flooding caused by extreme weather events, nuisance flooding is on the rise and disrupts the day-to-day activities of North Carolinians. Nuisance flooding refers to lower levels of inundation that

[6] "HUD Approves NC Plan for Spending Hurricane Florence Recovery Funds," NC Department of Public Safety, April 30, 2020, https://www.ncdps.gov/news/press-releases/2020/04/30/hud-approves-nc-plan-spending-hurricane-florence-recovery-funds-0.

[7] "County/State Population Projections," North Carolina Office of State Budget and Management, December 15, 2023, https://www.osbm.nc.gov/facts-figures/population-demographics/state-demographer/countystate-population-projections.

can occur more frequently in urban, suburban, and rural areas and poses additional costly challenges to taxpayers and governments, as well as public safety risks. As recently as Fall 2023, many regions of the state experienced severe drought followed by intensive rain and flash flooding that restricted road access to neighborhoods and vital community services like hospitals, caused strain on transportation infrastructure, and tested the limits of stormwater infrastructure.

In highlighting the current flood risk that threatens North Carolina, it is important to consider the role of a changing climate, including increases in rainfall and sea level rise, and its potential to worsen the crisis. Recent scientific analyses, including through the North Carolina Climate Risk Assessment, observe that the state has witnessed an escalation in flooding occurrences. North Carolina is expected to experience further amplification of flood risk, partly attributed to rising precipitation levels and heightened flooding intensity, both inland and along the coast.[8] While all North Carolinians will experience these effects in the future, resource-limited communities are disproportionately located in flood-prone areas, meaning these communities may bear a greater share of the increased flood risk.[9]

To better equip the state and its communities to manage current and future flood risk, the North Carolina General Assembly passed Section 5.9(c) of Session Law 2021-180 in 2021, which directed the North Carolina Department of Environmental Quality (NCDEQ) to develop a Flood Resiliency Blueprint (Blueprint).[10] The General Assembly provided additional guidance on the Blueprint's development in 2022 in Section 22 of Session Law 2022-75.[11]

Session Law 2021-180 Section 5.9(c) lays out the General Assembly's intentions for the Blueprint by stating it should "identify the major watersheds affected by flooding and direct these funds toward the activities which are central to the creation of an actionable blueprint, namely flood risk assessment, identification of data gaps, and recommendations to reduce flood risk for each target watershed." The subsequent Session Law 2022-75 expands on this vision with the addition of several key elements stating that the Blueprint should "(1) Set up a standardized method to create requirements and guidelines for major flood risk modeling datasets with statewide application, including the collection, updating, and storing of GIS data. (2) Develop consistent guidelines to ensure common standard hydrology and hydraulic watershed models can be used for regional studies. (3) Create and maintain a publicly accessible repository for data and modeling outputs and technical reports to allow local government units and other organizations to access the information."

Blueprint Purpose and Goals

The Blueprint is a statewide initiative designed to bring together and build upon all the relevant existing resources and knowledge in the state to create one unified effort to increase community resiliency to flooding. It includes a statewide flood planning framework and decision-support tool that enables state, tribal, regional, and local entities and their stakeholders to identify, prioritize, and direct resources to implement effective flood resiliency strategies based on the best available science and understanding of likely future conditions. Through the development and implementation of river basin specific flood resiliency strategies, the Blueprint serves as the backbone of North Carolina's

[8] "North Carolina Climate Science Report," North Carolina Institute for Climate Studies, June 2020, https://ncics.org/programs/nccsr/.

[9] Alireza Ermagun, Virginia Smith, and Fatemeh Janatabadi, "High Urban Flood Risk and No Shelter Access Disproportionally Impacts Vulnerable Communities in the USA," *Communications Earth & Environment* 5, no. 1 (January 2, 2024), https://doi.org/10.1038/s43247-023-01165-x.

[10] 2021 Appropriations Act, SL 2021-180, https://ncfloodblueprint.com/documents/SL2021-180.pdf.

[11] Regulatory Reform Act of 2022, SL 2022-75, https://ncfloodblueprint.com/documents/SL2022-75.pdf.

flood planning process. Intended stakeholders, participants, and end-users of the Blueprint include technical and local experts; local, regional, tribal, and state decision-makers; and members of communities affected by flooding.

The overarching goal of the Blueprint is to build a more resilient North Carolina by working together and using a common platform. In addition, the desired outcomes are to:

- Reduce the frequency and severity of flooding events;
- Mitigate the impacts of flooding; and
- Enhance a community's ability to maintain and quickly resume pre-storm activities following a flooding event.

Additional features of a successful Blueprint are to maximize return on the state's investment while also seeking positive co-benefits across social, environmental, and economic dimensions. By investing in a more flood-resilient state now, North Carolina will protect and improve the lives and livelihoods of North Carolinians, secure and build upon its thriving economy, expand tourism, support agriculture, forestry, and other working land businesses, fortify transportation infrastructure, protect critical aspects of the military mission, and steward natural resources.

The Blueprint will provide a standardized, basin-wide flood resiliency approach applicable to all 17 North Carolina river basins (Figure 1-2). This process will better inform how and where resources should be directed and will assist in identifying flood resiliency projects and strategies. The Blueprint is not envisioned as a static tool or set of reports but rather as a dynamic process incorporating new information as it becomes available. The Blueprint and its components will provide multi-scale modeling, scenario exploration systems, guidance documents, and an interactive online decision-support tool to increase decision-makers' ability to identify, prioritize, and implement flood resilience actions to protect communities and economies from flood damage and flood risk. It will help link and build on existing data, strategies, projects, plans, and efforts underway by local, regional, tribal, state, and federal entities, academia, businesses, and nonprofits, and will incorporate local knowledge. The vision for this project was developed through the legislation and extensive communication with interagency staff, other states involved in flood mitigation and resiliency, municipalities, communities on the front line of flood events, academics, non-profits, climate and flood resiliency experts, legislators, and other stakeholders.

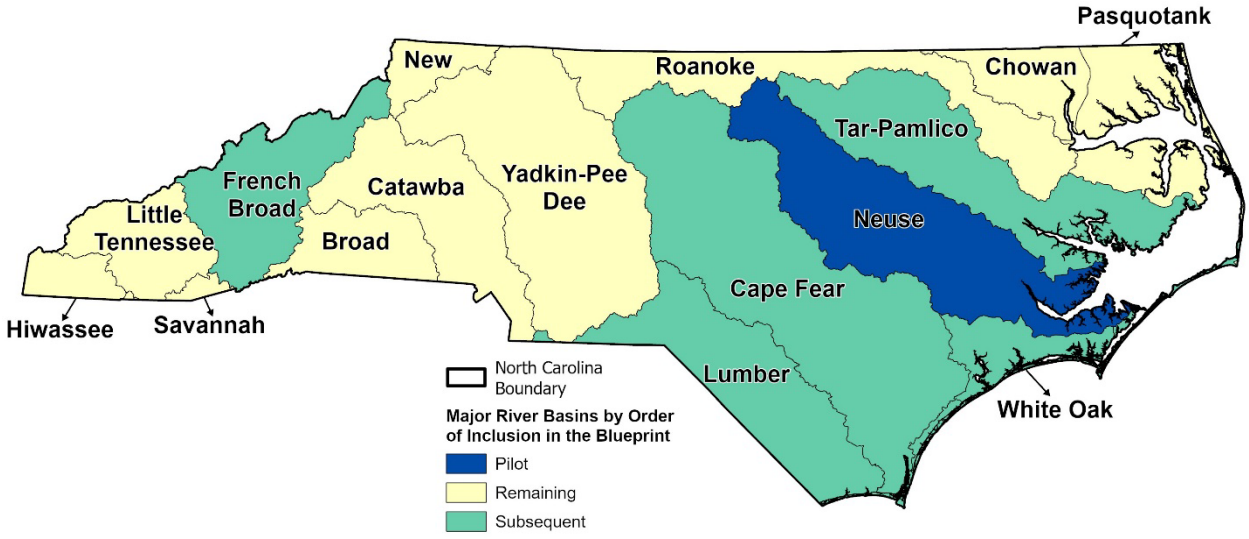


Figure 1-2. North Carolina Major River Basins by Order of Inclusion in Blueprint

1.1 Purpose of this Blueprint Document

This document serves as the programmatic and procedural framework to advance and implement the North Carolina Flood Resiliency Blueprint.

This draft Blueprint document provides a roadmap for the North Carolina Flood Resiliency Blueprint that ultimately helps inform decision-makers on where and how to invest in flood resiliency (e.g., structural, non-structural, nature-based, etc.), in what order to make investments, and what the impact of those investments may be. It outlines the structure of the Blueprint and offers recommendations on how to build out the program. These planning elements are captured within the standardized methodology and basin-specific action strategies.

The Blueprint document and the River Basin Action Strategies will be enhanced by an online decision-support tool (undergoing development in Phase II) that will provide the best available data, multi-scale flood modeling, flood solution selection and scenario exploration capabilities, guidance documents, and interactive online planning tools to increase decision-makers' ability to identify, prioritize, and implement flood resiliency actions. Accessibility is a primary focus of the Flood Resiliency Blueprint Tool (Blueprint Tool). To ensure the Blueprint Tool works towards bridging community resource gaps, the tool will incorporate local knowledge while developing additional technical resources that build on existing data, strategies, projects, plans, and efforts underway by state, federal, regional, and local governments, academia, businesses, and nonprofits.

No element of the Blueprint (e.g., documents, tool, program, staff) is intended to add any regulatory steps or authorities. It is also not intended to replace or usurp any federal, state, or local plans, projects, or authorities. The Blueprint is meant to link and enhance existing flood resilience efforts and provide new tools for decision makers. Participation is completely voluntary.

1.1.1 Summary of Blueprint Phases

The Blueprint is being executed in multiple phases (Figure 1-3), as described below.

Flood Resiliency Blueprint Phase I: NCDEQ developed a broad-ranging participatory advisory process to ensure that the agency received expert advice and recommendations from stakeholders across the state, representing wide-ranging interests, during the development of the Blueprint. NCDEQ recruited 120 subject matter experts for its six technical advisory groups (TAGs), 29 members for the basin-specific Neuse Regional Advisory Group, and 30 members for the Principal Advisory Group (PAG). The six technical advisory groups were divided by subject matter and included:

- Governance
- Partnership / Funding
- Hazard Identification
- Vulnerability / Risk / Impact
- Resilience / Mitigation / Reduction
- Tool Development / Acceptance

Figure 1-3. Blueprint Phases

Key outcomes in Phase I were the requirements for developing the Blueprint Tool, the Preliminary Draft Neuse River Basin Flood Resiliency Action Strategy (River Basin Action Strategy), and the Draft Flood Resiliency Blueprint document. Development of these key elements were accomplished over four primary tasks, which built on each other towards the key end products. The four tasks were as follows:

Phase I – Task 1: Conduct outreach and engagement activities; inventory of existing data, plans, programs, and efforts; and literature review. This task allowed the Blueprint team and TAGs/PAG to incorporate statewide and Neuse River Basin-specific stakeholder priorities and previous research and planning efforts into the Blueprint development process.

Phase I – Task 2: Develop a gap analysis based, in part, on the data and literature review from Task 1. This task allowed the Blueprint team and TAGs/PAG to determine where the gaps were and what could be improved upon from prior and current flood resiliency efforts at the statewide and Neuse River Basin scales and where the Blueprint needs to enhance these efforts.

Phase I – Task 3: Develop recommendations based, in part, on data and literature review (Task 1) and gap analysis (Task 2). These recommendations include online decision-support tool application requirements and other planning and programmatic components. This task begins to develop the foundations for a roadmap for the program development and implementation of the Blueprint.

Phase I – Task 4: Develop the Draft North Carolina Flood Resiliency Blueprint and Draft Neuse River Basin Flood Resiliency Action Strategy documents. The Draft Blueprint document combines all work completed into one comprehensive set of recommendations. At the same time, the Draft Neuse River Basin Action Strategy is a pilot of how the program may be applied in a specific region, along with offering lessons learned that inform the final Blueprint.

Currently underway and remaining phases include:

Flood Resiliency Blueprint Phase II: Phase II consists of the development (i.e., writing, testing, and deploying computer code) of the Blueprint Tool. Phase II is running concurrent with the latter portion of Phase I. The initial version of the Blueprint Tool has an estimated completion date of late 2024.

Flood Resiliency Blueprint Phase III and Project Implementation: Phase III is the creation of River Basin Action Strategies in additional targeted basins, including the application of the Blueprint Tool developed in Phase II and this Draft Blueprint framework as developed in Phase I. The additional

targeted river basins in North Carolina are the Cape Fear, Lumber[12], Tar-Pamlico, White Oak, and French Broad basins. Phase III is expected to begin in mid-2024. Further, the Neuse River Basin Action Strategy will be refined in this phase. NCDEQ also expects to begin funding implementation before or during this phase.

In addition to the Blueprint's initial funding, which is being used to develop the Blueprint and priority River Basin Action Strategies, the General Assembly appropriated $96 million for the implementation of flood resiliency projects. Session Law 2021-180 authorized, set the requirements, and allocated the funds to NCDEQ, while Session Law 2022-43 amended the requirements. NCDEQ is developing the spending strategy for these funds and will implement on-the-ground projects in parallel to the continued development of the Blueprint Tool and action strategies.

Additional Future Phases: Future phases of the Blueprint are expected to extend River Basin Action Strategy development to the remaining basins in the state. Other work in future phases is expected to include ongoing Blueprint Tool maintenance, program refinement, administration, further on-the-ground project implementation, etc.

1.2 Summary of Research

The recommendations for the Blueprint were informed by nine months of comprehensive research and analysis, community outreach, stakeholder engagement, and feedback provided by the Principal and Technical Advisory Groups. The Blueprint team conducted extensive outreach and engagement activities during the initial effort in Phase I. Next, the team conducted literature reviews and landscape analyses of statewide and local datasets, planning efforts, research, and regional-scale modeling related to flooding and flood resilience. With this information in hand, a comprehensive gap analysis was conducted, and an initial set of recommendations were developed to determine how to best to develop the Blueprint program and enhance resiliency across the state. The following tables summarize the engagement and research conducted (see Table 1-1 through Table 1-4):

1.2.1 Outreach and Engagement

Table 1-1: Outreach and Engagement Conducted

Number Conducted	Description
7 rounds of Technical Advisory Group meetings	Seven rounds of meetings with over 120 Technical Advisory Group members were held for each of the six TAG groups, divided by subject matter, and for the Neuse Regional Advisory Group. Members were identified from those individuals who had worked on the work plan and suggested for group membership by NCDEQ. The members were selected from state agency staff, federal partners, local floodplain administrators and engineers, non-profit organizations, business sector, and academic experts in climate, flooding, hazards, and modeling.
5 Principal Advisory Group meetings	Meetings with the 30 Principal Advisory Group members were held so that subject matter experts from various sectors and state program representatives could provide advisory input and feedback on the Blueprint Tool regarding the policy, process, engagement,

[12] On September 21, 2017, the Lumbee Tribe approved the Joint Resolution Seeking the Renaming of the Lumbee River" for the river to be designated the "Lumbee River" (CLLR-2017-0921-01, September 21, 2017) https://www.lumbeetribe.com/_files/ugd/6ca8af_d6f8484f63b84a74929b8bf34cf6cfd0.pdf).

Number Conducted	Description
	modeling, tools, and support for implementing the decision-support tool and the Blueprint at large.
13 community meetings	Open house-style public meetings and workshops, including councils of government, municipal and county leaders, private interest groups, non-governmental entities, tribal representatives, and representatives of under-resourced and underserved populations, including populations protected by Title VI of the Civil Rights Act. *Note:* 10 meetings have occurred with three Neuse Regional Advisory Group workshops planned for Spring 2024.
30+ presentations	Information meetings or speaking engagements open to the public, such as conferences and information coordination meetings.

1.2.2 Literature Review

The literature resources reviewed met three inclusion criteria: having a statewide geographic or Neuse River Basin-specific scope, being credible material vetted by state agencies and/or subject matter experts and being the latest version of the document (see Table 1-2). In addition, peer state programs were reviewed as directed by the legislation.

The comprehensive literature review comprises several reports, including *Literature Review and Data Collection Inventory* (Subtask 1.1), *Peer State Flood Resiliency Programs* (Subtask 1.5), *Statewide Planning Efforts with Flood Resilience Recommendations* (Subtask 1.7), and *Neuse River Basin Literature Review Expansion* (Subtask 2.3).

Table 1-2: Literature Review Conducted

Sources Reviewed	Description
48 Plans	Review of North Carolina flood resiliency or reduction plans and strategies
14 Reports	Review of North Carolina technical reports and memos related to flood risk reduction and prevention
Multiple Policies	Review of state laws and policies related to flood control, prevention, and resiliency, including North Carolina Executive Orders 80 and 246, as well as the North Carolina Department of Transportation (NCDOT) Resilience Policy, among others
10 Studies	Review of research projects and studies on flooding in NC
6 Programs	Review of existing North Carolina flood resilience programs

1.2.3 Data Collection and Synthesis

Table 1-3: Data Collection and Synthesis Conducted

Sources Reviewed	Description
8 Data Tools	Performed an analysis of web-based data tools that assist users in accessing, interpreting, and visualizing datasets related to flood resiliency

Sources Reviewed	Description
6 Peer State Programs	Reviewed programs and governance schemes from five peer states (Louisiana, Massachusetts, South Carolina, Texas – two programs, and Virginia) with examples of how datasets, models, and platforms are being used for decision-making and the levels at which governance decisions are made
22 Online Funding Navigator Tools **69 Funding Vehicles** **16 Technical Assistance Mechanisms** **3 Creative Strategy Case Studies**	Performed an analysis of related tools and funding vehicles for flood risk project funding
36 Flood Mitigation Strategies	Performed a landscape analysis of existing strategies for mitigating and reducing flood risk and protecting the environment, formatted into a toolkit for easy reference
31 Potential Restrictions to Implementation	Identified existing federal, tribal, and state restrictions that impact the ability of state and local governments to implement flood resilience strategies. These range from funding requirements to government interdependencies and permitting requirements
12 Existing Recommendations	Identified specific recommendations from existing statewide planning efforts, as identified in the Literature Review, which correspond with flood resilience strategies with the most effective connection to the Blueprint
3 Online Mitigation Decision-Making Support Tools	Identified and evaluated three existing online flood mitigation decision-support tools. The analysis included pros, cons, and recommended changes for incorporation into the Blueprint
8 AI/ML Methods	Identified artificial intelligence/machine learning tools that can be used or developed to improve the Blueprint
7 Under-resourced Communities Identified for Neuse River Basin Action Strategy	Identified vulnerable, underserved, and under-resourced communities in the Neuse River Basin using 3 datasets

1.2.4 Gap Analysis

Table 1-4: Gap Analysis Conducted

Sources Reviewed and Identified for Inclusion	Description
128 Sources of Data	Identified and evaluated datasets within North Carolina that could be available for use in projects performed as part of the Blueprint
21 Modeling Datasets	Identified and evaluated riverine hydrologic and hydraulic modeling within North Carolina that could be available for use in projects performed as part of the Blueprint
10 Future Flood Hazard Datasets	Identified scientifically defensible data necessary to analyze future flood hazards: future land use, climate, etc.

Sources Reviewed and Identified for Inclusion	Description
10 Research and Planning Nature-Based Solutions (NBS) Initiatives **7 Federal NBS Datasets** **13 State NBS Datasets** **4 State NBS Policies** **6 Federal NBS Policies**	Assessed existing datasets and methods for identifying natural infrastructure and estimating their functions

The research outlined above informed seven recommendation reports on the Flood Resiliency Blueprint Tool development, incorporation of local priorities into the Blueprint, North Carolina hydrological and hydraulic modeling, standardization of datasets, use of artificial intelligence and machine learning (AI/ML), staffing, program development, and local stormwater management. The recommendations are synthesized and summarized in the Draft Blueprint herein. The full list of Phase I reports is provided below.

1.2.5 List of Phase I Blueprint Reports

Table 1-5: Phase I Blueprint Reports

Subtask	Report Title	Description
1.1	Literature Review and Data Collection Inventory	The purpose of this document is to conduct a thorough literature review and data collection inventory of existing data, planning efforts, research projects, studies, and regional scale modeling that have been developed to provide a basis for understanding, to build upon existing efforts, and to help meet the intent of the Blueprint.
1.3	Outreach and Engagement Plan for the North Carolina Flood Resiliency Blueprint	As part of the Blueprint, NCDEQ developed an Outreach and Engagement Plan to coordinate stakeholder engagement in accordance with the overall NCDEQ Public Participation Plan. The PAG and TAGs will be engaged throughout the contract period to ensure successful development of the Blueprint.
1.4	Catalogue of Government and Organization Watershed Planning Efforts in the Neuse River Basin	This document is a catalogue of local, regional, and state organizations engaged in watershed planning or resiliency efforts in the pilot river basin. This document includes the mission, history, level of engagement, area of expertise, capacity to engage in flood resilience planning and implementation through providing local input, and other information that will inform the Blueprint team on how to complement existing efforts and skills.
1.5	Peer State Flood Resiliency Programs	This document aims to review governance schemes from a minimum of five peer states and provide examples of how datasets, models, and platforms are being used for decision making and the levels at which governance decisions are made (e.g., regional, local, state).
1.7	Review of Statewide Planning Efforts with Flood Resilience Recommendations	The purpose of this review is to document identified specific recommendations from existing statewide planning efforts that correspond with flood resilience strategies, and to provide an understanding of

Subtask	Report Title	Description
		completed and ongoing statewide efforts related to watershed and resiliency planning.
1.10	Blueprint Recommendation Process	The purpose of this document is to propose and refine a process for the Blueprint Advisory Groups to provide recommendations to NCDEQ to build alignment and establish how final decisions are made, specifically targeting the process to deal with differing perspectives. The recommendation document is considered a supplement to the Outreach and Engagement Plan (Subtask 1.3) for the Blueprint and can be more efficiently used in combination with that plan.
2.1	Flood Risk Resiliency Types and Sources of Flooding Inventory Gap Analysis	The purpose of this document is to identify and evaluate datasets in North Carolina that could be available for use in projects performed as part of the Blueprint. These datasets contain the critical components of a successful flood resiliency effort such as probability of hazard occurrence, risk assessments, estimated damages enabling the evaluation of the effectiveness of mitigation, and resiliency projects.
2.3	Neuse River Basin Literature Review Expansion	The purpose of this document is to expand the previous literature review to document the most current plans, reports, and documents that identify current flood resiliency efforts and sources of flooding within the Neuse River Basin. This includes existing local/regional/state resilience efforts, policy, and plans.
2.4	Hydrologic and Hydraulic Modeling Gap Analysis	The intent of this document is to identify and evaluate H&H modeling within North Carolina that could be available for use in projects performed as part of the Blueprint. Specifically, this document is intended to provide a Gap Analysis for H&H modeling available within the state, including those developed as part of resiliency assessments.
2.5	Future Flood Hazards Gap Analysis	The purpose of this document is to identify scientifically defensible data necessary to analyze future flood hazards: future land use, climate, etc.
2.6	Flood Risk Reduction Project Funding Analysis	The purpose of this document is to list federal, state, local, and private funding sources for flood risk resiliency projects to be used for planning and implementation. This includes the amount, frequency of availability, and limiting factors that may determine which solutions are applicable to grant options.
2.7	Existing Inventory of Toolkit Flood Resilience Strategies	This report provides inventory and evaluation of existing flood resilience and mitigation strategies for development of the Blueprint. The following strategies were considered: Infrastructure-Based Solutions, Nature-Based Solutions, Planning and Policy, and Programmatic Best Management Practices.
2.8	Nature-Based Solutions Gap Analysis	The purpose of this document is to identify and evaluate existing datasets for all or portions of North Carolina that are available to identify potential projects to reduce the effects of flooding using nature-based solutions as part of the Blueprint. Specifically, this document is intended to provide a Gap Analysis for NBS datasets and methods available in the state.
2.9	Project Restrictions Analysis	This document identifies and evaluates the ability of the state government and local governments to implement flood resilience strategies that were

Subtask	Report Title	Description
		identified in the best management practices analysis that is dependent on federal, state, and local restrictions.
2.10	Identification of Existing Recommendations	The purpose of this report is to identify specific recommendations from existing statewide planning efforts that correspond with flood resilience strategies and how they can be effectively connected to the Blueprint. This will build an awareness of existing efforts to help connect identified strategies to the intent of the Blueprint.
2.11	Identification and Evaluation of Online Flood Mitigation Decision-Making Support Tools	This document identifies and evaluate three existing online flood mitigation decision-making support tools. This report also includes pros, cons, and any changes recommended for incorporation to meet the Blueprint requirements.
2.12	Artificial Intelligence and Machine Learning Tools to Support the Development of the Blueprint	The purpose of this document is to identify artificial intelligence/machine learning tools that can be used to develop or improve the Blueprint: for example, reducing costs of updates, increasing the accuracy of web-based decision tools, or improving engagement and decision making.
2.13	Nature-Based Solutions Existing Opportunities Gap Analysis in the Neuse River Basin	The purpose of this document is to identify and evaluate existing datasets for North Carolina that are available to identify spatial distribution, coverage, and potential effectiveness of projects to reduce flooding using nature-based solutions as part of the Blueprint.
2.14	Identification of Vulnerable, Underserved and Under-resourced Communities in the Neuse Basin	The scope of this task is to support the Blueprint through the identification of vulnerable, underserved, and under-resourced communities in the Neuse River Basin that experience or will experience flooding and possible solutions for increasing the resiliency of those communities and adjacent ecosystems, based in part on stakeholder engagement with those communities.
3.1-2, 3.13	Flood Resiliency Blueprint Tool Recommendations	This report provides recommendations regarding the Blueprint Tool. The recommendations span several topics, including recommendations on developing, implementing, and maintaining multi-scale risk decision-making tools as well as recommendations for linking solutions identified in the toolbox and beyond to identify regional and local flooding issues within the Blueprint online tools.
3.3	Recommendations for Integrating Federal, State, and Regional Flood Resiliency Efforts	This document recommends how the Blueprint can implement the existing knowledge, experience, and resources that already exist within the federal, state, and regional programs dedicated to flood resiliency.
3.4	Recommendations for Incorporating Local, Regional, Tribal and State Priorities	The purpose of this document is to outline recommendations for incorporating local, regional, and state priorities (water quality, life safety, economic stability, etc.) into the Blueprint Tool. This would allow for a range of decision-making approaches (e.g., strict risk-based, economic priorities) to be completed for the best outcome.
3.5-7	Recommendations: Open Access H&H Modeling, Storm Frequencies, and Climate Forecast Models Support Tools	The purpose of this document is to summarize Phase I recommendations for: open-access hydrologic and hydraulic (H&H) modeling software and approaches, including how various models can be leveraged and cross-utilized; model scale; storm frequency options; and climate forecast model(s) selection.

Subtask	Report Title	Description
3.8, 3.16	Addressing Challenges and Future Recommendations	The purpose of this document is to address challenges related to new technology, programs, and strategies identified in Tasks 1 and 2 of Phase I, provide lessons learned, and formulate recommendations to best overcome the identified challenges.
3.9-10, 3.14	Recommendations: Standardized Statewide Datasets	The purpose of this document is to summarize Phase I recommendations for standardizing datasets and models for statewide implementation; identify efforts, datasets, models, etc. that can be immediately developed statewide; and provide recommendations on strategies to maintain the Blueprint.
3.11	Recommendations for the Utilization of Artificial Intelligence and Machine Learning to Inform Blueprint	This document provides recommendations for AI use in the Blueprint. Artificial Intelligence/Machine Learning Tools (Subtask 2.12) gives a broader understanding of the current AI/ML environment.
3.12	State Level Staffing and Support Recommendations	This document makes recommendations for a Blueprint program with both permanent, full-time staff and an augmentation of contractual services to successfully oversee the operations of each cycle.
3.15	Recommendations for Developing and Maintaining Local Stormwater Management Programs	This report provides recommendations for developing and maintaining local stormwater management and maintenance programs in association with development of the Blueprint. The recommendations include the level of resources required to maintain these programs, possible funding sources, and ways to address the funding gaps of small, under-resourced communities.
4.0	Glossary of Terms & Definitions	This document provides a comprehensive list of definitions applicable to multiple Blueprint documents. Definitions were created using trusted and vetted sources. A collaborative review effort between NCDEQ, stakeholders, and the contractor ensured definitions met the intent and standards of Blueprint.
4.1	Flood Resiliency Blueprint Tool Requirements	This document outlines recommendations for the requirements needed to develop a suite of functions to produce an online decision-support tool.
4.2-3	Flood Resiliency Blueprint Tool Storyboards, Wireframes, and Mockups	This document provides recommendations for storyboards – identifying specific functions users will want to perform in online tools – and wireframes and mockups – depicting the look and feel of an online interactive decision-support tool.
4.4	Preliminary Draft Neuse River Basin Flood Resiliency Action Strategy	This document serves as the preliminary draft for the Neuse River Basin Flood Resiliency Action Strategy, the first five-year action strategy to be developed.
4.5-7	Draft North Carolina Flood Resiliency Blueprint	This document serves as the framework for implementation of the Blueprint.

2 River Basin Action Strategy Development Process

Flood resilience planning is fundamental to effective project selection and implementation: it is the roadmap to sound flood resilience investing. Watershed-based planning of any kind has the following basic elements: 1) stakeholder engagement; 2) existing data compilation and inventory; 3) gap analysis; 4) actions that fill identified gaps; 5) technical analysis; 6) project identification, evaluation, and prioritization; 7) plan and project implementation; and 8) adaptive management. The Flood Resiliency Blueprint planning process was developed to guide the creation of River Basin Action Strategies across the state that are science-based, cost-effective, and ultimately lead to the enhancement of community flood resilience using a watershed approach. The process described below is also scalable for others to apply outside of the River Basin Action Strategies using the Blueprint Tool and the inventory of Blueprint foundational reports and resources found on the Blueprint website.

The Blueprint planning process described in this section is intended as a roadmap for development and implementation of River Basin Action Strategies by the state and communities across North Carolina. Consistent with the authorizing legislation, the Blueprint seeks to establish a standardized methodology for flood planning in North Carolina through a consistent set of practices and procedures applicable statewide while remaining sufficiently flexible. The flexibility is designed to account for different physiographic settings, development intensity, regional differences, flood types, and other types of variability. Differing characteristics such as these along with growth rate, the existing infrastructure, existing available data, and financial and technical capacity are inevitable and will result in unique starting conditions and needs for each river basin. However, utilizing the Blueprint's high-level standardized methodology for planning and implementation will support consistency.

The Workflow streamlines the flood planning process to help communities and the state understand flood risk, identify and evaluate solutions, and make informed decisions to enhance flood resilience in each river basin. The Workflow promotes a customizable approach to reflect the existing resources and conditions in each basin with the objectives of:

1. Yielding higher community participation and buy-in;
2. Supporting actions that benefit those most vulnerable to flood impacts; and
3. Developing a sustainable approach that can be updated and refined over time.

The approach below will shape the development of each basin's action strategy and set precedence for an adaptively managed process to update and renew on a multi-year cycle. Each River Basin Action Strategy iteration will serve as first-hand accounts highlighting the strengths (what worked well), weaknesses (what did not work), opportunities (what could be improved), and threats (what posed challenges). Continuous improvement in the decision Workflow will result in an enhanced basin plan every cycle and strengthen statewide flood resiliency in the long term. The river basin approach also provides the opportunity for communities to work together for effective solutions.

For progress to be made in the early years of implementing the Blueprint, decisions must be made in a timely manner. An advisory group was created for the Neuse River Basin Strategy as a resource to NCDEQ. In addition, a Principal Advisory Group supported by six Technical Advisory Groups was tasked with advising the department on development of the Blueprint as a whole. Going forward,

NCDEQ expects these groups to continue in an advisory capacity in some form, and NCDEQ intends to mirror the river basin-specific advisory group model in other basins.

2.1 Flood Resiliency Blueprint Tool

Phase II of the Blueprint is the development of the online decision-support tool, referred to as the Flood Resiliency Blueprint Tool. The tool will be designed to fulfill key components of Session Law 2021-180 Section 5.9.(c) and Session Law 2022-75 Section 22.a.(3). Phase II began in November 2023 with NCDEQ and a vendor and is expected to continue through 2024 with key milestones including a prototype, a beta version and beta testing with dozens of users, a Version 1, and a Version 2. NCDEQ has engaged a 10-person "user group" to inform development of the tool along with additional technical advisors drawing on the TAG membership.

The Blueprint Tool will be a publicly accessible, data- and model-driven, GIS-enabled web application that supports flood planning and implementation across the state. It will support and enable the development and management of the Blueprint program including supporting a standardized statewide methodology for understanding flooding, its impacts, and possible solutions. The Blueprint Tool will assist state agencies, local governments, tribes, regional entities, and others in identifying and selecting flood mitigation and resilience strategies, including funding options.

Described in the next section, a multi-step planning process has been developed to support River Basin Action Strategies. The Blueprint Tool and how it can be used is addressed in the description of each step. Refinement of the process will occur as the Blueprint Tool and the action strategies are being developed.

2.2 Blueprint Planning Workflow Overview

The process and steps outlined in this planning Workflow create a structured and systematic approach for developing River Basin Action Strategies that support effective implementation of resiliency actions that support the goals and desired outcomes of the Blueprint. The steps of the Workflow are intended to establish requirements for successful flood resilience planning and implementation. When reviewing the Workflow, it is important to keep the following in mind:

1. The Workflow describes a dynamic process that will result in adaptively managed plans that are renewed on a cycle and refined over time to better address flood resilience at the river basin and community level.
2. The planning Workflow and the steps contained therein are based on the research and gap analyses performed in Phase I of the Blueprint project.
3. The steps included in the Workflow are to be used as a general guide and should not be interpreted as an inflexible approach nor place any specific new burden on communities. Flexibility in developing River Basin Action Strategies exists to account for different physiographic settings, development intensity, regional differences, flood types, and other types of variability. In addition, the development of each River Basin Action Strategy may employ tailored approaches to achieve regional collaboration while ensuring locally driven input. Finally, communities will have the ability to choose who represents them in the Blueprint planning process (e.g., themselves, a regional entity such as a COG, another entity or organization they delegate, etc.).
4. The Workflow's planning process is supported by the Blueprint Tool that will be built in Phase II of the project. Therefore, some elements related to integration of the Blueprint Tool into the Workflow are forthcoming and will be included in an Addendum once completed. NCDEQ is

committed to continual engagement with its partners in the project, including through Phase II.

5. As a supplement to the Workflow, a procedural document will be developed that serves as a more detailed manual for development of River Basin Action Strategies.
6. NCDEQ will lead the development of the overall River Basin Action Strategy for each river basin. The agency may identify government or nonprofit partners such as Councils of Government, Soil and Water Conservation Districts, etc. that can support regionalized planning efforts for the Blueprint. The intent is for the River Basin Action Strategy to incorporate local priorities and solutions, regional collaboration, considerations, and solutions, all of which is rolled up to the river basin level in the form of the basin-wide action strategy.
7. The development of River Basin Action Strategies is not intended to replace or duplicate other federal, state, or local entities' flood resiliency efforts but to recognize, leverage, link, and build upon existing initiatives.
8. Each river basin will be different in terms of the level of effort and timeframe needed to develop its River Basin Action Strategy. Factors that affect the timelines are the size of the river basin, the scale and accuracy of existing data, population, and the level of existing flood resilience efforts within the basin. Typically, the development of the initial strategy will be approximately 18 months. Larger river basins or basins with limited accurate data may take up to 24 months.

More details on Workflow implementation will be found in the River Basin Flood Resiliency Strategies Procedures Manual when that document becomes available.

Figure 2-1 shows the Blueprint Planning Workflow that the state, stakeholders, and communities will follow to develop, implement, and track River Basin Action Strategies.

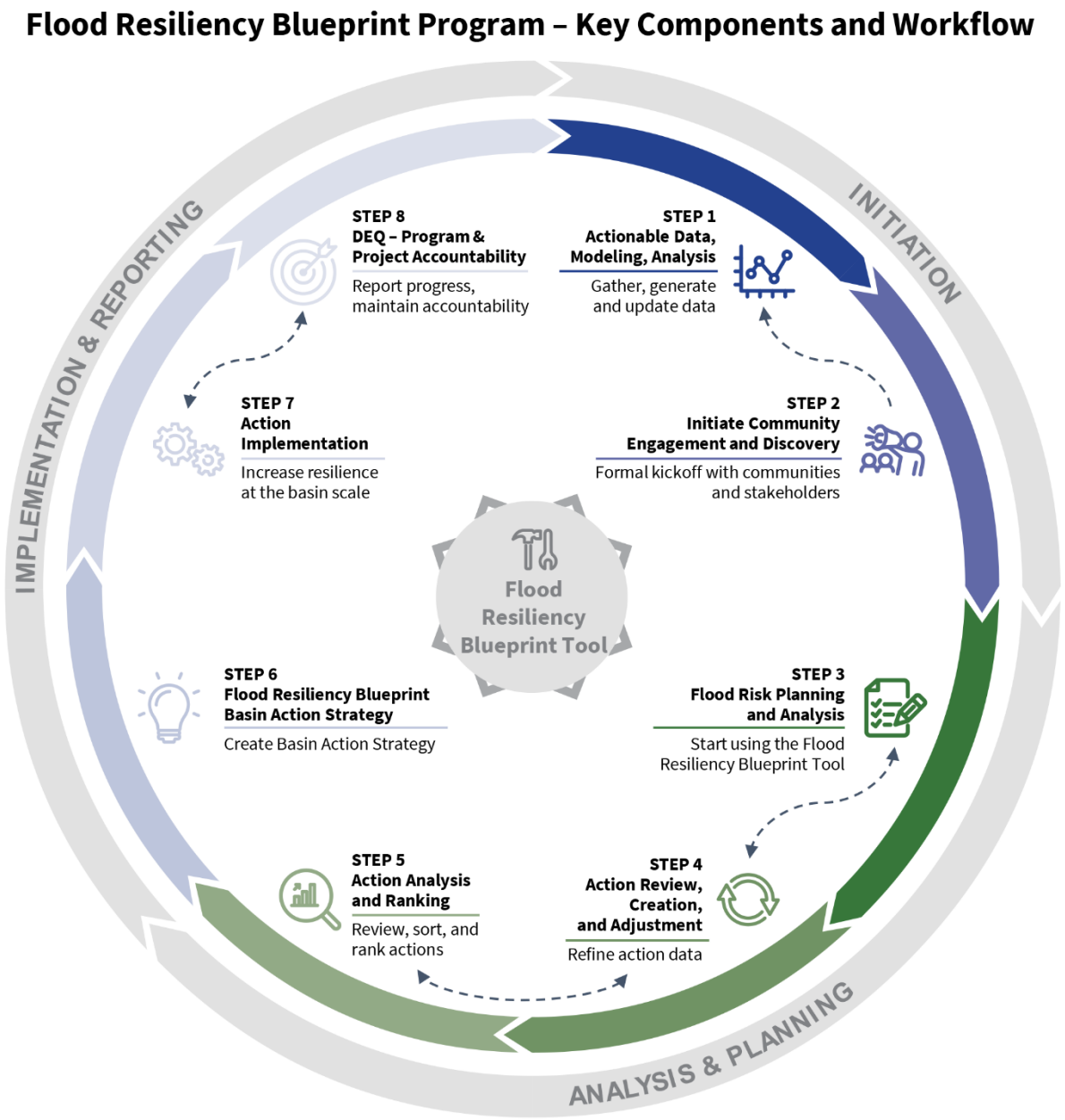


Figure 2-1: Blueprint Planning Workflow

2.2.1 Workflow Step 1: Actionable Data Collection, Modeling, and Analysis

2.2.1.1 Purpose

The purpose of Step 1 is to compile, inventory, and summarize existing data and information to support the planning process and development of the strategy. Actions taken in this step will identify where there may be gaps in the information needed to support the flood risk planning and analysis that occurs in later Workflow steps, including through a river basin analysis of vulnerable, underserved, and under-resourced communities. Step 1 will also include compilation of new or updated 2-D future flood conditions modeling that, when possible, would be developed prior to this step. In addition to the data gathering elements of Step 1, NCDEQ will establish the river basin-specific River Basin Advisory Group. It should include a diverse group of stakeholders, including representatives from communities identified from the community analysis referenced above.

2.2.1.2 Administration

NCDEQ is the lead agency for Step 1 in managing all information used to support the planning process. The agency initiates the process and guides it throughout. Where needed, NCDEQ will use partnerships and contract services to support this function.

2.2.1.3 Process

Step 1 includes the collection and coordination of existing datasets and sets a standardized baseline set of data and modeling. Examples of existing information and datasets for use are described in several Phase I reports but generally include existing state and federal spatial datasets, existing flood-related modeling, previous planning efforts within the river basin, relevant locally derived information and data, and current resilience projects (existing and proposed) within the basin.

The Blueprint will construct a seamless, centralized, and standardized baseline for large-scale future conditions 2-D modeling across the state. Ultimately, the individual river basin's modeling should be developed prior to the start of each River Basin Action Strategy. However, in order to move forward with implementing Phase 3 in the prioritized river basins, the modeling will have to occur concurrently for those basins. NCDEQ intends to develop these through partnership with the North Carolina Floodplain Mapping Program and as an enhancement to the existing 2-D Advisory Modeling program. This modeling will provide results from a wide range of future scenarios and address a variety of flood types and sources including but not limited to fluvial (riverine), pluvial (rainfall), stormwater, and coastal flooding (including compound flooding). The primary purpose for the large-scale 2-D modeling is to inform flood risk and vulnerability and initial solution development across the river basin. The level of model resolution at this stage may not support the development of all possible solutions nor support site-specific design.

Collaboration is a critical element of Step 1 as it includes compiling existing data and relevant information from federal, tribal, state, and local agencies and other stakeholders. NCDEQ and the Blueprint program will not replace or duplicate existing programs and planning initiatives, but instead will work to link these current efforts and build upon them, filling in gaps and providing for enhancements as needed. In collaboration with other state and local agencies, NCDEQ will include recommended resiliency actions contained in existing state and local planning initiatives (e.g., Hazard Mitigation Plans, local stormwater plans, and existing state programs such as the Resilient Coastal Communities Program, Regions Innovating for Strong Economies and Environment, etc.) for linkage

and plan consistency. In addition, existing resiliency actions that have already been implemented should be compiled.

A request for existing data will be circulated among state and local partners within the river basin as part of this effort. Locally generated data or modeling will be reviewed and assessed for potential inclusion in the planning process.

A **River Basin Advisory Group** will be organized at this stage. Building from the model applied in the Neuse Strategy Pilot, membership will be selected by NCDEQ to include subject matter experts and other key interests in the river basin. These representatives would span a variety of groups including but not limited to:

- Local Governments
- Vulnerable, underserved, and under-resourced communities
- State agencies and programs
- Business community representation
- Working lands, agriculture, and/or timber industry
- Environmental community
- Development community
- Special groups or industries specific to the basin (tourism, seafood, mining, etc.)
- Federal partners
- Academia/community colleges
- Local water, wastewater, and stormwater utilities
- Drainage districts

Gap Analysis

Using information compiled in this step, NCDEQ will conduct a gap analysis across the following elements: spatial information, relevant quantitative information, previous planning efforts and relevant studies, modeling, partnerships, and capacity. The goal is to identify where the Blueprint can utilize and link existing resources and planning, and where gaps exist that can be addressed as part of strategy development. Some may be longer-term gaps that are filled over time.

During Steps 2 and 3, additional information needs may be identified or requested by communities or the River Basin Advisory Group to further support resilience analysis and planning. Where appropriate, the Blueprint program will seek to incorporate that need and identify resources available to fill it through the process of developing the River Basin Action Strategy, either in the current cycle of development or as a subsequent effort to be completed. This decision will be based on timing and funding.

2.2.1.4 Blueprint Tool Update for River Basin Action Strategy

Data, modeling, and analysis generated or updated in Step 1 will be incorporated into the Blueprint Tool and described in the River Basin Action Strategy document developed in a later step of the Workflow. For the Blueprint Tool, these data inputs will typically involve river basin-specific data rather than existing statewide datasets that will already be included in the Blueprint Tool as part of its initial development. The data in Step 1 will be tracked and updated as needed, as the first cycle of a River Basin Action Strategy moves through Workflow steps and, in the future, as the strategies are updated on a regular cycle.

2.2.2 Workflow Step 2: Initiate Community Engagement and Discovery

2.2.2.1 Purpose

Step 2 initiates Community Engagement and Discovery, which serves as the formal kick-off of stakeholder engagement for a river basin. The purposes of this step are to (1) introduce the Blueprint, the River Basin Action Strategy development process, and the resources available to community stakeholders, local government representatives, and the river basin representatives; (2) promote initial interest among community and local government stakeholders and work to identify and resolve any gaps in representation; and (3) validate existing information and conduct further information discovery regarding both data and flooding issues. Using the information gathered, a detailed outreach and engagement plan will be developed and implemented to ensure robust community engagement and empowerment, especially among those with less capacity.

While community engagement is initiated in this step, it continues throughout all steps that follow.

2.2.2.2 Administration

Development of each River Basin Action Strategy is led by NCDEQ Blueprint staff in close collaboration with a River Basin Advisory Group, other state and regional leaders, and communities. With partner and contractor support as needed, the Blueprint staff will (1) craft basin outreach and engagement plans; (2) identify and maintain stakeholder points of contact; (3) communicate, coordinate, and facilitate outreach and engagement sessions throughout the river basin; and (4) coordinate and support the River Basin Advisory Group that was stood up in Step 1.

2.2.2.3 Process

During Step 2, communities within the river basin will be engaged according to an outreach and engagement plan developed by NCDEQ. The plan will identify participants, ensure representation, guide outreach efforts, and include the results of technical and financial capacity assessments to identify under-resourced communities that may need additional support to participate effectively. The River Basin Advisory Group will provide guidance to NCDEQ on the approaches, timing, and participants of the stakeholder engagement plan.

From Step 2 forward, it is important that community stakeholders and local government representatives remain engaged, stay informed, and advocate for their needs and concerns. Attention should be given to setting the conditions for the inclusion and representation of all communities and interests— including under-resourced communities, business interests (including agriculture and forestry), advocacy organizations, faith organizations, etc.— and engaging in a manner that promotes long term two-way collaboration and engagement.

Next, each river basin will be divided where necessary into manageable geographic groupings of communities to facilitate effective and productive working groups. NCDEQ may partner with government or non-profit entities to organize and manage this process (this may include funding of those efforts where needed). The groups will consist of local governments, community representatives, and other interests in effective geographic extents from a planning and engagement perspective. For example, the larger Cape Fear River Basin might be divided into three regions due to its size, whereas the White Oak is smaller in geographic size might not need to be divided. The right sizing of the groupings and associated meetings to engage local government representatives and stakeholders is necessary to ensure efficiency, effectiveness, accessibility, and representation. The intent is for the River Basin Action Strategy to incorporate local priorities and solutions, regional

collaboration, considerations, and solutions, all of which is rolled up to the river basin level in the form of the basin-wide action strategy. As a part of this, communities will have the ability to choose who represents them in the planning process (e.g., themselves, a regional entity such as a COG, another entity they delegate, etc.).

A robust and effective stakeholder and community engagement effort will consist of multiple meetings at strategic touch points as well as multiple ways to engage in the process. Engagement plans may differ based on river basin-specific needs and requests, but each river basin will have the following standard meetings: 1) Kickoff, 2) Draft Gap Analysis, 3) Blueprint Tool Training, 4) Draft Risk/Vulnerability Analysis, 5) Project Prioritization, 6) Draft River Basin Action Strategy, and 7) Final River Basin Action Strategy. This series of meetings will share information and solicit input and feedback on flooding issues in the constituent communities. The number of sessions may vary per river basin and sessions may be virtual, in-person, or hybrid depending on preference and need. Strategic locations and times will be selected for in-person meetings to ensure accessibility and optimize attendance. Based on lessons learned from the process of developing the Draft Neuse River Basin Action Strategy, highly experienced facilitators should be used, and the maximum driving distance for an in-person meeting participant should not exceed 1 ½ hours where possible. Some of the incremental actions taken as part of Step 2 may be carried out by partnering agencies or organizations.

In addition to the identification of locally generated data not identified in Step 1, community stakeholder and local government representatives will provide input into an analysis of technical and financial capacity, which will be used to develop a community needs assessment relative to under-resourced communities that may need additional assistance in participating in the process and with implementation.

2.2.2.4 Blueprint Tool

The Blueprint Tool will be introduced to stakeholders in this step and applied throughout the planning process. In addition, prior to accepting and incorporating any additional information collected during community engagement, it must be determined that the additional data meets the needs and standards for the program. These standards and criteria will be developed in parallel with the Blueprint Tool development to ensure all data achieves a level of consistency, quality, and relevancy to the Blueprint and is in a format the Blueprint Tool can accept. If incorporated, the new data will feed back into Step 1. The information collected at this time will also help support the effort in Step 3: Flood Risk Planning and Analysis, as recommendations to increase flood resilience in the basin are created and updated within the Blueprint Tool. Additional details on this effort will be developed during the course of developing the Blueprint Tool and an addendum with the requirements will be issued.

2.2.3 Workflow Step 3: Flood Risk Planning and Analysis

2.2.3.1 Purpose

The goal of Step 3 is to conduct strategic flood risk and vulnerability analysis and initial solution development across the river basin using information collected and developed in prior steps and with close collaboration between local communities and the NCDEQ Blueprint team and its partners.

2.2.3.2 Administration

NCDEQ will facilitate the overall process with its contractors, partners, and local communities. For feasibility purposes, NCDEQ partners from the government or nonprofit sectors may take the lead in facilitating the regionalized community stakeholder meetings in this step.

2.2.3.3 Process

The step begins by bringing forward the information developed from Steps 1 and 2 including the large-scale 2-D modeling results and the compiled existing resiliency actions (proposed or implemented), among others. These will be used for large-scale risk and vulnerability analysis across the river basin to evaluate hazards, assess impact, and inform solution development. Next, further actions and projects will be identified based on the areas of need in terms of flood risk, building from previous planning efforts and identified project proposals and filling in gaps and providing updates where needed. A selection of hot spots and initial ideas for new resilience or mitigation actions by region will be developed by NCDEQ. NCDEQ will use this information as a basis for discussion with stakeholders and a collaborative selection of actions and projects for inclusion in the next steps of the planning process. Solutions may be localized within a community or regional in nature and impact.

There may be a need to conduct higher resolution modeling and analysis building off the large-scale 2-D modeling to support further resiliency action identification and confirmation for select areas. It is anticipated that NCDEQ would support some, but not all, of the desired smaller-scale modeling analyses, with an emphasis on supporting under-resourced communities. Additional modeling may need to be conducted by individual communities or coalitions. This may also be flagged for future efforts. More information on modeling approaches is provided in the foundational Blueprint Phase I reports, including *Recommendations: Open Access H&H Modeling, Storm Frequencies, and Climate Forecast Models Support Tools* (Subtask 3.5-7) and later in the Recommendations section herein.

The scope of community stakeholder collaboration in this step will depend on several variables such as the size of the basin, the capacity of participating communities, the number of communities participating, the nature of any regional groupings that may be employed, and other items, as necessary. The number of meetings needed to facilitate this collaborative effort should be determined when scoping the work for each individual basin.

Step 3 of the Blueprint will lead to the development of community-based resilience actions and prioritized actions that reflect specific flood vulnerabilities and objectives of the program. Vulnerability types include, but are not limited to, losses of life, property loss or impact (including agriculture and timber industries), and lack of access to critical facilities (hospitals, water treatment plants, highways), etc.). This will inform the Action Profile analytics in the Blueprint Tool and plan generation in Steps 4 and 5. Steps 3, 4 and 5 will comprise an iterative process where needed.

2.2.3.4 Blueprint Tool

The actions initially developed during Step 3 will be input into the Blueprint Tool Action Profiles, which feature the hazard, impact, and the defined action or mitigation project for that specific hazard risk to the community. The Action Profile will further include cost estimates, feasibility, and complexity for completing the action, if this information is known at this stage. Gaps in this information may be filled in the next step of the Workflow. The Action Profiles will include existing and proposed regional resiliency/mitigation actions (i.e., larger scale projects such as levees, off-line detention facilities, some nature-based solutions, etc.), which will help to identify opportunities for

collaboration, as well as gaps, and prevent the duplication of effort. The Blueprint Tool can also be used directly by communities to develop or evaluate resiliency actions for their consideration.

2.2.4 Workflow Step 4: Resiliency Action Review and Adjustment

2.2.4.1 Purpose

The purpose of Step 4: Resiliency Action Review and Adjustment is to refine resiliency actions and their profiles ensuring the data feeding the Blueprint Tool is complete for proper ranking and to assist in evaluation of actions. NCDEQ will rely on communities or their representative/delegated authority to provide some of this information and enter it directly into the Blueprint Tool. NCDEQ or a partner agency will support under-resourced communities as needed.

2.2.4.2 Administration

In Step 4, NCDEQ, local government, and stakeholders will review the action items developed in Step 3 to verify that all the information in the Resiliency Action Profiles has been included. NCDEQ, or a partner agency, will help with accessing and training for the Tool. These partners will help clarify for Blueprint Tool users what data is needed for NCDEQ and the River Basin Advisory Group to complete the river basin level analysis and project ranking most effectively in Step 5, Resiliency Action Analysis and Ranking. NCDEQ will work with the communities, other state agencies, non-profit organizations, and other groups that are instrumental in increasing resilience in the basin to determine missing information and to develop a process for collecting that data and understanding the impact of the missing information. After the minimum information has been populated in the Blueprint Tool, the River Basin Advisory Group will be engaged in Step 5 to review the recommended actions (community and regional) and provide feedback at the basin scale from their unique perspectives.

2.2.4.3 Process

Actions developed in the Blueprint Tool will contain core Action Profile data, where feasible, such as:

- Capital and 5-Year Cost
- Project Benefits (e.g., reductions in flow or flooding)
- Benefit-to-Cost Ratio (BCR)
- Return on Investment (ROI)
- Goal Alignment/Support
- Permitting/Regulatory Profile
- Community Priority
- Project Complexity/Scale
- Added Value/Multi-Benefit Characteristics

At a minimum, planning level information will be sought. Where more precise information is known, it can be added. If a specific project was proposed in another plan or explored by another agency, that analysis and data can be used in developing the Resiliency Action Profile for that project, though this information should be evaluated for potential update if necessary. Such data may include prior cost estimates, anticipated increase in cost over time, analysis of level of effort, and proposed schedules. The purpose of these Action Profiles is for each action to have an in-depth profile that covers essential information when determining the project's feasibility and implementation. Including these details consistently in each Action Profile is critical for the comparative analysis and ranking conducted during the following Step 5: Basin-Wide Action Analysis and Ranking process.

Within the Blueprint Tool, proposed funding options will be provided, and the user can explore some high-level funding information while developing Action Profiles. The goal will be to provide a holistic view of what funding is available and to use the developing Action Profiles to determine the best funding mechanisms and make them known to Blueprint Tool users. Throughout the action review, creation, and adjustment, NCDEQ and/or partnering agencies will offer assistance to all communities with an emphasis on assistance to under-resourced communities.

As mentioned in the previous step, regional actions will be incorporated into the Blueprint Tool. Users can view regional actions in relation to community actions in effort to leverage opportunities for collaboration, identify any major gaps, and prevent the duplication of effort. The River Basin Advisory Group will be engaged in this step to enhance the proposed approach to increase resilience at the basin scale and to minimize upstream/downstream conflicts that may be created by proposed resiliency actions.

2.2.4.4 Blueprint Tool

The Blueprint Tool will be used by NCDEQ and communities during this refinement process to fill in required Action Profiles details for analysis purposes and to update gaps in data. Action Profile data or the calculation of individual parameters within, proposed funding strategies, and further detailed steps to be taken within Step 4 will be covered in the River Basin Flood Resiliency Strategies Procedures Manual and in the Blueprint Tool documentation.

2.2.5 Workflow Step 5: Basin-Wide Action Analysis and Ranking

2.2.5.1 Purpose

The purpose of Step 5: Basin-wide Action Analysis and Ranking is for NCDEQ to review, sort, and rank the potential resiliency actions at the basin, sub-basin, regional, and/or other scales using the Blueprint Tool in a transparent manner. This basin-level analysis and ranking will then feed into the final River Basin Action Strategy created in Step 6. Each basin will include a process of ranking and creating final strategies with their priorities, interconnected proposals, and action outcomes clearly defined for their basin. It will be important for the process to have consistency so that projects from river basin to river basin can be compared as well for funding decisions.

2.2.5.2 Administration

NCDEQ will lead this process partnering with communities and stakeholders and in collaboration with the River Basin Advisory Group. Communities can use the Blueprint Tool to rate, sort, and rank actions from various agencies at the basin scale. In Step 5, the River Basin Advisory Group should observe how communities are using the Blueprint Tool to rank actions and if/how that supports or conflicts with the regional actions that are under consideration. Results should be shared with the community stakeholders.

2.2.5.3 Process

The Blueprint Tool will be used to apply a ranking methodology to the collection of proposed river basin actions (community and regional) by a method that ensures consistency with program priorities such as life, safety, protection of critical facilities, preference for multi-benefit solutions, and ultimately increasing local flood resilience for communities. Parameters may also consider different aspects such as co-benefits, multi-jurisdictional impacts, equity, social vulnerability, and committed funds (in-kind or matching) if applicable. As this ranking process is taking place, scenarios of analysis

and ranking can be saved by users, which will help communities and the River Basin Advisory Group review the action options they have developed and progressively identify how projects can best work together to accomplish the greatest impacts and most positive outcomes for flood resiliency in their basin.

2.2.5.4 Blueprint Tool

Using the Blueprint Tool to create or update a River Basin Action Strategy, the proposed actions will be reviewed, sorted, and ranked using a designated set of parameters (with the final parameters to be determined in Phase II Blueprint Tool development). These parameters may include action complexity, capital, operations, and maintenance cost, added value, funding strategy, governance, ROI, performance and benefits, and basin-wide priority.

In addition, the fund navigator database can be used to match the resiliency project to relevant funding and finance options through a search or artificial intelligence (AI) match. All actions will be developed within the Blueprint Tool and used to generate the final action profile. As the actions from the plan move into the implementation phase of the Workflow (Steps 6 through 8), NCDEQ will be responsible for updating the implementation progress of each individual action profile in coordination with regional and community stakeholders.

The Blueprint Tool development process will be responsible for creating several methodologies to sort, rank, and rate certain parameters and determine the appropriate metric. In essence, the Blueprint Tool will configure the backend of the Action Profile Analysis Tool to ensure (1) methodologies and metrics are accurately assigned, (2) users have the ability to search and select specific parameters based on preference or concern, and (3) the output produces a prioritized list of actions reflective of the parameters selected.

2.2.6 Workflow Step 6: Flood Resiliency River Basin Action Strategy

2.2.6.1 Purpose

NCDEQ in collaboration with a basin-specific River Basin Advisory Group and basin-wide community partners will create the River Basin Action Strategy document based on the information developed in the previous Workflow steps including the final Resiliency Action Profiles and ranking. For each action identified in the Action Strategy, the Blueprint Tool can also provide potential funding options, including a grading function for identifying the most appropriate funding mechanisms for specified actions. Funding mechanisms will include a variety of state and federal programs, including any directly affiliated with the Blueprint program. Communities are not bound to these funding options–they may use local funds to implement an action or leverage the Blueprint to pursue other funding sources.

2.2.6.2 Administration

The River Basin Action Strategy is the component that utilizes all the necessary technical and non-technical information to identify and prioritize projects to be implemented and identifies potential funding sources for those projects. The River Basin Action Strategy creation process is led by NCDEQ with key advice from the River Basin Advisory Group and community and stakeholder input. The River Basin Action Strategies are critical components to the Blueprint's reporting cycle, which will be established on an annual basis as detailed in Step 8. NCDEQ, other state agencies, and the legislature will use the River Basin Action Strategies for coordinated and effective funding and implementation

decision-making. This will fulfill the legislative intent of the Blueprint to use the best available science to produce actionable projects that help North Carolina communities.

2.2.6.3 Process

The River Basin Action Strategy will be a publicly available report developed from all the information compiled, summarized, and analyzed in the previous steps of the Workflow. A project atlas will be developed and included in an appendix that incorporates existing and newly proposed resiliency actions of the overall action strategy along with ranking information. Most of the underpinning data will be stored in the Blueprint Tool. An assessment will be conducted as part of Step 6 to determine if any additional studies or modeling are needed in a specific area or for a particular action. Additional studies may be pursued by individual local governments, regional groups, or the state. The Blueprint may provide technical assistance in some instances (e.g., limited capacity). In some cases, higher-resolution modeling may be needed to fully flesh out a recommended action. This is referenced in the Blueprint Recommendations as a "two-tiered approach" for modeling. Furthermore, most actions in the form of projects will not be shovel-ready at this stage (i.e., will require a fuller engineering design process), but the goal is to generate enough information to support grant funding applications or local design RFPs where possible. If and until an alternative decision-making authority is created, NCDEQ in consultation with other stakeholders will select resiliency actions for Blueprint-specific funding. A funding schedule will be developed and reviewed on an annual basis.

2.2.6.4 Blueprint Tool

In Step 6, the Blueprint Tool provides much of the technical information used to create the River Basin Action Strategy document.

2.2.7 Workflow Step 7: Resiliency Action Implementation

2.2.7.1 Purpose

Step 7 will kick off the resiliency action implementation phase of the Blueprint Workflow. The Blueprint Team and responsible party (i.e., community/local government champion or regional/state agency that will be receiving funding) will work in partnership to implement the approved actions. The program will also seek to provide non-financial support where appropriate to actions not funded directly by Blueprint funds.

2.2.7.2 Administration

Implementation can be carried out by any entity using any available funding sources. NCDEQ will utilize available state funding to implement resilience actions. When possible, NCDEQ will also seek to leverage external funding sources such as federal grants to supplement available state funding. NCDEQ will utilize a variety of methods to administer available funding: direct payment to a local government like a grant program, NCDEQ-hired design and construction contractors, full delivery or design-build projects managed by NCDEQ, partnership with other state agencies and nonprofits, etc. While NCDEQ intends to implement as many actions as funding will allow, other organizations are free to implement Blueprint actions without input from NCDEQ.

2.2.7.3 Process

The details of the funding program and delivery will be developed in a subsequent phase of the Blueprint.

Communities that elect to participate and include local projects in the Blueprint planning process will not be bound to the state's Blueprint. These municipalities can, and are encouraged to, still use other funding to implement actions. Information from the Action Strategy and the Blueprint Tool should help support these efforts.

2.2.7.4 Blueprint Tool

As the action implementation progresses, the responsible party will be required to input select data and metrics into the Blueprint Tool to report on the project and track its progress over the course of implementation. NCDEQ will seek ways to encourage communities, regional groups, and other state agencies to update the Blueprint Tool as they implement actions that are not Blueprint-funded. If the funding originated from another state agency, the agency responsible for managing the awarded funds may require the grant recipient to update the Blueprint Tool as action implementation progresses.

2.2.8 Workflow Step 8: Program and Project Accountability

2.2.8.1 Purpose

Program and project accountability will address the programmatic needs of the Blueprint and be supported by a Blueprint Tool dashboard that shows actions, funding, and action progression. The dashboard is intended to be both an operational and communication tool that will become instrumental in communicating project management details, actions, and metrics.

2.2.8.2 Administration

Funded action tracking and mechanisms for reporting are being determined as part of Phase II Blueprint Tool development. NCDEQ and responsible parties will have Blueprint Tool module access to fill in information on pertinent actions showing status and needs of the funded actions. The Blueprint Tool dashboard will track progress, report risk reduction and other benefit metrics where appropriate and possible and provide information for each action at the basin scale. User roles will be set up in the dashboard to ensure that visualization is driven by the information needed by the system users. A goal of the dashboard is to show all actions and projects associated with flood resiliency through the state and through any grant mechanism. Further details of the funded action tracking and mechanisms for reporting will be determined as part of Phase II Blueprint Tool development.

2.2.8.3 Process

Program and project accountability is a critically important function within the Blueprint. The dashboard will eventually be a rolling cycle of information that shows all actions and how they are ranked, what was funded, and the status of the project. Project updates will be uploaded into the tool, using a module designed specifically for project reporting. The updated Project information will be reviewed and approved for accuracy by NCDEQ. The goal is for the dashboard to track metrics on spending, risk reduction, and milestones for completion, as applicable, for each action. As actions are completed or data becomes available because of an action, that information would be integrated into Step 1 to be available for the next round of basin needs in the action plan.

2.2.8.4 Tool

The dashboards in the Blueprint Tool will provide information in Step 8 to communicate project accountability, actions, and metrics that help stakeholders and advisory authorities track and monitor

progress in the program. The designated responsible party will input project updates into the tool using the module created for project reporting. NCDEQ will review the information entered in the tool/system by the responsible party and sign off on the update.

2.3 Blueprint Roles Framework

Following are the roles and responsibilities of staff, potential contractors, community participants, etc. in the context of Blueprint activities.

Blueprint Team

NCDEQ Blueprint Program Manager: Oversees a wide variety of administrative duties, strategic planning, policy initiatives, program development and maintenance, technical oversight, operations, action strategy development and implementation, partner relations, and contractual services associated with the program.
NCDEQ Project Manager: Serve as program point of contact with communities on policy, process, resources, action reporting and evaluation, and funding. Provide hands-on guidance for action strategy development, implementation, and reporting of assigned river basins with a focus on community engagement and coordination and efficient project implementation.
NCDEQ Grant Administrator: Provide oversight, coordination, and hands-on management of all grants that have been selected for implementation.
NCDEQ Information Technology Analyst: Perform updates and maintenance to the Blueprint Tool. Provide training on the Blueprint Tool for state and local users and assist with access- or system-related questions pertaining to the Blueprint Tool.
Contractor/Consultant: Private consultants hired by NCDEQ to support Blueprint program implementation. Will assist with development of River Basin Action Strategies, provide technical expertise, and quality control. Consultants may also be used for project development and implementation support including for under-resourced communities.
NCDEQ Government or Nonprofit Partner: A government agency or nonprofit entity that partners with NCDEQ to help facilitate regional planning in the context of Blueprint and development of River Basin Action Strategies.
Community/Local Government Project Manager: Member of a particular community who is responsible for the implementation of the approved and funded actions of the Blueprint**.**
Community Stakeholder: Member of the public who may participate in the plan development by providing public comments and feedback.
Other Stakeholder: NGOs, interest groups, academia, and other stakeholders that may participate in the Blueprint efforts.
General Assembly: Any member or staff that will make legislative and financial decisions regarding funding and policy recommendations generated through the Blueprint.
Local Government: Officials elected or hired to work for a town, city, or county that may create a Blueprint Flood Resiliency Action Plan and otherwise participate in Blueprint efforts.
Local Land-Use Authority: A town, city, or county who oversees and manages all policy, development, and permitting for floodplain management within their jurisdiction.

3 Case Study

The following case study describes how two fictional towns participate in the development of River Basin Action Strategies in the context of a watershed-based approach facilitated by NCDEQ and its partners. Additional case studies (e.g., unincorporated, rural areas; larger cities) may be added to future versions of this document.

3.1 Blueprint Use Case Profiles

3.1.1 Town A

Town A is a fictional local government developed for the purpose of this Blueprint Use Case Profile. It is sited in an eastern North Carolina county within the Neuse River Basin.

Staff: Limited local staff and no planning staff. The town belongs to the Down East Rural Transportation Planning Organization. The town is also a part of the Eastern Carolina Council COG, a multi-county, local government planning and development organization. These councils are forums where local officials determine priorities for the larger area in which their communities are an integral part. The Eastern Carolina Council provides technical assistance to local governments and administers projects and programs.

3.1.1.1 Key Statistics

- Population: 305
- Employment Rate: 68.9%
- Median Household Income: $33,879
- Identified as Disadvantaged according to the Climate Economic Justice Screening Tool? All census tracts = Yes.
- Center for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI): The census tract is considered “high vulnerability.”
- Considered a “Tier 1” county in North Carolina, indicating the most distressed of three possible categories.

3.1.1.2 Flooding Context

Historic flooding: Hurricane Florence (2018) flooded 87 homes in Town A. During the event, the river rose approximately 27 feet. Local businesses and the Town Hall were unable to continue operation. Town A also experienced severe flooding during Hurricane Floyd in 1999.

Flood planning background: Relative to larger local governments, this town has conducted limited flood and resiliency work within its limits and has relied on the local COG and other state organizations for assistance. The town is part of the Neuse River Basin Regional Hazard Mitigation Plan (2020). Parts of the town along Main Street are in the 50-, 100-, and 500-year floodplain.

3.1.2 Town B

Town B is a fictional town, larger than Town A. It is sited in an eastern North Carolina county further upstream within the Neuse River Basin.

Staff: Full planning, public works, and stormwater departments

3.1.2.1 Key Statistics

- Population: 13,000
- Employment Rate: 53%
- Median Household Income: $42,587
- Identified as Disadvantaged according to the Climate and Economic Justice Screening Tool?
    - 3 census tracts = Yes
    - 2 census tracts = No
- CDC-SVI: All census tracts are considered "high vulnerability."
- Considered a "Tier 1" county in North Carolina, indicating the most distressed of three possible categories.

3.1.2.2 Flooding Context

Historic Flooding: In Hurricane Matthew, 25 properties flooded in Town B, impacting essential infrastructure such as the local fire station.

Flood planning background: A Stormwater Action Plan was completed in 2017, which recommended the creation of a full-time stormwater program manager to identify and implement proposed flooding/stormwater actions. The county is covered by the Cape Fear Regional Hazard Mitigation Plan (2020). A regional Feasibility Study was completed by a federal and state agency.

The towns are served by a Regional Hospital located in Town B that lies in the 500-year floodplain. The county recently completed a study on the Regional Hospital in Town B to evaluate the cost-to-benefit ratio to raise the existing levee or relocate the hospital outside of the floodplain. Additionally, large swaths of downtown lie in the 500-year floodplain.

3.2 Blueprint Use Case Study Steps

The following Blueprint Workflow steps are taken for the case studies described above. The timelines provided are estimates and some of the steps may overlap. For example, Step 4 can begin before Step 3 ends.

Step 1 – Actionable Data Collection, Modeling, and Analysis (approximately 3 months): NCDEQ announces the commencement of the River Basin Action Strategy planning process. Blueprint staff, in collaboration with partners and contractors, gathers information and data required to create the River Basin Action Strategy within the applicable river basin. An NCDEQ Project Manager collaborates with Town A and Town B to include locally generated modeling and planning information when appropriate, following a call for information from local and regional government, communities, and other state agencies. Assistance is also requested from existing regional NGOs (e.g., COGs) in the river basin and posted on the Blueprint website. NCDEQ forms the River Basin Advisory Group and holds initial meeting.

Step 2 – Initiate Community Engagement and Discovery (initially 3 months and continued throughout the next steps): At the completion of Step 1, the Blueprint Project Manager assigned to the Neuse River Basin sends to both local governments, and all other communities within the Neuse River Basin, a notice that the Blueprint planning process is starting. The project manager also sends an invitation to attend one of several Flood Resiliency Blueprint Initiation kickoffs. Via email and/or online form (and regular mail where necessary), the following is requested: (1) confirm if the local government intends to participate in the process, (2) identify the point of contact, and (3) if needed, requests resources and assistance in participating the process. NCDEQ partners with the local COG to

facilitate the stakeholder process, which will be organized into three distinct regions of the Neuse River Basin: upper, middle, and lower. Local soil and water districts also commit to participate in order to assist with engagement of rural areas and working land interests.

Town A, which will participate in the lower Neuse Region, has conducted limited flood and resiliency work within its limits. The Town relies heavily on the COG and other state partners. NCDEQ identifies the Town as under-resourced and will provide additional assistance throughout the planning process. Town B received detailed flood analysis and solution identification through a regional Feasibility Study and conducted local studies by hiring an engineering firm. Unlike Town A, Town B is large enough to have an independent Planning Department and several staff in its public works and stormwater departments. The Town as a whole is not under-resourced and will participate directly in the Blueprint planning process and be represented directly by a Town staff member. They will participate in the Middle Neuse regional grouping. NCDEQ and the COG organizes kick-off meetings in each regional planning group (i.e., 3 meetings total across the basin).

Step 3 – Flood Risk Planning and Analysis (approximately 8 months): NCDEQ and its contractor complete flood risk planning and vulnerability analysis. This information will be summarized and presented to stakeholders. Next, the COG leads a series of meetings with each of the multi-town regional planning groups. Three meetings are held within each region during this step. The effort will involve:

1. Meeting to discuss flood risk and vulnerability results and initial solution discussions. Include discussion of any potential regional solutions. An evaluation is conducted to determine if additional higher resolution modeling is needed in some areas; a select number of these move forward pending resource availability.
2. Meeting to present the Blueprint Tool in the form of a short training workshop. Local governments may use the tool to help develop further ideas. Local governments or their designee will also begin adding resiliency action proposals to the Blueprint Tool.
3. Meeting to finalize proposed resiliency and mitigation options for each region and finalize regional proposals. Resiliency actions are added to the Blueprint Tool.

The results from these meetings, along with data identified or developed, are the foundations of the River Basin Action Strategy.

Step 4 – Action Review and Adjustment (approximately 2 months): After actions are identified, Town A and Town B work to complete and refine project data for integration into the Blueprint Tool. In Town A, the Blueprint Program staff assists representatives in filling any action data gaps and uploading to the Blueprint Tool. With more local government resources available, Town B completes this process independently. At the end of this step, both Town A and Town B have a set of complete Action Profiles within the Blueprint Tool.

Step 5 – Action Analysis and Ranking (approximately 1 month): NCDEQ and the River Basin Advisory Group review, sort, and rank the proposed resiliency actions, including regional projects.

Step 6 – River Basin Action Strategy (report development starting earlier in the process and draft report prepared approximately 3 months after final basin-wide ranking): NCDEQ generates a 5-year River Basin Action Strategy based on the preceding data collection, analysis, stakeholder input, and resiliency action development. Within the Blueprint Tool, Action Profiles are created for Town A

and Town B and all other communities in the basin. They include all prioritized actions, key performance indicators, and potential funding options.

Step 7 – Action Implementation (continuous): Select actions identified in the Action Profiles for Town A and Town B are funded through a combination of federal grant funding, Blueprint funding, and other state funding programs. Town B may also pursue certain actions on their own through their Capital Improvements Plan or self-procured grants. NCDEQ assigns a Blueprint Project Manager to support implementation of approved actions for the Town A. Town B assigns a local Project Manager and hires an engineering firm. The project managers input data and metrics into the Blueprint Tool for progress tracking and reporting. Blueprint staff reviews this information and signs off on any updates.

Step 8 – Program and Project Accountability (continuous): The Blueprint Project Manager tracks action progress against the River Basin Action Strategy using the Blueprint Tool. This reporting is publicly available on the Blueprint Tool so that communities can compare Action Profiles and progress. This information feeds into Step 1 of the next cycle of action strategy development. Additional studies identified during strategy development are pursued.

4 Blueprint Recommendations

The recommendations provided in this section are necessary steps to implementing the Blueprint program and ensuring its long-term success. The recommendations will be used by NCDEQ and its partners to implement the Blueprint. These recommendations are derived from input provided by TAG and PAG members, NCDEQ staff, and vendors and were approved by NCDEQ leadership. Table 4-1 shows a summary of the recommendations and their approximate timeline.

Table 4-1. Summary Crosswalk of Recommendations with Approximate Timeline

	Recommendation	Year 1 - 2024	Year 2 - 2025	Year 3 - 2026	Year 4 - 2027	Year 5 - 2028
Program Development	• Integrate Other Flood Resiliency Strategies into the Blueprint's Planning Process and the Blueprint Tool	✓	✓			
	• Create and Administer Stakeholder Engagement Programming	✓	✓	✓	✓	✓
	• Build the Blueprint's Staffing Capacity	✓	✓	✓		
	• Integrate Lessons Learned from Peer State Programs into the Blueprint	✓	✓			
	• Evaluate Options for a Blueprint Oversight Group	✓	✓			
	• Create a Nature-Based Solutions Policy Digest		✓	✓		
Tool Development	• Implement Lessons Learned from Existing Online Flood Mitigation Decision-Support Tools	✓				
	• Use the Best Available Data for the Flood Resiliency Blueprint Tool and Planning Process	✓	✓	✓	✓	✓
	• Use Advanced Technologies Where Appropriate	✓	✓	✓	✓	✓
	• Update Statewide Datasets Relevant to the Blueprint	✓	✓	✓	✓	✓
Characterizing Flooding	• Partner with NCEM and NCDOT to Conduct 2-D Future Conditions Flood Modeling	✓	✓	✓	✓	✓
	• Use a Two-Tiered Approach to Flood Modeling	✓	✓	✓	✓	✓
	• Study the Benefits of Natural Assets for Flood Reduction,		✓			

	Flood Storage, and Flood Dispersion					
Workflow Implementation & River Basin Strategy Development	• Implement a 5-Year Cycle for Action Strategies	✓	✓	✓	✓	✓
	• Develop and Implement a Data Quality Review Process	✓	✓			
	• Update Tool with Resiliency Action Plan Project Information Annually	✓	✓	✓	✓	✓
	• Create River Basin Advisory Groups for Each River Basin	✓	✓	✓	✓	✓
	• Conduct Basin-Specific Financial and Technical Capacity Needs Assessments	✓	✓	✓	✓	✓
	• Provide Support to Under-Resourced Communities Throughout the Implementation of the Blueprint	✓	✓	✓	✓	✓
Project Ranking	• Develop a Dynamic Resiliency Project Ranking Methodology	✓	✓			
	• Incorporate Local Priorities into Project Ranking	✓	✓	✓	✓	✓
Financing and Funding	• Integrate Identified Funding Sources	✓	✓	✓	✓	✓
	• Develop a Compensation Program for the Agricultural Community Based on the Use of Farmland for Flood Storage and Reduction		✓	✓		
	• Implement Multiple Finance and Organizational Approaches to Address Local Stormwater Programs		✓	✓	✓	✓
	• Provide Grant Opportunities to Establish Stormwater Programs			✓	✓	✓
	• Incentivize Multipurpose and Multi-benefit Solutions	✓	✓	✓	✓	✓
	• Coordinate State-Funded Projects Through the Flood Resiliency Blueprint	✓	✓	✓	✓	✓
Pilot Project Implementation	• Complete Implementation of Stoney Creek Pilot Projects	✓	✓			
	• Explore Agency Partnerships for Implementation	✓	✓	✓	✓	✓

	• Implement Pilot Flood Resiliency Projects from River Basin Action Strategies	✓	✓	✓	✓	✓

This section includes priority recommendations that have been developed in Phase I of the Blueprint based on comprehensive inventory, review, and analysis of existing data, programs, and efforts and the feedback of over 150 technical advisory group members representing local, state, and federal groups, NGOs, private business, agriculture and forestry, and academic experts. There are additional recommendations found in the Phase I, Task 3 reports.

4.1 Program Development

Taking the Blueprint from a draft framework to cost-effective resiliency project prioritization and implementation that meets the needs of the state and local communities will require additional actions. Some of the key actions related to program development include integrating strategies and lessons learned from other planning efforts and peer state programs, working with partners on stakeholder and community engagement, hiring and training Blueprint staff, determining long-term advisory and decision authorities, and providing guidance on potential project methodologies.

4.1.1 Integrate Other Flood Resiliency Strategies into the Blueprint's Planning Process and the Blueprint Tool

Description

Flood resiliency strategies are being developed and implemented across North Carolina by local, tribal, state, and federal agencies. The existing strategies are detailed in Phase I reports including the *Existing Inventory of Toolkit Flood Resiliency Strategies* (Subtask 2.7) and *Recommendations for Integrating Federal, State, and Regional Flood Resiliency Efforts* (Subtask 3.3). Examples include the US Army Corps of Engineers' (USACE) Flood Risk Management Program, the NC Department of Agriculture and Consumer Services' Streamflow Rehabilitation Assistance Program, and regional hazard mitigation plans. These strategies are based on detailed, technical planning intended to identify areas with the most critical needs and solutions. Many local North Carolina communities have extensive stormwater and flood management programs. Regions create hazard mitigation plans, plans responding to specific hazard events, and community resilience programs for recovery, economic, and environmental resilience. Existing state programs are also actively working to address state flooding through floodplain mapping, mitigation planning, risk assessments, resiliency planning, and project implementation. Federal strategies include funding programs, mitigation support, mapping, geospatial analysis, data compilation, policy, regulation, and project proposals. The Blueprint should integrate, complement, and leverage these existing flood resiliency efforts into the program and in River Basin Action Strategies.

There are a number of potential touchpoints in the Blueprint Workflow for integrating existing strategies into the planning process. The first and most critical is Step 1: Actionable Data Collection, Modeling, and Analysis. This includes a robust and comprehensive inventory and evaluation of existing flood resilience information and other ongoing flood resiliency strategies for each river basin. NCDEQ will work with the owners and developers of these strategies to incorporate them into the planning process and the Blueprint Tool. Examples include relevant programs such as grant

opportunities, projects, more refined local policies, updated modeling and data, and cost projections. Examples of sources of existing data include the State Hazard Mitigation Plan, regional Hazard Mitigation Plans, the North Carolina Climate Risk Assessment and Resilience Plan, related local Capital Improvement Plans, NC Office of Recovery and Resiliency's (NCORR) Regions Innovating for Strong Economies and Environment (RISE) program efforts, NCDEQ Division of Coastal Management (DCM) resiliency planning (e.g., Resilient Coastal Communities Program), and the NCDOT Resilience Strategy Report. This data will be combined with additional proposed actions. Further opportunities to identify and incorporate this information are in the stakeholder and community outreach and other steps.

Justification

Existing programs within other state agencies and local governments should be integrated into the Blueprint implementation process and Blueprint Tool to prevent duplication and promoted collaboration. Coordination will make it easier to align funding and planning efforts across the state which should result in well-planned resiliency actions that are more likely to receive full funding, gain comprehensive support, and be implemented successfully.

Alternatives Considered

These recommendations were based on a robust inventory and analysis of existing flood resilience efforts within the state and a review of the approaches of other states. Each effort had slightly different approaches but ultimately follow long-standing watershed planning and project implementation practices of various scales.

Critical Dependencies: Relevant previous planning efforts must be identified and incorporated using the *Review of Statewide Planning Efforts with Flood Resilience Recommendations* (Subtask 1.7) report identifying recommendations from existing plans during the development of each River Basin Action Strategy.

4.1.2 Create and Administer Stakeholder Engagement Programming

Description

Community and stakeholder outreach is a central element of the Blueprint. Initial stakeholder engagement will take place during Workflow Step 2 with kick-off meetings and a focus on data collection and receiving local insight. However, stakeholder engagement should be a continuous thread throughout the planning process. Further, NCDEQ will develop a broader communication strategy to reach across sectors and the general public. As a first step in this effort, a Blueprint website has been developed that houses information and documents, including the foundational reports developed during Phase I, and other information developed for the program.

As part of River Basin Action Strategy development, NCDEQ will develop an outreach and engagement plan to support and facilitate an effective watershed-based planning process. This will include working with the River Basing Advisory Group to develop strategies for engaging a diverse group of private, public, and non-profit representatives; engaging large audiences; educating the public; and ensuring traditionally under-represented communities are meaningfully engaged, as well as implementing feedback from stakeholders. Communities will have the ability to choose who represents them in the Blueprint planning process (e.g., themselves, a regional entity such as a COG, another entity or organization they delegate, etc.). NCDEQ may partner with other government

entities or non-profit organizations to help facilitate stakeholder engagement. The engagement plan will involve messaging to stakeholders and a series of sessions to initiate the River Basin Action Strategy planning process. When appropriate and as resources allow, professional facilitation will be used to ensure effective participation. After the kickoff event, meetings will transition to focus on engaging stakeholders on flood risk planning and solution development. The process will be iterative and collaborative, with reoccurring loops in engagement until the Action Profiles are completed and ready for inclusion in the final River Basin Action Strategy.

Justification

Community resilience does not happen without active participation of local communities themselves. The Blueprint's successes will depend on how well stakeholders and communities are involved and meaningfully engaged in the process. In addition, throughout Phase I, local governments expressed concerns over their capacity to participate in the Blueprint. For under-resourced communities, NCDEQ will need to provide capacity support so that they can effectively participate.

Alternatives Considered

These recommendations were based on a robust inventory and analysis of existing flood resilience efforts within the state and a review of the approaches of other states. Each had slightly different approaches but ultimately follow long-standing stakeholder engagement professional practices of various scales.

Critical Dependencies: NCDEQ must approve a stakeholder engagement plan and secure resources to facilitate the process and conduct meetings.

4.1.3 Build the Blueprint's Staffing Capacity

Description

The Blueprint Phase I results indicate that the most effective way to fully implement the legislative requirements for the Blueprint is with additional full-time staff committed to building the state's flood resiliency. The concerns expressed by local governments over their capacity included a focus on participation in the River Basin Action Strategies, utilization of the tool, and implementation of flood resilience projects. NCDEQ has a long history of leveraging the private sector to increase capacity. NCDEQ recommends development of a small program team to implement the Blueprint and provide local support, with the private sector augmenting staff efforts. This would allow the Blueprint to increase state and community resilience while keeping staff levels to a minimum and engaging the private sector.

As the Blueprint strategies are developed and implemented in river basins across the state, the amount of work to develop River Basin Action Strategies and move to project implementation increases substantially. A fulltime staff will be required to adequately serve the Blueprint across the North Carolina. The position recommendations assume staffing over the course of the next five years. This is in line with peer states that have similar programs.

- **Program Manager:** A Blueprint Program Manager will oversee a wide variety of administrative duties, strategic planning, policy initiative, program development and maintenance, technical oversight, operations, action strategy development and implementation, partner relations, and contractual services associated with the program. This position will ensure that the program is

efficiently and effectively supporting communities and stakeholders in the development and implementation of the program vision and requirements.

- Currently, the position is time-limited. Recurring funds would improve NCDEQ's ability to attract and retain quality candidates.
- **Project Managers:** Several Blueprint Project Managers will serve as the program point of contact with communities on policy, process, resources, action reporting and evaluation, and funding. The project managers will provide hands-on guidance for action strategy development, implementation, and reporting of assigned river basins with a focus on community engagement and coordination and efficient project implementation.
- Currently six time-limited positions are funded. Recurring funds would improve NCDEQ's ability to attract and retain quality candidates. The six positions are adequate to develop the next five River Basin Action Strategies. However, as those strategies are implemented and new strategies are developed, additional positions will be needed.
- **Grant Administrators:** Accessing federal and private grants for project implementation will save the state and local governments millions of dollars. However, grant application and reporting requirements are time-consuming. Two Blueprint Grant Administrators are needed to provide oversight, coordination, and hands-on management of all grants that have been selected for pursuit. With the volume of anticipated grants identified by different communities, contractual services may be established to provide additional grant management services. Of the two grant administrators, one position will be more senior with the additional responsibility of managing the grants management contractual services.
- **Information Technology (IT) Analyst:** The Blueprint Tool is data-intensive and will need frequent updates and maintenance. An IT Analyst will perform these duties and provide training on the Blueprint Tool for state and local users. The position will assist with questions around the Blueprint Tool as well as any access or system questions.

Justification

All peer states with similar programs that were evaluated for the Blueprint created a program and hired staff to build and maintain the program. A consistent theme heard from communities is that they have limited capacity to develop, fund, and implement flood resilience projects and strategies. NCDEQ staff can help bridge those capacity deficits. The six Blueprint Project Manager positions are needed to cover the next five basins and other Year 1 and 2 activities. The basins included in Years 1 and 2 are: Cape Fear, Tar-Pamlico, White Oak, Lumberton, and French Broad. After that, additional project managers will be needed support the needs of other basins as they are added. A grant function is recommended and embedded in the Workflow. This position works with the local communities to assist in managing grants, projects, and capacity-building of small communities that do not have the capacity to manage their Blueprint needs.

Alternatives Considered

Many approaches were considered to determine how the Blueprint can best serve the needs of the state. Ultimately it was determined that a small team supplemented by private contractor services and with partnerships with state, regional, and nonprofit entities was the most effective way to deliver flood resilience improvement for communities across the state. The level of staffing needs will vary over time and should be revisited annually.

Critical Dependencies: Position funding and contracts for support rely on General Assembly funding.

4.1.4 Integrate Lessons Learned from Peer State Programs into the Blueprint

Description

Several other states have gone through a process of designing flood resilience funding programs that use various datasets, models, and platforms for decision-making, with similar intended outcomes to those of the Blueprint. These programs are documented in detail in the *Peer State Flood Resiliency Programs* (Subtask 1.5) report. A few takeaways from the effort include 1) building flood resilience is a complicated issue with no silver bullet; 2) it is an expensive endeavor that requires long term commitment; 3) to make the best decisions takes robust data, modeling, analysis, and solution development; 4) there is a tradeoff in accuracy of analysis vs. time and money to implement projects; and 5) their programs have revealed lessons learned that will be useful to NCDEQ and Blueprint staff in the implementation of North Carolina's own program. Additional elements that were reviewed included what modeling approach was selected, the timing of data collection and modeling vs. timing of action implementation, the role of governance and watershed regional groups, long-term maintenance of the program, and funding models and how decisions are made. North Carolina continues to participate in several peer-to-peer flood resilience groups, including with neighboring states, so that all can continue to learn from each other.

Justification

Some similar programs have already started to be developed or have been developed in peer states, and lessons learned have been collected through a review of their published content and one-on-one interviews. NCDEQ has used these resources to help identify program elements that have been effective as well as issues that might be avoided.

Alternatives Considered

No alternatives were considered.

Critical Dependencies: NCDEQ, supported by the PAG, TAG and the consultant team, will choose which lessons learned from peer states to integrate into the Blueprint.

4.1.5 Evaluate Options for a Blueprint Oversight Group

Description

Several peer states have created or added flood resiliency responsibilities to existing water management entities. Some states have advisory committees with limited decision-making responsibilities. Some states have boards with broad decision authority. NCDEQ should evaluate options for a formal advisory or oversight group to assist NCDEQ and local communities in approving Blueprint funding decisions and aiding in program refinement. To evaluate and create this group in a timely manner that does not impede Blueprint implementation, a two-phase approach is recommended:

Phase 1: Use the existing PAG and TAGs as the foundation for a similar, smaller group of advising experts. NCDEQ will be the decision authority for distributing the current $96 million in available implementation funding.

Phase 2: Evaluate options for a formal Oversight Group. The evaluation should explore the types of authority (e.g., limits to policy, technical, funding, project approval decisions) and structure (e.g., representation and selection of members).

Justification

Since the inception of the Blueprint, stakeholder and partner engagement has been an essential piece of program development. The PAG and TAGs have contributed invaluable expertise and guidance– this engagement should move forward into the Blueprint's implementation.

A formal Blueprint Oversight group may help long-term success by providing a consistent decision authority to provide approval of major policy and funding decisions.

Alternatives Considered

All options and considerations on how to create the group are still available.

Critical Dependencies: Legislative approval will be required to create a formal Oversight Group if that approach is recommended.

4.1.6 Create a Nature-Based Solutions Policy Digest

Description

In accordance with guidance from Conservation International on implementing green and gray infrastructure, the state should develop and maintain a policy digest that documents existing laws and regulations related to Nature-Based Solutions (NBS), identifies potential modifications to remove barriers to implementation, and showcases relevant examples and research, building on the work that has already been done in the state.[13] Examples of work already taking place in North Carolina that can support the Blueprint's efforts include the Natural Infrastructure Flood Mitigation Program (NIFMP), watershed planning, and NC Coastal Federation's Action Plan for Nature-Based Stormwater Strategies.[14]

Justification

No comprehensive summary of policies and practices affecting the adoption of NBS currently exists for North Carolina. This resource will help to bridge the gap in knowledge and enhance the implementation of NBS methods where applicable and appropriate.

Alternatives Considered

Different types and means to create and distribute this policy digest are being considered.

Critical Dependencies: Additional funding may be required for experts to develop and maintain the Digest.

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[13] "Global Green-Gray Community of Practice," Conservation International, https://www.conservation.org/projects/global-green-gray-community-of-practice.

[14] Action Plan for Nature-Based Stormwater Strategies: Promoting Natural Designs that Reduce Flooding and Improve Water Quality In North Carolina, March 2021, https://www.nccoast.org/wp-content/uploads/2021/03/NBSS-Action-Plan.pdf.

4.2 Tool Development

Development of the Flood Resiliency Blueprint Tool is the primary focus of Phase II of the Blueprint. Throughout the development and implementation of the Blueprint Tool, there will be many considerations incorporated in order to make it as useful and successful as possible in allowing decision-makers at all levels and other end users to assess current and future flood risk and vulnerability, identify and prioritize flood resiliency solutions, understand funding options, and track project implementation. Necessary considerations include building on lessons learned from existing online decision-support tools, ensuring the use of best available data, exploring utilization of advanced technologies, and supporting updates to relevant statewide datasets.

4.2.1 Implement Lessons Learned from Existing Online Flood Mitigation Decision-Support Tools

Description

Several existing online flood mitigation decision-support tools are already being used to support risk reduction, increase resilience, and implement mitigation projects both in North Carolina and other states. These programs and tools are detailed in the *Identification and Evaluation of Online Mitigation Decision-Making Support Tools* (Subtask 2.10) report. Lessons from these tools, which are operating at various scales from countywide to statewide, were included in the initial Phase II Blueprint Tool work plan and will continue to be used in the development of the Blueprint Tool. Important lessons include the following:

- The tool should be a repository of flood resiliency data and updated on an ongoing basis.
- Decision-support functionality should be a key component of the tool.
- The Blueprint Tool and its data should be accessible to all North Carolina communities regardless of their local capacity.
- A diverse range of recommended resiliency actions and project types, including structural and nonstructural mitigation, nature-based solutions, and other approaches, should be included in the Blueprint Tool to allow comparison and selection of the best project to fit the problem.
- Standards for quantifying hazard risks, impacts, and project benefits should be included in the Blueprint Tool so that action comparisons and scenarios can be made on a consistent foundation.
- Localized priorities should be incorporated.
- Flexible inputs would allow for change over time as actions are being developed, planned, and compared.
- The tool should incorporate future condition projections developed from large-scale 2-D modeling and corresponding analysis functions.
- Modeling should be performed outside of the Blueprint Tool with results fed into it. Model runs require enormous computational capacity—a small catchment can take 30 minutes on a super-computer to run. Keeping the two data tools within separate databases will enhance the user experience with the Blueprint Tool.
- The Blueprint Tool should be easy to use with minimal training.
- The Blueprint Tool should include a manual and tutorial videos, and the rollout should include workshops for broad acceptance by the user and the public.

- Additional decision-support tools and approaches should be reviewed in Phase II to support tool development and understand the full suite of functionality options.

Justification

North Carolina is experiencing many of the same problems that other coastal and riverine areas in the country are because people find it desirable to be located near water resources. Any prototype lessons that can be implemented from existing tools will help NCDEQ conduct a smoother, more comprehensive rollout of the Blueprint Tool.

Alternatives Considered

No alternatives were considered. Lessons learned from other example tools were always intended to be part of the Blueprint development.

Critical Dependencies: NCDEQ must decide which lessons learned to incorporate into the Blueprint. This will occur during Phase II Tool development. Additional tools may be reviewed or created to support tool development.

4.2.2 Use the Best Available Data for the Flood Resiliency Blueprint Tool and Planning Process

Description

Initial incorporation and long-term maintenance of the Blueprint Tool dataset is required for adequate and accurate data to inform the planning process and resiliency action development. There are many datasets required. Examples include topographic data, building data, critical infrastructure/key resources, statewide risk scores for building and transportation assets, and statewide transportation hydraulic crossing datasets, in addition to output from 2-D modeling. Efforts by the North Carolina Geographic Information Coordinating Council (GICC)— which coordinates geographic information with state, local, regional, and federal partners, universities, utilities, and the private sector— will assist in maintaining the accuracy and completeness of data for the Blueprint Tool and planning process. The GICC develops geospatial data standards and policies to make geospatial information for the state more accurate, accessible, regulated, and reliable. It also promotes collaboration to avoid duplication of effort. Many of the datasets listed above are included in the framework datasets for the state and have a primary owner, standards, and a method to determine needs of the data. Extensive collaboration with partnering agencies through the committees of the GICC, such as the State Government GIS Users Committee (SGUC), Statewide Mapping Advisory Committee, and the Local Government Committee are paramount to coordinating needs of data across the state and ensuring the most accurate dataset is being used. SGUC members maintain most of the datasets mentioned in this document. Additionally, many local governments create data and models, and these need to be reviewed and potentially included in the Blueprint Tool.

Justification

Datasets must be maintained and frequently updated to capture changes within each river basin that impact flood resilience, such as new development, in order to maintain the accuracy of the Blueprint Tool.

Alternatives Considered

Further alternatives and methods for maintaining data within the Blueprint Tool will be considered in Phase II of the Blueprint.

Critical Dependencies: None.

4.2.3 Use Advanced Technologies Where Appropriate

Artificial Intelligence/machine learning (AI/ML) is a growing area of research and implementation across sectors. In future, it may decrease the time and costs of watershed modeling and improve comparative analysis and data development and analysis. However, it has not been sufficiently developed for incorporation into the Blueprint at this time. The *Recommendations for the Utilization of AI/ML to Inform Blueprint* (Subtask 3.11) report goes into detail on how to ensure the potential integration of AI technology into the Blueprint program and processes. AI integration is something that should be considered for the future but currently should be used sparingly as the standards and guidance around this technology are still being determined.

4.2.3.1 Develop a Data Governance Strategy

Description

Establish a data governance strategy to ensure the data foundation is mature enough to apply AI technologies. A framework would be comprised of four overarching components: 1) Data Strategy, which is further broken down by Data Requirements, Data Management, Data Quality, and Data Use Analytics; 2) Responsibilities and Skills; 3) Policies and Governance Model; and 4) Information and Technology and Systems. More details can be found in the *Recommendations for the Utilization of AI/ML to Inform Blueprint* (Subtask 3.11) report.

Justification

Data governance can ensure accessibility, usability, relevance, accuracy, timeliness, and integration of Blueprint data to support decision-making with a reliable data pipeline. A well-established data governance framework can improve data transparency and fill in the knowledge gaps within multiple entities.

Alternatives Considered

Specific alternatives for the use of AI are not ready to be considered. As the Blueprint moves forward, AI will be further evaluated.

4.2.3.2 Improve Data Sharing & Interagency Collaboration

Description

Using natural language processes may improve data sharing among agencies and the public. With a mature data foundation, a chatbot can be developed to be a resource to provide potentially useful information for a variety of end goals. For example, deploying a chatbot on a website which can serve as a virtual assistant to help with the onboarding of new staff by directing them to follow a process to complete their daily task. The single database behind the chatbot can ensure the information is

consistent across the board to all new staff, which can avoid miscommunication or incorrect training instructions.

The foundation of the Blueprint Tool is good data, including geospatial data. The GICC has been and will continue to be engaged in the Blueprint and may be able provide advice on AI in the future.

Justification

The use of natural language processes can improve the decision-making transparency and reduce the miscommunication among agencies.

Alternatives Considered

Alternatives for the use of AI in this function are under consideration and will be updated pending more information on the topic becoming available concerning integration of data and tools.

4.2.3.3 Use AI/ML to Fill Data Gaps

Description

Rich model input data can improve modeling accuracy and provide more precise flood hazard analysis. Some datasets used to support model set-up and parameterization have gaps in both time and space. Methods for data processing that incorporates machine learning could be used to fill those gaps in some situations.

Justification

Image processing or machine learning will improve data collection, data acquisition, data quality control, and data analytics process.

Alternatives Considered

Alternatives for use of AI in this function are under consideration and will be updated pending more information on the topic becoming available concerning integration of data and tools.

4.2.4 Update Statewide Datasets Relevant to the Blueprint

Description

In addition to the data collection and identified gaps in the *Hydrologic and Hydraulic Modeling Gap Analysis* (Subtask 2.4), the following are standardized statewide datasets that should be developed or updated as soon as practical (see Table 4-2). These datasets will be needed for future phases and river basins for the statewide implementation of the Blueprint.

Table 4-2: State Datasets Recommended for Development or Update

Statewide Dataset	Description / Recommendation
Statewide High Resolution Topographic Data	North Carolina should continue to provide annual updates to the Light Detecting and Ranging (lidar) datasets statewide, including continuing to enhance the lidar / remote-sensed derivative products to include classified building outlines, roadways, and bridges. This will allow for semi-automated extraction of building polygons, and 3-D road elevation datasets for risk assessment and disaster

Statewide Dataset	Description / Recommendation
	response. Remote-sensed lidar data should be leveraged to develop or enhance land use / land cover datasets as well as impervious coverage datasets statewide. These datasets should be maintained on a frequency synchronized with the lidar phases.
Bathymetry	Detailed knowledge of nearshore and inshore river bathymetry is necessary for many geospatial data applications in coastal areas and inland areas. One vital dataset for modeling and risk assessment is the development of seamless, topo bathymetric digital elevation models. These digital elevation models integrate multi-sensor, topographic and bathymetric datasets to provide a base layer for coastal analysis applications such as storm surge and wave height modeling, flood hazard determination, wetland mapping and monitoring, sea level rise assessment, benthic habitat mapping, erosion monitoring, and storm impact assessments. Updates and new data collection are necessary across the state.
Building Data	A critical geospatial dataset in flood mitigation planning is building footprint data and the associated building level attributes. This dataset is a useful tool in performing flood risk assessments, risk scoring, and determining the benefits and effectiveness of various structural and nonstructural flood mitigation alternatives. North Carolina is currently updating the statewide building footprint database using lidar and other technologies. North Carolina should update and enhance the building footprint dataset to include the following minimum attributes for each building contained in proximity to a special flood hazard area or North Carolina Advisory flood hazard areas: first floor elevation measurements, lowest adjacent grade elevation from lidar, highest adjacent grade elevation from lidar, occupancy type, building type, number of stories, foundation type, age of structure, and information on valuation.
Critical Infrastructure / Key Resources	Critical infrastructure includes those assets, systems, networks, and functions—physical or virtual—which are vital to the State of North Carolina such that their incapacitation or destruction would have a debilitating impact on security, economic security, public health or safety, or any combination of those matters. North Carolina should conduct a detailed gap analysis of existing Critical Infrastructure and Key Resources datasets available at the statewide and countywide scale. The results of this gap analysis will be a recommendation for dataset enhancements. North Carolina should develop the geospatial data layer for Critical Infrastructure and Key Resources statewide.
Statewide Risk "Scores" for Buildings and Transportation Assets	The Blueprint recommends that a flood risk score be established for every building within the pilot Neuse River Basin and eventually statewide. This building-specific flood risk score would be possible given the updated building statewide dataset discussed previously in this document and the recommended statewide fluvial and pluvial modeling as recommended by the Blueprint. These flood risk scores would provide an objective metric of flood risk for each building and could be aggregated for sub-basins, counties, municipal limits etc. for risk assessment and mitigation alternative analysis. The cumulative or aggregated flood risk scores would serve as a baseline for flood resilience progress tracking and metric based goals for communities, river basins, and statewide. A model for a similar implementation would be Mecklenburg County's Risk Assessment and Risk Reduction dataset and tools. In addition to the building-based flood risk score, transportation assets could be scored based on roadway classification, flooding probability, and depth. These Transportation Flood Risk Scores could be applied to at-risk segments of road. Flood mitigation alternatives can be evaluated based on any benefit from reductions in flooding along at-risk transportation corridors. These Transportation Flood Risk Scores can be cumulated or aggregated similar to the building level flood risk scores for baseline conditions and flood resilience progress tracking.
Statewide Transportation Hydraulic Crossing Dataset, and Others	The Blueprint recommends a pilot program to enhance the existing NCDOT hydraulic structure inventory for the Neuse River Basin. This dataset would be enhanced with data from best available sources and/or field-collected data as needed. Key information will be collected for each hydraulic crossing to aid in the cost-effective development of baseline modeling for flood mitigation.

Statewide Dataset	Description / Recommendation
Other Datasets	Data on the vicinity to hazardous materials (Underground Storage Tanks or other) and high hazard dams should be considered as part of risk score and flood solution development. Higher resolution land cover datasets will also be useful for the Blueprint planning process; data is currently available for areas of the coast and NCDEQ and partners are currently evaluating extending the collection to the rest of the state. Incorporation of drainage district infrastructure where absent should be included in the appropriate datasets above.

Having these standardized, statewide datasets developed and supported, at least in part, by the Blueprint will save state, regional and local government significant time and funds as well as help to bridge the resource gap between urban and rural communities.

Planning-level cost estimates are provided in the *Statewide Dataset Recommendations* (Subtask 3.9).

Alternatives Considered

None.

Critical Dependencies: NCDEQ will finalize the dataset inputs for the Blueprint Tool as part of Phase II.

Currently available datasets will be used for the tool development, and they will be updated as new datasets are developed. The more accurate the data, the more accurate and higher functioning the Blueprint Tool will be. The state should invest in these datasets which can be used by most of its agencies, private companies, and communities for their planning and project development purposes.

4.3 Characterizing Flooding

There are many types and sources of flooding that create negative impacts to human safety, structures, infrastructure, business and public operations, and the environment. These sources of flooding may occur independently, but often occur concurrently with each other. Sources of flooding in North Carolina can include:

- Riverine (fluvial)
- Excess rainfall-based flooding independent of an overflowing waterbody (pluvial)
- Urban stormwater
- Flash
- Dam and levee breach
- Coastal flooding including storm surge
- Flooding exacerbated by sea level rise (including associated storm sewer surcharges or sunny day flooding)
- Other secondary flooding sources including groundwater, ice jams, log jams, beaver dams, overland ponding, agriculture/mine flooding

4.3.1 Partner with NCEM and NCDOT to Conduct 2-D Future Conditions Flood Modeling

Description

NC Emergency Management (NCEM), NCDOT, and NCDEQ are all working on projects that require watershed modeling. These agencies participated in the TAGs and PAG and recognize the compounding effectiveness of pooling modeling needs and resources. A specific area where this approach will be effective is in the generation of 2-D future conditions flood modeling.

The North Carolina Floodplain Mapping Program's (NCFMP) statewide regulatory modeling dataset is predominantly comprised of one-dimensional Hydrologic Engineering Center-River Analysis System (HEC-RAS) models for riverine areas and Advanced Circulation models for coastal areas. These datasets are updated on an annual cycle, though funding for updates each year covers a relatively small percentage of the state. Models are based on the best available topography (light detecting and ranging [lidar]) and bathymetry available at the time of the model development and include either field survey or measurements of hydraulic structures (bridges, culverts, dams) depending on the level of detail implemented.

In 2020, the NCFMP began working to develop advisory (i.e., non-regulatory) two-dimensional modeling, floodplain mapping, and risk assessments to provide enhanced awareness of potential fluvial and pluvial flooding beyond the limits of the 1-D models (see Figure 4-1) of the current regulatory program as well as the evaluation of extreme events and future conditions. Figure 4-1 shows the advisory mapping (purple) overlaid with regulatory mapping (grey) available in NCFMP's Advisory 2-D Flood Viewer.

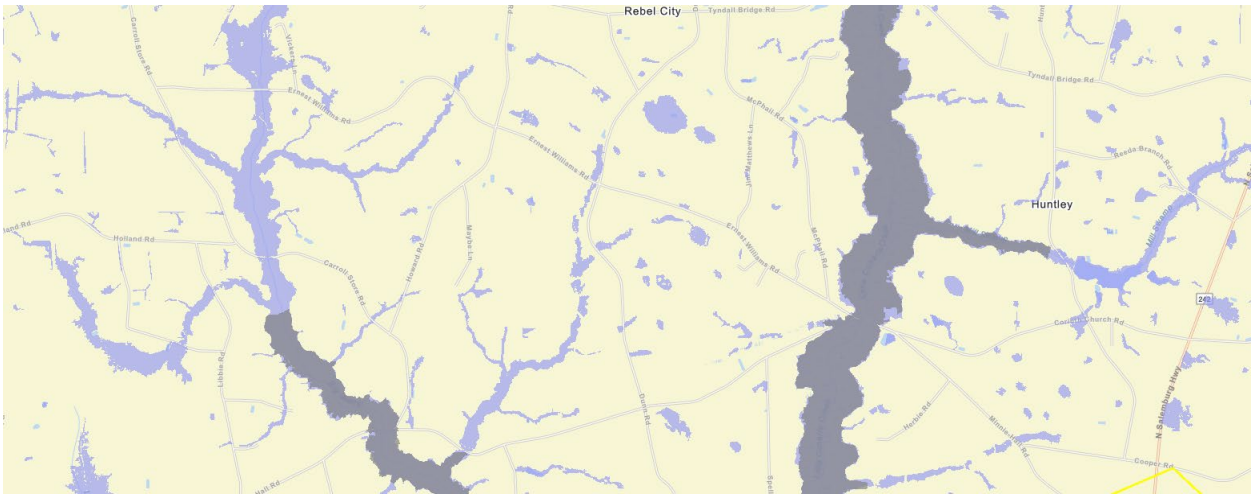

Figure 4-1: Advisory Mapping Compared with Regulatory Mapping from in NCFMP's Advisory 2-D Flood Viewer

The Blueprint will incorporate the following recommendations with respect to large-scale 2-D Hydrologic and Hydraulic (H&H) modeling approaches:

- Use 2-D H&H modeling methods as the basis for Blueprint modeling efforts using the open-access HEC-RAS model (and associated RAS Mapper GIS) and the rain-on-grid approach that integrates hydrology and hydraulics in the same model platform. These models are at the

hydraulic unit code (HUC)-10 scale and address both fluvial and pluvial flooding (see Figure 4-2.

- Leverage available HEC-RAS model geometry developed from field surveys of channels and hydraulic structures that are available in the NCFMP FLOOD database to implement targeted and scalable improvements to base-level 2-D models.
- There is a need to have connectivity between HUC-10 models, the mainstem, and the larger river basin. The modeling should be configured in a way that allows mainstem flow to propagate downstream and provides valid flood impact results for the mainstem within the model. There are different options and approaches to achieve this, and these should be addressed in coordination with NCFMP as more 2-D modeling is conducted.
- Use 2-D HEC-RAS models to evaluate basin-wide effects of implementing potential resiliency/mitigation strategies at different recurrence intervals within targeted basins.
- Model mitigation alternatives should include a full suite of various structural, nonstructural, traditional and green stormwater, and nature-based alternatives.
- Develop building-level risk assessments and perform benefit-cost analyses for potential mitigation strategies.
- The Blueprint should consider modeling events such as 20, 10, 4, 2, 1, 0.5, 0.2, and 0.1 (5-, 10-, 25-, 50-, 100-, 200-, 500-, and 1,000-year) events, as well as buildout scenarios. The final events selected and modeled will be determined by staffs of the Blueprint and NCFMP.
- The FEMA Freeboard Value Approach will also be considered. This includes the elevation and flood hazard area that result from adding an additional 2 feet to the 1% flood elevation for non-critical actions and by adding an additional 3 feet to the 1% flood elevation for critical actions.
- Future climate scenarios: NCDOT and NC State University conducted research on future precipitation extremes in North Carolina by assessing future precipitation through the utilization of scaling factors. To incorporate the entire spectrum of scale factors in North Carolina, four climate scenarios (10, 30, 50 and 70% increase of 1% rainfall depth) were chosen based on the range of scale factors for mean and upper bounds in RCP4.5 mid-century and RCP8.5 end-century projections. The final scenarios will be determined by staffs of the Blueprint and NCFMP and a reevaluation conducted once Atlas 15 is available for North Carolina.
- Partner with NCFMP and others as appropriate to develop models jointly to reduce redundancy, contracting administration, and costs. Completed models and their output should be made publicly available through the most appropriate platform, which may include the Blueprint Tool among others.
- The models should be used to develop flood risk information and, where possible, as a basis to propose and evaluate potential flood risk solutions and resiliency actions, including regional solutions as well as those at the community scale. There may be some cases where more detailed modeling of certain hot spots is needed to fully formulate a solution that is sufficiently detailed and grant-ready (see two-tiered approach recommendation in Subsection 4.3.2).

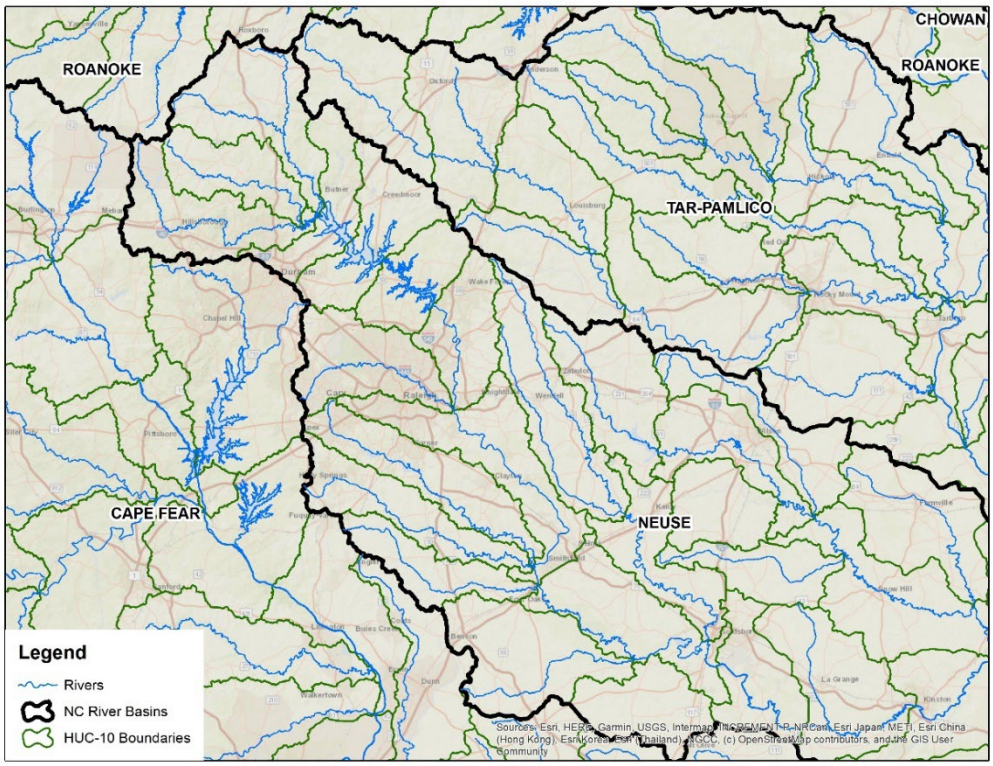

Figure 4-2: HUC-10 Basin Scale Shown Above in Green

4.3.1.1 Coastal Modeling

Modeling along the coast requires additional considerations such as tidal effects, storm surge, sea level rise, overland waves, erosion and runup. Further, these interact with riverine flow from upstream to create compound flooding events where there are multiple sources of flooding. While North Carolina has a number of existing modeling studies along the coast, there is a need to create a seamless, updated set of coastal models at a resolution appropriate for the Blueprint planning process. For example, the USACE South Atlantic Coastal Study is relatively recent but was conducted at a resolution that is too coarse for Blueprint utilization.[15] Other available data is dated.

A rough planning level estimate to conduct this type of work ranges between $3M-$6M depending on the specific features of the effort and how linkage to inland modeling is achieved and conducted. **Advanced Circulation Model (ADCIRC)** may be most appropriate tool for this effort; however, a thorough model selection/confirmation step should be conducted. Such an effort is funding dependent. In the meantime, a more limited approach will be used initially in the Neuse that leverages previous approaches that are part of the NCFMP regulatory program. The approach uses earlier NCFMP storm surge data and overland wave modeling flood boundaries and rasters. Interim considerations of sea level rise could include use of information from the NCEM 2014 Sea Level Rise study.[16]

[15] "South Atlantic Coastal Study," US Army Corps of Engineers, August 2022, https://www.sad.usace.army.mil/SACS/.
[16] "North Carolina Sea Level Rise Impact Study," North Carolina Emergency Management – Geospatial and Technology Management, June 2014,

Justification

The justifications for the completing the 2-D modeling for the Neuse River Basin and the remaining river basins statewide are as follows:

Age of Study: As identified in the *Hydrologic and Hydraulic Modeling Gap Analysis* (Subtask 2.4) conducted for the Blueprint, the average age of the H&H modeling in North Carolina is over 15 years old (see Figure 4-3). This is partially due to regulatory burden and due process required to develop effective Flood Insurance Rate Maps for National Flood Insurance Program compliance. The majority of North Carolina's modeling is 1-D and does not reflect changing rainfall intensities, climate change projections, or future and recent watershed development.

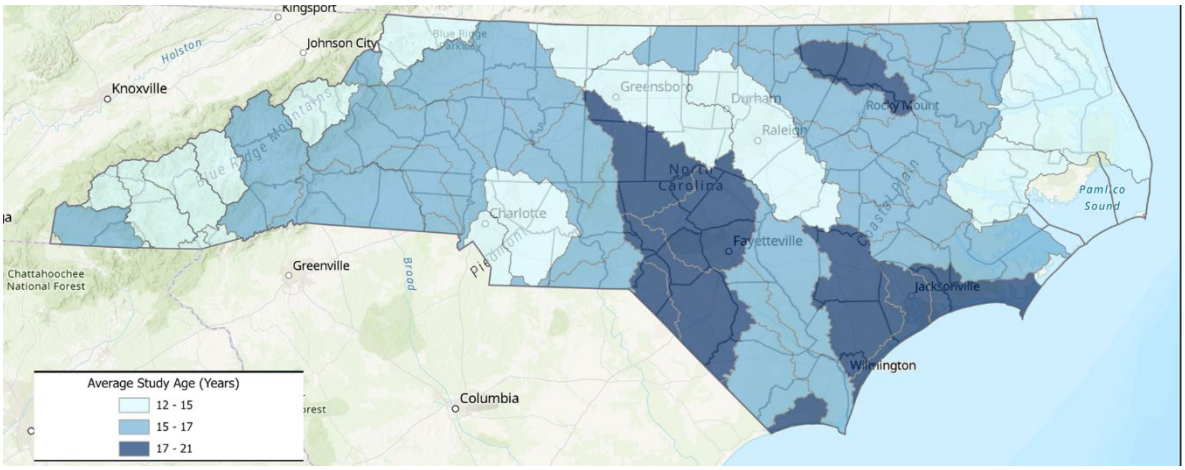

Figure 4-3: Average Study Age of North Carolina's River Basins

Insufficient Current Storm Frequencies and Future Conditions Not Considered: Most of North Carolina's flood hazard areas only consider the 1% (100-year) and 0.2% (500-year) annual exceedance probability. Approximately a quarter of the state's models consider the 10% (10-year) and 2% (50-year) annual chance events. NCFMP does have the 10, 25, 50, and 500-year events datasets available in effective or preliminary (draft) form for all counties except for Forsyth and Davidson counties as of 2023. Additional storm frequencies and future conditions events should be analyzed to better compute average annual loss and plan for increases in flood hazards and related impacts due to climate change. For the coastal modeling, the age and resolution of existing data and models suggest new modeling should be conducted in the near term and coast-wide for efficiency.

Cost Estimate

Table 4-3 shows the planning level cost estimates based on current work being done in North Carolina for the development of 2-D modeling for the Neuse River Basin (pilot basin) and remainder of the state. These costs are based on two considerations: modeling to fill in spatial gaps and updates of existing modeling. Both aspects need to be considered for each basin, and Table 4-3 will need to be reassessed when basins are done. It is currently more cost-effective to update existing modeling.

https://media.coastalresilience.org/NC/North%20Carolina%20Sea%20Level%20Rise%20Impact%20Study_FinalReport_20140627.pdf.

Table 4-3: Planning Level Cost for 2-D Modeling Development

Basin	Area (sq miles)	Planning-Level Cost Estimates
Neuse (Pilot)	6,234	**$996,000**
New	753	**$188,000**
Tar-Pamlico	5,570	**$1,393,000**
Watauga	205	**$51,000**
Cape Fear	9,320	**$3,169,000**
French Broad	2,829	**$707,000**
Catawba	3,285	**$881,000**
Little Tennessee	1,797	**$449,000**
Broad	1,513	**$378,000**
Lumber	3,334	**$834,000**
Savannah	171	**$43,000**
White Oak	1,261	**$315,000**
Chowan	1,378	**$345,000**
Pasquotank	3,635	**$1,005,000**
Roanoke	3,502	**$1,018,000**
Yadkin	7,221	**$2,234,000**
Hiwassee	644	**$161,000**
Total	**52,652**	**$11,983,000**

Alternatives Considered

In addition to determining the existing 1-D modeling in the state would not fully support the Blueprint's goals, the other approach considered was Probabilistic Flood Risk Analysis (PFRA). This is an alternative to the deterministic modeling of the 2-D rain-on-grid H&H modeling recommended above. The PFRA approach leverages the existing and developed 2-D modeling as a baseline input dataset. The difference is that probabilistic modeling uses an array of rainfall events based on varying storm frequencies, duration, and intensity. Hundreds of rainfall events are modeled using the PFRA

approach. Additional statistical analyses are performed on these model results to yield a more probabilistic floodplain boundary and enhanced risk products. This approach is computation-heavy and requires a cloud-based computing and modeling system to perform the model storm iterations. The additional datasets allow for refined computation of flood risk (including annualized damages) and the evaluation of mitigation alternatives.

One drawback to the PFRA approach described above is cost based on current computing capabilities. At this time, probabilistic methods are estimated to be approximately 300% higher in cost than deterministic 2-D H&H modeling. Based on the cost difference, this level of modeling statewide is not recommended for the next phases of the Blueprint. However, the Blueprint program will consider this approach in future years.

Critical Dependencies: NCDEQ (or another department) must provide funding for 2-D modeling and contract firms for implementation.

NCDEQ is partnering with NCEM to conduct additional 2-D modeling in the Neuse River Basin in 2024 and expects to use that approach in subsequent river basins. While current Blueprint funding may be adequate to conduct the inland 2-D modeling for the Neuse and next five river basin. At this time, sufficient funding has not been identified for the additional river basins to include New, Watauga, Catawba, Little Tennessee, Broad, Savannah, Chowan, Pasquotank, Roanoke, Yadkin, and Hiwassee.

4.3.2 Use a Two-Tiered Approach to Flood Modeling

Description

The Blueprint program will implement a two-tiered approach to 2-D flood modeling to address instances where further model resolution and detail are needed. The following is a summary of the approach.

Tier 1: Large-Scale Basin-Wide 2-D Modeling, Risk Assessment, and Solution Development. Tier 1 modeling will be performed at the HUC-10 river basin scale as described in the previous recommendation for 2-D modeling. This scale of modeling is appropriate for the following:

- The development of cost-effective hazard identification and flood mapping for areas covered by current regulatory mapping and flooding beyond those areas.
- Building asset-based risk assessments, structural and content loss (costs) estimations, flood risk scores and annualized damage estimates for all impacted assets in the studied basins.
- Developing geospatial products to better communicate the flood hazards, consequences, and risks to stakeholders via the display of flood extents, depths, and building impacts (depths, structure, and content losses).
- The development of flood mitigation measures including structure elevation, floodproofing, relocation, and/or acquisition, including the computation of the benefit-cost ratio for each of the building-specific mitigation alternatives.
- Some regional flood resiliency/mitigation strategies that appropriate using the large scale 2-D models as part of the Tier 1 analysis.
- Other flood resiliency/mitigation strategies, including at the community scale, that may be appropriate given the large-scale resolution.

Tier 2: Higher Resolution and More Detailed Modeling and Alternatives Analysis. Following the Tier 1 (large-scale) modeling, areas should be identified for further higher resolution analysis to

confirm the location and type of flood resiliency action and compare alternatives. This should include situations where the large-scale modeling tools are not detailed enough to identify solutions that can be represented in the Blueprint Tool.

Additional regional solutions would be included where they cannot be initially evaluated using the larger scale modeling. Some of the smaller scale analyses can be supported by NCDEQ as part of the development of the River Basin Action Strategy. Alternatively, individual local governments or regional groups may opt to conduct the additional analysis on their own. NCDEQ anticipates funding priorities to include regional solutions and under-resourced communities. Costs for Tier 2 modeling may range from $20,000 to $200,000 based on the complexity and level of effort required.

An additional level of analysis will likely be needed to support a full design of a recommended resiliency/mitigation project. The level of analysis would occur outside of these two tiers and outside the scope of River Basin Action Strategy development.

Justification

This two-tiered approach supports the development of solutions that are ready for funding, design, and construction. The process reduces the burden for communities and ensures more useful and effective River Basin Action Strategies.

Alternatives Considered

No alternatives were considered.

Critical Dependencies: For any Tier 2 modeling to be performed, the initial basin wide 2-D modeling should be completed first. The more detailed modeling is also dependent on available resources and will require additional funding.

4.3.3 Study the Benefits of Natural Assets for Flood Reduction, Flood Storage, and Flood Dispersion

Description

Work with the University of North Carolina (UNC) Collaboratory on a study to evaluate the benefits of natural assets and land features (e.g. wetlands, forest, buffers, open fields, and cropland and working lands) in North Carolina for flood reduction, protection, or restoration. This effort should build on prior and ongoing work in the state.

Justification

Land features such as wetlands, forest, and fields are important for flood mitigation. However, not all land features are created equally. A science-based analysis should be performed that identifies what types of land features are most important in what locations so that the state can decide whether and how to protect or restore them. The UNC Collaboratory has worked on similar projects and has the technical resources to carry out the study.

Alternatives Considered

Other considerations include waiting on others to develop the data, working with other agencies and academics to develop this data over time, and searching for a grant and other academic partners to fulfill this task.

Critical Dependencies: This recommendation requires coordination with subject matter experts to determine the variables needed to include in a study. It may require additional funding.

4.4 Workflow Implementation & River Basin Strategy Development

As part of implementing the Workflow, the Blueprint program and River Basin Action Strategies will require refinement and routine maintenance to allow for continuous improvement and incorporation of updated data. The creation of advisory groups and understanding of community needs, especially related to where support should be provided to under-resourced communities, will facilitate development of the River Basin Action Strategies. Recommendations include establishing a 5-year program lifecycle for River Basin Action Strategies, implementing a data quality review process, updating information on action plans, creating River Basin Advisory Groups, conducting capacity needs assessments, and providing support to under-resourced communities.

4.4.1 Implement a 5-Year Cycle for Action Strategies

Description

The Blueprint River Basin Action Strategy Workflow is designed to operate within a 5-year cycle in each river basin, with a new update beginning every 5 years following the end of the previous strategy development. Each basin will be on a rolling update cycle once that cycle's strategy is completed. River Basin Action Strategy project implementation tracking for each river basin will involve assessing and documenting project status on a regular basis to secure additional funding and support completion. Data maintenance will be reviewed annually to ensure the best available data is being used to inform Blueprint actions.

Justification

Based on reviews of other programs inside and outside of North Carolina and feedback from PAG and TAG members it was determined that a 5-year cycle was most appropriate. However, the 5-year clock should begin once a River Basin Action Strategy is finalized so in practice this could mean five years plus the amount of time it takes to develop the strategy within the initial cycle, which can be up to two years. Many action strategies included in the Blueprint will require a significant investment of time and resources, and this time horizon allows for proper planning, execution, and evaluation. Some projects will require more than five years for completion; within this period, implementation can begin, and progress can be tracked for future years and/or cycles.

Alternatives Considered

Two alternative timeframes were considered, with the first being a 3-year cycle. While a 3-year cycle may be suitable for certain projects, particularly those that may have previously committed efforts or funds, it is likely an insufficient amount of time for extensive, basin-wide actions to take place. It was determined that a shorter period does not account for varying levels of complexity and scale, unforeseen challenges, or measuring impact.

The second alternative considered was a 10-year cycle, which was determined to be too long due to challenges with accountability, adaptability, and alignment. Decision-makers often seek a relatively shorter ROI period. Waiting 10 years to see tangible outcomes from a project may be seen as a risk, and it can be challenging to maintain accountability over such a prolonged timeline. Long-term projects may struggle to adapt to these changes, leading to potential obsolescence or inefficiency. In terms of alignment, a 10-year plan may lack a sense of stability and continuity due to the extended timeline.

Critical Dependencies: The Legislature must provide recurring program funding to implement updates over time.

4.4.2 Develop and Implement a Data Quality Review Process

Description

The databases that inform the Blueprint Tool should be designed and constructed to facilitate ongoing data maintenance and updates to ensure accuracy and accessibility. During the development of River Basin Action Strategies, there will be an opportunity for communities and local governments to submit additional data for use in the program. This information will be submitted to the Blueprint Project Manager for a quality assurance/quality control (QA/QC) review to ensure that the data meets or exceeds the standard requirements for integration into the tool. Once validated, the data will need to be uploaded into the Blueprint Tool.

Justification

As the planning process continues and action plans move to the implementation phase, there may be more up-to-date data, modeling, and analysis available from the initial baseline that will need to be included and updated within the Blueprint Tool. Prior to updating, the data will need to go through a QA/QC review process.

Alternatives Considered

No alternatives were considered.

Critical Dependencies: Research must be conducted on best practices for a QA/QC procedure that ensures data inputs to the Blueprint Tool are accurate and compatible. This needs to be developed as part of the initial Blueprint Tool.

4.4.3 Update Tool with Resiliency Action Plan Project Information Annually

Description

The Blueprint will create individual River Basin Action Strategies and update the Blueprint Tool with project planning data that feature hazards, impacts, benefits, and defined actions for mitigation as well as cost estimates, feasibility, and complexity for completing the action. As a project moves forward into the implementation phase, the data should be updated on an annual basis to capture the progress of each project. New or updated information on the progress of the project will need to be included and reviewed for accuracy and compared to the project's established key performance indicators. This information may include the status of the action, new or updated modeling that

impacts the end result of the project, or updated funding availability. These changes need to be captured within the project profile.

To maintain audit readiness, the usage of the Blueprint Tool should align with standard operating procedures for project/action implementation that reinforce state and federal (for projects using federal funding) policies and procedures. This will be determined and, when possible, implemented in the Blueprint Tool.

Justification

Establishing a regular pattern for updating Action Profiles will promote accurate progress tracking. In addition, communities can view Action Profiles for other jurisdictions for inspiration and collaboration opportunities.

Alternatives Considered

No alternatives were considered.

Critical Dependencies: One full cycle of the Blueprint Workflow must be complete.

4.4.4 Create River Basin Advisory Groups for Each River Basin

Description

Building off the experience with the Neuse River Basin pilot, River Basin Advisory Groups should be established as part of the River Basin Action Strategy development process. This entity will consist of people and organizations that are willing to provide river basin-specific technical and non-technical information, as well as local knowledge of flooding and flood resilience efforts and needs. The creation of this group should happen as part of Step 1 of the Blueprint Workflow. Each River Basin Advisory Group will work with NCDEQ to develop the River Basin Action Strategy in collaboration with communities. The effort will include priority resiliency actions that can be implemented at the community and regional level.

A Neuse River Basin Advisory Group was formed during the development of the pilot Neuse River Basin Action Strategy. Members of this group were selected by NCDEQ in consultation with numerous partners from the state, local/regional groups, non-profit organizations, and others. This group will continue its work as part of the refinement of the Draft Neuse River Basin Action Strategy to include additional modeling, risk and vulnerability, solution development, and feedback from stakeholders and communities within the river basin. NCDEQ will continue to gather feedback to improve the process. Some of the lessons learned thus far are: 1) a comprehensive community and stakeholder education effort needs to take place before, during and after the River Basin Action Strategy is developed to ensure greater participation and acceptance; 2) more time is needed to maximize participation and ensure a good end product, 3) in-person meetings need to occur throughout the river basin; 4) strategies for increasing representation need to be developed and implemented; and 5) many communities need capacity support to participate effectively.

Justification

The River Basin Advisory Groups will provide contextually informed insight for proposed projects and strategies recommended for the River Basin Action Strategy. Through the planning process, members within each River Basin Advisory Group will develop common knowledge and help leverage local and

regional networks necessary to collaboratively advise NCDEQ during the development of the Action Strategy for each basin.

Alternatives Considered

Several alternatives were considered for how to best advise and support the creation of River Basin Action Strategies for each basin. A basin-specific commission similar to Texas Water Management Boards was discussed. This approach would allow more responsibility for decision-making to be delegated to river basin officials and provide communities with more ownership of the River Basin Action Strategies. However, it would require legislative approval and a member appointment process. There was support for this recommendation among some PAG and TAG members, and it should be explored further. Nonetheless, the development of additional River Basin Action Strategies in the near term should not be delayed in order for this to be established.

Critical Dependencies: NCDEQ will need to work with PAG and TAG members and local and regional groups such as COGs to develop membership for each River Basin Advisory Group. At minimum, these groups will consist of representatives from state and local governments, working lands, drainage districts, soil and water districts, under-resourced communities, private business, historically under-represented communities, and flood resilience experts.

4.4.5 Conduct Basin-Specific Financial and Technical Capacity Needs Assessments

Description

As part of Step 2: Initiate Community Engagement and Discovery, a Financial and Technical Capacity Needs Assessment will be conducted to determine how capable communities within each river basin are to participate in the collaborative Blueprint planning process and implementation of funded actions. The community capacity needs assessment will have a targeted focus on identifying under-resourced communities. Based on the findings, NCDEQ can be determine what resources may be necessary to ensure effective community participation across the river basin.

Justification

Participation in the Blueprint is voluntary; however, throughout the process there may be communities and local governments that do not have the capacity to participate in the Blueprint planning process or to implement projects. For communities that want to participate but have capacity challenges, NCDEQ staff will partner with other entities or contract with private companies to help bridge the capacity gap. As examples, lead regional organizations and COGs could be engaged to support communities and/or NCDEQ staff could provide some assistance. In addition, NCDEQ could offer design services to communities with the help of on-call contracts with engineering firms.

Alternatives Considered

The alternative of providing no capacity assistance was considered. However, the primary goal of the Blueprint is to get projects implemented to increase flood resilience across all North Carolina communities. In order to achieve that goal, capacity challenges must be addressed. A priority of the Blueprint and NCDEQ is to assist in resolving those challenges and to see that the resiliency actions are implemented.

Critical Dependencies: NCDEQ must determine the level of assistance the state will provide to communities, and specifically under-resourced communities, in carrying out Blueprint planning and actions.

4.4.6 Provide Support to Under-Resourced Communities Throughout the Implementation of the Blueprint

Description

Throughout Phase I, local governments expressed concerns over their capacity to participate in the Blueprint, while underscoring that community stakeholders and local government representatives need to remain engaged, stay informed, and advocate for their needs and concerns. As such, attention should be given to setting the conditions for the inclusion and representation of all communities and interests— including under-resourced communities— and engaging in a manner that promotes long term two-way collaboration and engagement. In general, NCDEQ will need to provide capacity support for under-resourced communities so that they can effectively participate in the Blueprint. Support for under-resourced communities has been built into each relevant step of the Blueprint Workflow and is laid out in more detail as appropriate in each step.

Justification

Resource-limited communities are disproportionately located in flood-prone areas, meaning these communities may bear a greater share of the increased flood risk that is expected to be experienced across the state.

Alternatives Considered

Additional ways in which to provide support to under-resourced communities will continue to be considered.

Critical Dependencies: Under-resourced communities must be identified in order to receive support, which will depend in part on the completion of the financial and technical capacity needs assessments.

4.5 Project Ranking

A fundamental goal of the Blueprint is to ensure that it aids in determining how and where resources should be allocated to implement projects that increase community flood resiliency. To accomplish this aim, the Blueprint Tool must include a set of project ranking criteria that reflect a project's cost and effectiveness in increasing flood resilience as well as providing a variety of co-benefits such as economic development, social benefits, and additional environmental and ecological benefits in various quantitative and qualitative ways. These factors, applied in Step 5: Action Analysis and Ranking of the Blueprint Workflow, can also allow the Blueprint to reflect the priorities of communities and local institutions in the decision-making process. The ranking process enabled by these factors will assist NCDEQ and decision-makers on where to invest in flood resilience; what type of approach to apply including, where applicable, innovative approaches like nature-based solutions; and why to invest there.

4.5.1 Develop a Dynamic Resiliency Project Ranking Methodology

Description

The Blueprint Tool will include a multivariable, data-driven, performance-based ranking module for ranking flood resilience projects and actions based on selected criteria. A user will be able to select or create candidate projects in the Blueprint Tool to address flood risks at a given location. Then, these candidate actions will be evaluated by the Blueprint Tool in two major areas:

- **Single Strategy Performance Evaluation:** Individual actions will be assessed through a multi-criteria framework encompassing variables such as benefits and impacts, location factors, limiting factors (cost, technical difficulties, etc.), and funding opportunities. Expected outputs include rankings and scores, as well as associated metric values.
- **Multiple Strategy Aggregation Assessment:** In addition to the results of the individual actions assessments, it is important to consider the appropriate distribution and cumulative impacts of projects among all communities with flooding needs within a unit of local government, region, or river basin. The Blueprint Tool will allow aggregated actions/projects to be evaluated. This also includes the ability to understand how projects contribute and supports resilience on a watershed scale, including upstream and downstream analysis.

Figure 4-4 below demonstrates an example decision-support framework adapted for the Blueprint Tool.

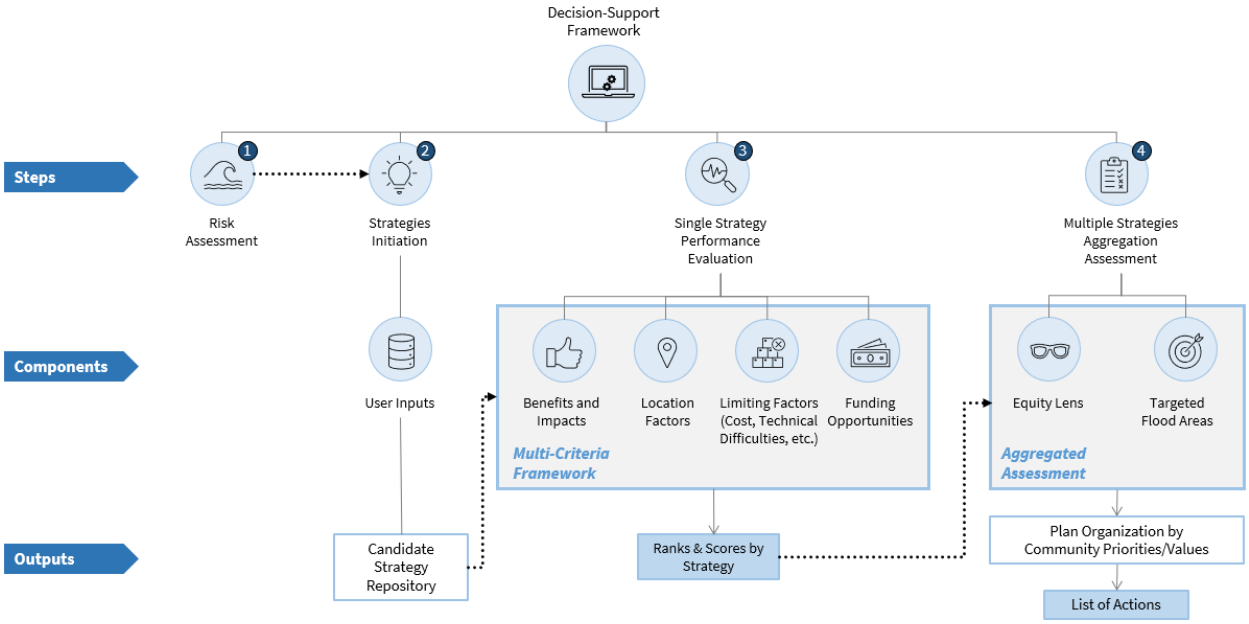

Figure 4-4: Example Decision Support Framework

The Blueprint Tool will allow the state and communities to apply weighting where desired for multiple variables to generate project priority lists and compare projects. For example, the state could decide that its highest priority is to ensure flood resilience for all local Emergency Management Facilities in a river basin to address that vital public safety function and to ensure that infrastructure damage is minimized, and recovery time is limited. The Blueprint Tool will allow the state to identify all such

facilities and their hazard level. They may then decide that this is cost-prohibitive for a 500-year flooding event but choose to evaluate the costs to improve facilities for a 100-year event. Further examples could include a community that may want to evaluate how to address road flooding for a 50-year event and compare other options. Other users may want to evaluate projects that could serve multiple functions, such as a park that is allowed to flood in certain storm events to protect the road from overtopping. The Blueprint Tool will allow communities and the state to make these and other types of comparisons.

The process for developing a decision-support framework for the Blueprint Tool may consist of the following four key steps and as shown in Figure 4-5:

- **Step 1: Visioning.** Identify major stakeholders and define the framework criteria. Expected outputs include defined goals, objectives, and requirements for the multi-criteria decision-support framework.
- **Step 2: Framework Development.** Develop a draft ranking methodology for a multi-criteria decision-support framework. Conduct offline testing of the project priority methodology.
- **Step 3: Framework Refinement.** Based on feedback from NCDEQ and stakeholders, refine the ranking methodology, which includes criteria, framework, and aggregated assessment.
- **Step 4: Framework Integration.** Apply the ranking methodology to projects as a part of the Blueprint Tool platform and final River Basin Action Strategy priority project list.

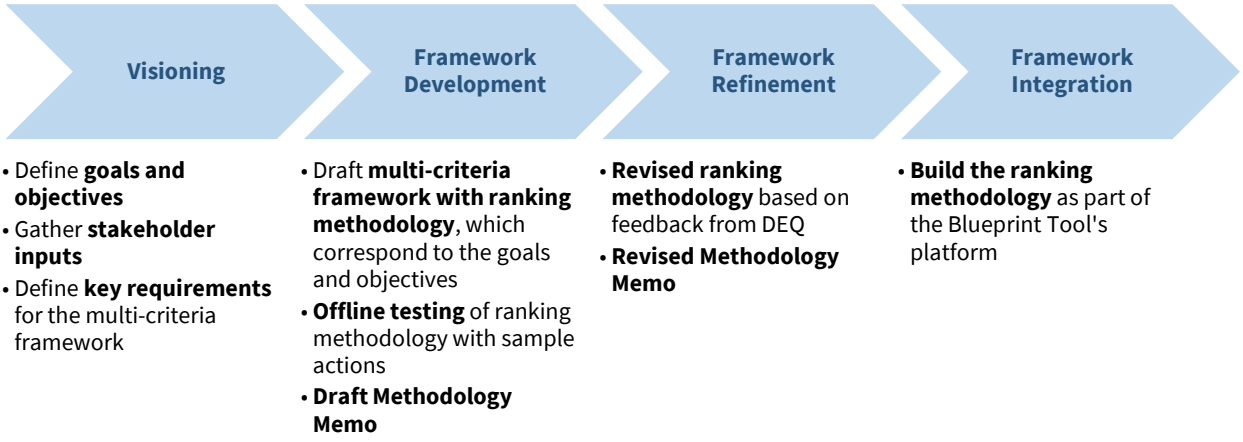

Figure 4-5: Four Key Steps of the Decision-Support Framework

Justification

Development of the ranking methodology will allow decision-makers to evaluate and compare actions using a variety of appropriate metrics to make good flood resilience investment decisions. It will also allow the Blueprint to reflect the priorities of communities in the decision-making process. This ranking should take place in parallel to Phase II Blueprint Tool creation.

Alternatives Considered

Alternatives for the development of a ranking methodology are being considered in Phase II of the Blueprint, which is underway.

Critical Dependencies: Meet with Blueprint partners and stakeholders to develop the ranking methodology and determining funding mechanisms.

4.5.2 Incorporate Local Priorities into Project Ranking

Description

The project ranking criteria within the Blueprint Tool play a crucial role in informing project decisions. The decisions should reflect the priorities of local communities while also addressing the Blueprint's core purposes.

Ranking criteria will be developed and included in the Blueprint Tool. NCDEQ, with input from Advisory Groups, will develop a core list of primary criteria for ranking all proposed mitigation actions to maintain consistency and allow comparison statewide. These criteria create common variables between user groups based on core Blueprint goals. Examples of potential variables could include ensuring public safety and public health, indirect community benefits, addressing water quality and multi-benefits where feasible, regulatory mandates and compliance, resource leveraging opportunities, inclusion of socially vulnerable communities, and other variables as appropriate.

To prevent overall project ranking skew, NCDEQ will ensure primary criteria are weighted higher than secondary community priorities. This will prevent the Blueprint Tool from skewing Action Profiles away from Blueprint's core priorities (increase flood resilience in the state, seeking multi-benefit solutions wherever feasible, etc.). These priorities and how to incorporate local dimensions will be further determined in Phase II with the creation of the Blueprint Tool.

Justification

Incorporation of local priorities into the Blueprint Tool action ranking process will allow the Blueprint to address community needs more effectively. If those community values are reflected in the Blueprint River Basin Action Strategy and associated Action Profiles, local governments, communities, and other stakeholders are more likely to accept program recommendations, implement actions, and sustain Blueprint efforts in the future.

Alternatives Considered

Many project ranking methodologies already exist in resilience plans across the US, including in peer state programs analyzed in the *Peer State Food Resiliency Programs* (Subtask 1.5) report that was created as part of Blueprint research.

Critical Dependencies: Meet with all communities participating in the Blueprint to establish community ranking criteria.

4.6 Financing and Funding

Financing and funding will be pivotal elements within the Blueprint, driving the transformation from potential flood resilience actions into actionable realities. Given the wide array of financial resources available from state and federal programs, including the Infrastructure Investment and Jobs Act, Inflation Reduction Act, Water Resources Development Act, and federal appropriations, numerous funding opportunities exist for eligible projects. These exist alongside any additional funding that may be made available in the future from the General Assembly. The intent of these recommendations is to

provide a foundation at the local level for ensuring long-term maintenance of all actions after implementation, including nature-based solutions. The identification, ranking, allocation, and use of these funding sources will constitute a fundamental aspect of the Blueprint, with oversight and coordination supported by NCDEQ staff.

4.6.1 Integrate Identified Funding Sources

Description

To integrate identified funding sources into the Blueprint, NCDEQ will develop a tool that will leverage existing data and logic that consolidates and tracks relevant funding opportunities. The tool will include a database with search parameters to match community profiles and resiliency actions/projects to appropriate federal, state, and other funding sources to move priorities forward into implementation. Data maintenance will be required as funding sources and requirements change throughout the course of the Blueprint, on at least an annual basis in some cases. NCDEQ should work with NCORR on this effort as initial work is underway for the NC Resilience Exchange and that initiative may be leveraged.

Justification

As outlined in the *Flood Risk Reduction Project Funding Analysis* (Subtask 2.6), there is a diversity of funding opportunities available, yet it can be challenging to match projects and actions to the most appropriate source (see Table 4-4). The frequency of availability, purpose, and required funding match are examples of factors that impact the feasibility of a funding source to be used for an action – and these factors can change by location and over time. In the future, the tool could leverage advanced technologies, machine learning and language processing technology to effectively match projects and actions with funding. Recommendation III: Funding Solutions in the *Recommendations for the Utilization of AI/ML to Inform Blueprint* (Subtask 3.11) discusses the potential benefits of AI in this context, including efficiently tracking and updating funding sources, matching and scoring projects against funding criteria, and performing gap analyses.

Table 4-4: Examples of Federal Funding Sources that Will Be Tracked Through the Funding Tool

Annual Federal Appropriations and Authorization Acts	Managing Agency- Funding
Energy and Water Development	USACE; Department of Insurance (DOI) - Bureau of Reclamation; Treasury - Appalachian Region Commission; Energy Efficiency and Renewable Energy
Interior-Environment	USACE; DOI - Bureau of Reclamation; DOI - US Geological Survey; DOI - Natural Resource Damage Assessment and Restoration; DOI - Indian Affairs; DOI - Fish & Wildlife and Parks; EPA - State and Tribal Assistance Grants; EPA - Environmental Programs and Management; EPA - Water Infrastructure Finance and Innovation Act
Homeland Security	Building Resilient Infrastructure and Communities; Pre-Disaster Mitigation; High Hazard Potential Dams; Cybersecurity; S&T; NextGen Warning; Climate Adaptation; Hazard Mitigation Grant Program

Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Crop Insurance; Rural Development	Farm Services - Risk Management; Natural Resources Conservation Service; Federal
Commerce-Justice-Science	Economic Development Administration; National Oceanic and Atmospheric Administration - National Weather Service
Water Resources Development Act (Biennial Authorization)	Policy, Funding Authorization
Farm System Reform Act of 2023	Policy, Funding Authorization
Inflation Reduction Act	Fiscal Year 2022-33 Funding, Tax Credits, Policy
Infrastructure Investment and Jobs Act/Bipartisan Infrastructure Law	Fiscal Year 2021-26 Funding, Set-Asides, Policy

Information about funding sources at the state level can be found in *Flood Risk Reduction Project Funding Analysis* (Subtask 2.6). State agencies that provide funding include:

- NCDEQ Division of Mitigation Services
- NC Department of Agriculture and Consumer Services (NCDA&CS)
- US Department of Agriculture Natural Resources Conservation Service
- NCDA&CS Division of Soil and Water Conservation
- NCDEQ Division of Coastal Management
- NCDEQ Division of Water Resources
- NCDEQ Division of Water Infrastructure
- NC Department of Commerce
- NC Department of Public Safety (NCDPS)
- NCDPS, Office of Recovery and Resiliency
- NCDPS, Emergency Management
- NC Department of Justice
- NC Department of Natural and Cultural Resources (NCDNCR)
- NCDNCR Division of Parks and Recreation,
- NC Wildlife Resources Commission
- NC Forest Service

There are other considerations that should be factored in: data maintenance, system interface, and grant management. Incorporation and costs are being considered for these in Phase II of the Blueprint.

- **Data Maintenance:** The cost of creating or expanding, updating, and maintaining data included in the funding tool. Cost of data maintenance will have to be considered for each set of data needed for a basin review. Statewide datasets are often owned and maintained by an agency who either has the need or mechanism for maintenance. For example, statewide imagery is owned and maintained by the NC Department of Information Technology through the NC Center for Geographic Information and Analysis (NCCGIA). This dataset has a funding source and process for collection. NCCGIA is a partner. Some data sources, such as lidar, are collected through coordination of several agencies. NCEM is the owner and collector of the lidar data, but they work with NCDOT on the quality control and review of the data. NCFMP is the repository of floodplain data throughout the state, and NCDEQ is the repository of headwater datasets. All data layers in North Carolina are done in coordination with other state agencies to provide information to as many needs as possible without duplicating effort.

- **System Interface:** The cost of creating a system interface to make the tool accessible for communities. This system will be created with the understanding that as NCDEQ addresses river basins throughout the state, the system may need to have adjustments or updates made based on new user needs, new data inputs, or new circumstances because of geographic location.
- **Grant Management:** The cost of tracking and managing grants that communities pursue and/or are awarded. It is understood that the Blueprint will not be the only program where grants are being acquired. There will be a coordination of needs that will show grants and actions receiving outside grant funds that will be created to reduce the workload for grant applications and requests.

Alternatives Considered

Funding options are frequently changing, and alternatives should continue to be considered.

Critical Dependencies: For the integration of identified funding sources to occur, the Action Profile creation must occur to confirm the projects and actions that the community will move forward with.

4.6.2 Develop a Compensation Program for the Agricultural Community Based on the Use of Farmland for Flood Storage and Reduction

Description

This effort would entail the creation of a compensation program for landowners who allow their land to be use as flood storage and water retention during flooding events to assist with flood reduction along a basin river network. Since many working lands are leased, the project should explore how to compensate all parties impacted by this approach. This effort should be led by the Department of Agriculture and Consumer Services and include a Department of Commerce economist input with assistance of the Blueprint Advisory Groups and academic experts.

Justification

This recommendation will allow for the use of working lands during flooding events as a part of a flood mitigation strategy. This would compensate owners of working lands to allow for water storage that benefits the river basin and local communities.

Alternatives Considered

Many alternatives are being considered to clarify funding and policy that will drive requirements for this incentive program.

Critical Dependencies: This recommendation requires participation from community stakeholder groups to identify and create appropriate incentives, coordination with the U.S. Department of Agriculture and the North Carolina Department of Agriculture and Consumer Services, funding, and the creation of a maintenance plan for funding during future flooding events.

4.6.3 Implement Multiple Finance and Organizational Approaches to Address Local Stormwater Programs

Description

Flood resilience investments require maintenance and repair in order to protect the initial investment. Local stormwater programs created as a requirement of Phase I and II of the National Pollutant Discharge Elimination System (NPDES) program are familiar flood resilience maintenance program types among communities. Under that program, local governments with a population over 10,000 must meet federal stormwater program requirements. These programs serve as models for flood resilience project maintenance programs, which may have projects that extend beyond normal stormwater projects (e.g., dry proofing a set of structures).

The level at which a local stormwater program is able to finance its maintenance and repair programs depends on the community size, resources, scale of operation, how they are organized, approach to taxation and use of fees, and financial capacity of the community. Generally, the use of fees has the advantage of creating a new revenue stream without directly modifying the general tax rates. Some additional benefits of fees compared to taxes are that they can assign rates according to the benefit (e.g., larger structures require more stormwater infrastructure and therefore pay larger rates), and tax-exempt entities are not exempt from paying fees for the stormwater service they require. Programs also often issue bonds to pay for large projects so that the cost of the project can be spread over time.

These methods are mature and well understood. A wealth of information on these methods can be found at the UNC School of Government Environmental Finance Center website.[17] Communities with existing stormwater financing could expand their model to cover flood resilience projects.

Stormwater infrastructure requires specialized skills and certifications to design, implement and maintain. Small communities often may not have the capacity to build and maintain a stormwater program capable of maintaining stormwater infrastructure. Below are several ways in which small communities may address their resource gaps:

- **Development of a stormwater enterprise utility for multiple communities in a region:** This could be a collection of small communities, small and medium communities, or small and/or medium communities partnering with a larger community. This is common in the water utilities sector. There are also examples in the NPDES Municipal Separate Storm Sewer System (MS4) sector. For example, Mecklenburg County, the City of Charlotte, and the towns in Mecklenburg County partner for all or part of their MS4 program requirements. This allows communities to leverage their resources to cost-effectively manage their NPDES MS4 program requirements and reduce the financial burden on all the communities.
- **Develop partnerships with local state agencies:** Some state agencies that are located in regions across the state have the skills and resources (equipment or contracts) to perform maintenance and repair for flood resilience projects. Examples of state agencies that may be viable partners include NCDOT, NCDA&CS Division of Soil and Water Conservation, and the NC Forest Service.

[17] UNC School of Government Environmental Finance Center, https://efc.sog.unc.edu/.

Contracts with the entities would reduce the burden of establishing a maintenance and repair staff. The individual community's program could be run by a community staff member or by a staff member from the state agency. Local funding would still be required but the program costs would be reduced.

Justification

Maintenance and timely repairs are the most cost-effective ways to protect investments and prevent loss of function and costly and time-consuming replacement. While over 100 communities across the state do have stormwater programs, most communities do not because they are often cost-prohibitive. To increase flood resiliency in the state, small communities will need methods that allow them to afford to protect flood resilient investments. Building partnerships is the most cost-effective way to meet this capacity gap.

Alternatives Considered

Other alternatives considered included establishing a river basin or statewide state maintenance and repair program. However, such programs would not be as responsive or as cost effective as more localized partnerships. Some consideration was given to developing private contracts for these services. While such contracts can be cost-effective, they would be more so on smaller scales with local contractors.

Critical Dependencies: This recommendation requires participation from community stakeholder groups to identify finance methods that are available and most applicable to under-resourced communities. Implementation of final policy recommendations will likely require financial assistance from the state.

4.6.4 Provide Grant Opportunities to Establish Stormwater Programs

Description

In 2021, the North Carolina General Assembly appropriated $1.69 billion from the state's allocation of the American Rescue Plan Act for drinking water, wastewater, and stormwater investments in Sections 12.13 and 12.14 of the Session Law 2021-180. Of this, approximately $100.5 million was allocated for stormwater projects in the Local Assistance for Stormwater Infrastructure Investments (LASII) fund. NCDEQ's Division of Water Infrastructure was charged with administration of these monies, of which approximately $82 million was allocated to fund projects for improving and/or creating infrastructure for controlling stormwater quantity and quality. Grant types available from the LASII fund included construction grants (approximately 70% of allocated funding) and planning grants (approximately 30% of allocated funding). Implementation of a stormwater utility was also an eligible use of LASII funding through stormwater construction funds.

To help communities develop stormwater programs that are capable of maintaining project investments, North Carolina should focus LASII grants specific to program development for smaller and under-resourced communities or create a similar program to LASII, but specific to the Blueprint.

Justification

Using LASII or a program like it could provide an opportunity for communities to develop or improve stormwater programs that will be able to maintain flood resilience investments.

Alternatives Considered

Alternate incentives to encourage local governments to establish or strengthen stormwater infrastructure should be considered further.

Critical Dependencies: Additional state or federal funding to support such a grant program.

4.6.5 Incentivize Multipurpose and Multi-benefit Solutions

Description

When possible, the state should promote and provide incentives for the application of flood resiliency solutions that serve multiple purposes and achieve multiple benefits. Recognizing the congruent nature of desired Blueprint outcomes— including reduction of frequency and severity of flooding events, mitigation of flooding impacts, and enhancement of a community's ability to quickly resume pre-storm activities following flooding, in addition to maximizing the state's return on investment— it follows that solutions that support positive co-benefits across these dimensions should be prioritized to the extent possible. Existing state programs that support implementation of such solutions and can work with the Blueprint include the NIFMP and watershed planning efforts housed in DMS.

Incentives can be offered to communities for choosing NBS in their flood resiliency action identification. Example guidance includes the North Carolina Coastal Federation's Action Plan for Nature-Based Stormwater Strategies[18] and guidance from the National Climate Task Force.[19] Initial ideas for incentives include:

- **Incorporate multi-benefit criteria in project ranking:** The ranking methodology for projects should incorporate multi-benefit criteria related to nature-based solutions.
- **Prioritize permitting for NBS**: The state should work with Federal agencies and interagency permitting teams to prioritize expediting permitting for nature-based solution projects to encourage their deployment, using mechanisms like the FAST-41 process, and exploring new ways to prioritize such projects within existing authorities.[20] This could also be applied to state programs and permits.
- **Develop Nationwide or General Permits for NBS:** The state should work with federal agencies to develop Nationwide or General Permits that will either allow approval without notification as long as general conditions are followed, short permit review timelines, and elimination of mitigation requirements for identified types of NBS.

[18] Action Plan for Nature-Based Stormwater Strategies: Promoting Natural Designs that Reduce Flooding and Improve Water Quality In North Carolina, March 2021, https://www.nccoast.org/wp-content/uploads/2021/03/NBSS-Action-Plan.pdf.

[19] Opportunities to Accelerate Nature-Based Solutions: A Roadmap For Climate Progress, Thriving Nature, Equity, & Prosperity - A Report to the National Climate Task Force, November 2022, https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf.

[20] "The FAST-41 Process," Permitting Dashboard | Federal Infrastructure Projects, https://www.permits.performance.gov/fpisc-content/fast-41-process.

- **Reduce discretionary cost-share and match requirements for NBS:** Especially in underserved and under-resourced communities, agencies should re-evaluate discretionary cost-share requirements for nature-based solution funding.
- **Other incentives:** Additional options should be developed in consultation with the Blueprint Advisory Groups.

Justification

Prioritizing NBS in flood resiliency actions requires additional layers of planning effort and technical expertise. The state should provide incentives to help reduce any increased burden and incentivize the use of NBS.

Alternatives Considered

All alternatives are being considered. There are funding and policy clarifications and requirements that could drive this incentive program.

Critical Dependencies: Research needs to be conducted and should include policy and funding mechanisms for incentives.

4.6.6 Coordinate State-Funded Projects Through the Flood Resiliency Blueprint

Description

The Blueprint program should coordinate with other state programs to incorporate additional state-funded flood resiliency actions into the Blueprint Tool. NCDEQ should work with other state agencies to determine the specifics of this recommendation, including whether to merely track project implementation and/or to use the ranking methodologies to inform funding decisions.

Justification

By adding all potential projects into the Blueprint Tool database, the Blueprint Tool provides a comprehensive overview of all state-funded resiliency work.

Alternatives Considered

Coordination and informational alternatives are being discussed on timing and best practices for sharing information and allowing access to the Blueprint Tool.

Critical Dependencies: Participation from other state agencies is required for this recommendation.

4.7 Pilot Project Implementation

River Basin Action Strategy development is an important step in ensuring flood resilience funds are spent effectively. However, there is an urgent need for flood resilience improvement and education. The state should work with River Basin Action Strategy Advisory Groups and local governments to identify pilot projects within river basins that can be implemented while the River Basin Action Strategy is being developed. This would serve several functions. It would address some flood problems in the near term and will serve as an education opportunity for the stakeholders. There are plenty of sources to develop potential projects. Examples include the DA&CS Streamflow

Rehabilitation Assistance Program, DCM's Resilient Coastal Communities Program, NCORR RISE Projects, Hazard Mitigation Plans, and the preliminary draft of the Neuse River Basin Action Strategy.

Preliminary pilot projects that are underway or will be in progress in 2024 include:

- **Complete Implementation of Stoney Creek Pilot Projects**
- **Explore Agency Partnerships for Implementation**
- **Implement Pilot Flood Resiliency Projects from River Basin Action Strategies**

Future versions of the Draft Blueprint may provide more specific information relevant to pilot projects across the state.

5 Conclusion

The North Carolina Flood Resiliency Blueprint is a first-of-its-kind program that will serve as the backbone of North Carolina's flood planning process to increase community resiliency to flooding. The investment in and development of a statewide planning framework will be supported by the Blueprint Tool, enabling state, regional, tribal, and local entities and their stakeholders to identify, prioritize, and direct resources to implement effective flood resilience strategies based on the best available science. The dynamic nature of the Blueprint, highlighted in the Workflow and Case Studies, leverages and builds upon the robust array of existing and ongoing flood resiliency efforts across the state. The framework, planning workflow, and program recommendations discussed herein were developed based on extensive research of data and methodologies available. Analyzing comparable initiatives in other states allows the Blueprint to enhance and leverage peer programs. The Blueprint's adaptable Workflow approach ensures that stakeholder collaboration is the foundation for River Basin Action Strategies, which address the unique flooding challenges of each river basin, region, and community.

This Draft Blueprint serves as the programmatic and procedural framework to advance and implement the North Carolina Flood Resiliency Blueprint. As a program designed to address the critical needs and risks of local communities, the Blueprint execution will be a dynamic and adaptive process. As the recommendations in this report are put into action, opportunities for improvement, new information, and refined needs will arise. It is critical that the program remain responsive to the evolving challenges and uncertainties of flood risk mitigation and resilience. As the state and communities develop River Basin Action Strategies, further gaps will be illuminated, and opportunities to improve the program will arise. The individual communities that make up each of North Carolina's 17 river basins have unique needs, a wealth of expertise, and a desire to find solutions to the challenges of flooding. As the Blueprint continues to advance and flood projects begin to take shape on the ground, every community in the state will be needed to help build a more resilient North Carolina.

The North Carolina Flood Resiliency Blueprint will require determined effort to effectively address North Carolina's current and future flood risk and to develop lasting solutions. Armed with the best available data and coordination with other state, local, tribal, and federal entities, the Blueprint supports the state in providing a collective and well-coordinated means to address the impact of flood risk across the state. Through meticulous data collection, planning, coordination, and strategic decision-making, the Blueprint offers a roadmap for responsible, systematic, equitable, and transparent flood mitigation and community resilience. This program's success hinges on collaborative efforts, dedicated policy initiatives, and future funding to empower North Carolina to proactively address its most pressing flooding issues. With this Draft Blueprint, the state paves the way for safer, more resilient communities to face the challenges of the future.

6 Acknowledgments

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Byron Reeves | City of Fayetteville
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Peer States

Louisiana

Louisiana Coastal Master Plan | Louisiana Coastal Protection and Restoration Authority
Louisiana Watershed Initiative | Louisiana Council on Watershed Management

South Carolina

Strategic Statewide Resilience and Risk Reduction Plan | South Carolina Office of Resilience

Texas

Texas State Flood Plan | Texas Water Development Board
Texas Coastal Resiliency Master Plan | Texas General Land Office

Virginia

Virginia Coastal Resilience Master Plan | Virginia Department of Conservation and Recreation

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7 Appendices

7.1 Appendix A: Definitions Glossary

Definitions in this section were informed by trusted and vetted sources including accepted federal and state agency definitions.

Actions: in the Blueprint, "actions" denote specific flood resilience measures identified and ranked at the basin scale. NCDEQ, in collaboration with communities, utilizes the Flood Resiliency Blueprint Tool to assess and prioritize these actions based on variety of parameters.

Adaptation: actions that prepare for and adjust to new conditions, thereby reducing harm or taking advantage of new opportunities. Adjustment in natural or human systems in response to actual or expected hazards or their effects, which reduces harm or exploits beneficial opportunities.

Agricultural Flooding: occurs when agricultural lands experience excess water due to heavy rainfall, poor drainage, or other factors. In this case, agricultural lands are not the source of, but rather the asset affected by, flooding.

Blueprint Workflow: the workflow that acts as a general guide for the development of the basin flood resiliency action strategies and application of the Flood Resiliency Blueprint Tool.

Blueprint Team: any staff member working directly with or for NCDEQ to implement the Blueprint Program.

Coastal Flooding: flood hazards along the coast that include wave action, storm surge, and tidal flooding.

Compound Flooding: a phenomenon in which two or more flooding sources occur simultaneously or subsequently within a short period of time. The most common type of compound flooding—a combination of storm surge and riverine flooding in coastal areas—can produce floodwaters that are longer in duration and more widespread than anticipated.

Community: for the purposes of this document, community is not only a unified body of individuals, such as a group with common interest living in a particular area, but also includes local governments (villages, towns, cities, tribal areas, and counties).

Dam and Levee Flooding: occurs when a dam or levee fails to contain floodwater. The failure can result from floodwater overtopping the dam or levee as well as if the dam or levee experiences a structural failure, or breach, resulting in a release of floodwater.

Draft Blueprint: a programmatic and procedural document providing the framework to advance and implement the North Carolina Flood Resiliency Blueprint program.

Equity: the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality.

Exposure: the predisposition of an environmental, physical, social, and/or economic system to be disrupted by a flooding hazard due to its location in the same area of influence.

Flash Flooding: characterized by a rapid rise in water, high velocities, and a large amount of debris. Rainfall intensity and duration, as well as the steepness of watershed and stream gradients, are major factors in flash flooding. The differentiator in this type of flooding is the speed of onset as opposed to origin of flood water.

Flood Hazard: an event or physical condition that can cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.

Flood Impact: measurable damage resulting from a hazardous flooding event on people, socioeconomic systems, environmental, structural, commercial and infrastructure assets.

Flood Resilience: the capacity of individuals, a community, business, or natural environment to reduce, withstand, respond to, and recover from flooding by positively mitigating the impacts of changing conditions and challenges including climate change, increasing rain fall, and sea level rise, and adapting to those conditions.

Flood Resiliency Action Profiles: a set of actions, developed by communities in collaboration with NCDEQ and its partners, informed by analyses of the relevant flood hazards, projected impact, and the defined action or resiliency/mitigation project for that specific hazard risk to the community. The Action Profile will further include benefit, cost estimates, feasibility, and complexity for completing the action. The Action Profiles will also include regional mitigation actions.

Flood Resiliency Blueprint Tool: the "Blueprint Tool" is an online decision-support tool that supports the development and implementation of River Basin Flood Resiliency Action Strategies. It will allow end users (e.g., state agencies, regional entities, communities, and local governments) to assess current and future flood risk and vulnerability based on the best available data and models, identify and prioritize flood resiliency solutions, provide guidance on funding options, and track implementation.

Flood Risk: combination of the likelihood of a flood hazard, the physical exposure of people and assets to that flood hazard, and the vulnerability of people and assets to suffer loss and damage during and after a flooding event.

Flood Vulnerability: the extent to which environmental, physical, social, and economic systems are susceptible to floods due to exposure, in conjunction with its ability (or inability) to reduce, withstand, respond to, and recover from a flood hazard.

Green Infrastructure: the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters.

Grey Infrastructure: traditional stormwater infrastructure in the built environment such as gutters, drains, pipes, and traditional retention basins.

Groundwater Flooding: occurs when the water table in an area rises above the ground surface.

Hydraulics: branch of science concerned with the practical applications of fluids, primarily liquids, in motion.

Hydrology: the science that encompasses the occurrence, distribution, movement, and properties of the waters of the earth and their relationship with the environment within each phase of the hydrologic cycle.

Historically Marginalized: individuals, groups, and communities that have historically and systematically been denied access to services, resources, and power relationships across economic, political, and cultural dimensions as a result of systemic, durable, and persistent racism, discrimination, and other forms of oppression.

Mining Flooding: occurs when water accumulates in mining operations such as open pits, underground mines, and tailings dams. This can occur due to a range of factors, including heavy rainfall, equipment failures, and human error. As with agricultural flooding, mine facilities are the assets affected. Additionally, mines can be the source of flooding in instances where tailings dams experience a breach or overtop or when a mine blowout occurs.

Mitigation: any effort that reduces the overall risk and severity of flood-related loss and damage to life and property.

Mitigation (Compensatory): offsetting unavoidable impacts to wetlands, streams, and other aquatic resources via restoration, establishment, enhancement, and/or preservation.

National Flood Insurance Program (NFIP): the program of flood insurance coverage and floodplain management administered under the National Flood Insurance Act and applicable Federal regulations promulgated in Title 44 of the Code of Federal Regulations, Subchapter B.

Natural Infrastructure Flood Mitigation Program (NIFMP): authorized by the North Carolina General Assembly in 2020, the program within DMS that seeks to incorporate flood storage capacity enhancement and nature-based solution projects into the division's activities.

Nature-Based Solutions (NBS): sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience and provide multi-benefit solutions. These solutions use natural features and processes to combat climate change, reduce flood risk, improve water quality, protect coastal property, restore and protect wetlands, stabilize shorelines, etc.

Non-Structural Mitigation: practices that reduce flood losses by removing people and property out of risk areas. Non-structural mitigation techniques include elevated structures, property buyouts, permanent relocation, zoning, subdivision, building codes, and stormwater detention requirements.

North Carolina Flood Resiliency Blueprint (Blueprint): the North Carolina Flood Resiliency Blueprint is a statewide initiative designed to bring together and build upon all relevant existing resources and knowledge in the state to create one unified effort to increase community resiliency to flooding. The Blueprint includes a statewide flood planning framework and decision-support tool that enables state, tribal, regional, and local entities and their stakeholders to identify, prioritize, and direct resources to implement effective flood resiliency strategies based on the best available science and understanding of likely future conditions. The Blueprint will serve as the backbone of North Carolina's flood planning process through the development and implementation river basin specific flood resiliency strategies. The report herein serves as the programmatic and procedural document providing the framework to advance and implement the North Carolina Flood Resiliency Blueprint initiative.

Overland Ponding: occurs when water accumulates on low-lying areas, resulting in the formation of ponds or standing water. This can happen during heavy rainfall events, when drainage systems are overwhelmed and water cannot be carried away quickly enough, or when there are obstructions or barriers that prevent water from flowing away from an area.

Parish: a territorial division corresponding to a county in other states.

Pluvial Flooding: a pluvial flood occurs when a significant rainfall event creates a flood independent of an overflowing water body such as a river. Pluvial flooding can happen in any location, urban or rural, and even in areas with no nearby bodies of water.

Principal Advisory Group: a committee of subject matter experts comprised of representatives from various sectors that provide advisory input and feedback on the Blueprint regarding the policy, process, engagement, modeling, tools, and support used for the implementation of the decision-support tool.

Repetitive Loss: an NFIP-insured building that has incurred flood-related damages on two occasions during a 10-year period ending on the date of the event for which the insured makes a second claim. The cost of repairing the flood damage, on average, must equal or exceed 25 percent of the market value of the building at the time of each flood. The insurer must verify that the NFIP paid a claim for both qualifying losses and that the state or community is enforcing a cumulative substantial damage or repetitive loss provision in its law or ordinance and declared the building substantially damaged on that basis.

Resilience: capacity of individuals, a community, business, or natural environment to reduce, withstand, respond to, and recover from flooding by positively adapting and mitigating the impacts of changing conditions and challenges, including flooding and climate change.

River Basin: the largest category of surface water drainage (i.e., an area of the landscape that is drained by a river and its tributaries); there are 17 river basins in North Carolina.

River Basin Advisory Group: a committee of subject matter experts and representatives from various sectors that provide advisory input and feedback on development of a River Basin Action Strategies.

River Basin Flood Resiliency Action Strategy: a “River Basin Action Strategy” is a strategic plan specific to an individual river basin developed with the assistance of the Flood Resiliency Blueprint Tool and informed by community and stakeholder input. This strategy outlines specific actions for flood resilience, which are accompanied by potential funding strategies.

Riverine (Fluvial) Flooding: fluvial, or riverine, flooding occurs when excessive rainfall over an extended period causes a river to exceed its channel capacity.

Stakeholders: people who contribute to the planning and decision-making processes of ongoing resilience efforts in communities where they live, work, play, and invest.

State Agency: any of the more than 400 sub-units within the executive branch of the State, including its departments, institutions, boards, commissions, universities, and units of the State.

State Departments: Department of Administration, Department of Agriculture and Consumer Services, Department of Commerce, Department of Natural and Cultural Resources, Department of Environmental Quality, Department of Health and Human Services, Department of Information Technology, Department of Insurance, Department of Justice, Department of Labor, Department of Military and Veteran Affairs, Department of Public Instruction, Department of Public Safety,

Department of Revenue, Department of State Treasurer, Office of the Secretary of the State, Department of Transportation, Wildlife Resources Commission, Office of State Budget and Management, Office of the Governor, Office of the Lieutenant Governor, Office of The State Auditor, Office of the State Controller.

Severe Repetitive Loss: an NFIP-insured building…

- That has incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claim's payments exceeding $20,000; or
- For which at least two separate claims payments (building payments only) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the building.

In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim. In determining Severe Repetitive Loss status, FEMA considers the loss history since 1978, or from the building's construction if it was built after 1978, regardless of any changes in the ownership of the building.

Structural Mitigation: practices that reduce flood losses by reconstructing landscapes. Structural mitigation techniques include floodwalls/seawalls, floodgates, levees, evacuation routes, and stormwater control measures.

Susceptibility: the elements exposed within an environmental, physical, social, and/or economic system that influence the probabilities of being harmed at times of hazardous floods.

Technical Advisory Group (TAG): the Blueprint TAGs is comprised of experts in their respective fields that have specific knowledge and experience in the flood resiliency space. TAGs provide feedback, input, expert opinion, and support to the Blueprint team. Seven TAGs contribute to the development of the Blueprint, each with a specific focus on either government, environmental, social, or Neuse River Basin-specific aspects. TAGS include Governance, Partnership/Funding, Hazard Identification, Vulnerability/Risk/Impact, Resilience/Mitigation/Reduction, Tool Development/Acceptance, and the Neuse Regional Advisory Group.

Underserved: populations sharing a particular characteristic, as well as geographic communities, who have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life.

Under-resourced: populations sharing a particular characteristic, as well as geographic communities, who have insufficient resources (often due to being underserved) to respond to and recover from external stresses.

Urban and Stormwater Flooding: occurs when excess rainfall in an urban area is greater than can be conveyed away from the developed area by the urban drainage system.

Vulnerable: (refers to socially vulnerable) populations sharing a particular characteristic, as well as geographic communities, which are more susceptible to adverse impacts of external stresses due to characteristics that impact their resiliency.

Watershed: an area of land that contains a common set of waterbodies (streams, rivers, lakes, or wetlands) that all drain into a single larger body of water. Watersheds can be defined at multiple geographic scales. In North Carolina, 17 "major" watersheds (basins) are defined by statute.

Workshop: a meeting at which a group of people engage in intensive discussion and activity on a particular subject or project. Workshops are designed to engage participants and foster their active involvement in the process.

7.2 Appendix B: Summary of Research

Research Type	Title	# of Occurrences or Sources	Description	Source Document
Data Collection & Synthesis	Data Tools	8 Tools	Resources meeting three inclusion criteria: statewide geographic scope, credible & vetted, latest version	(Subtask 1.1) *Literature Review*, and (Subtask 1.7) *Recommendations from Existing Plans*
Data Collection & Synthesis	Peer State Flood Resiliency Programs	6 Programs	A review of governance schemes from five peer states with examples of how datasets, models, and platforms are being used for decision making and the levels at which governance decisions are made	(Subtask 1.5) *Peer State Flood Resiliency Programs*
Data Collection & Synthesis	Flood Risk Reduction Project Funding Analysis	22 Online Funding Navigator Tools 69 Funding Vehicles 16 Technical Assistance Mechanisms 3 Creative Strategy Case Studies	An analysis of existing tools and funding vehicles for flood risk project funding	(Subtask 2.6) *Flood Risk Reduction Project Funding Analysis*
Data Collection & Synthesis	Inventory of Existing Flood Resilience Strategies	36 Strategies explored	A flood resiliency toolkit outlining existing strategies for mitigating and preventing flooding	(Subtask 2.7) *Existing Inventory of "Toolkit" Flood Resilience Strategies*
Data Collection & Synthesis	Project Restrictions Analysis	31 Potential Restrictions	Identification of existing federal, tribal, and state restrictions that impact the ability of state and local governments to implement flood resilience strategies. These range from funding requirements to government interdependencies and permitting requirements	(Subtask 2.9) *Project Restrictions Analysis*
Data Collection & Synthesis	Identification of Existing Recommendations	15 Recommendations	Identifies specific recommendations from existing statewide planning efforts that correspond with flood resilience strategies and how they can be effectively connected to the Blueprint	(Subtask 2.10) *Identification of Existing Recommendations*

Research Type	Title	# of Occurrences or Sources	Description	Source Document
Data Collection & Synthesis	Identification and Evaluation of Online Flood Mitigation Decision-Making Support Tools	3 Tools	Identifies and evaluates three existing online flood mitigation decision-support tools. The analysis includes pros, cons, and recommended changes for incorporation into Blueprint	(Subtask 2.11) *Identification and Evaluation of Online Flood Mitigation Decision-Making Support Tools*
Data Collection & Synthesis	Artificial Intelligence and Machine Learning Tools (AI/ML) to Support the Development of Blueprint	8 Methods	Identifies AI/ML tools that can be used or developed to improve the North Carolina Flood Resiliency Blueprint	(Subtask 2.12) *Artificial Intelligence and Machine Learning Tools to Support the Development of the Blueprint*
Data Collection & Synthesis	Identification of Vulnerable, Underserved and Under-resourced Communities in the Neuse River Basin	4 Data Sources and 6 Communities Identified	Identification of vulnerable, underserved, and under-resourced communities in the Neuse River Basin	(Subtask 2.14) *Identification of Vulnerable, Underserved and Under-resourced Communities in the Neuse River Basin*
Gap Analysis	Types and Sources of Flooding Inventory Gap Analysis	128 Types/ Sources Identified	Datasets within North Carolina that could be available for use in projects performed as part of the North Carolina Flood Resiliency Blueprint	(Subtask 2.1) *Types and Sources of Flooding Inventory Gap Analysis*
Gap Analysis	Hydrologic and Hydraulic Modeling Gap Analysis	21 Datasets	Identifies and evaluates riverine H&H modeling within North Carolina that could be available for use in projects performed as part of the North Carolina Flood Resiliency Blueprint	(Subtask 2.4) *Hydrologic and Hydraulic Modeling Gap Analysis*
Gap Analysis	Future Flood Hazards Gap Analysis	10 Datasets	Identifies scientifically defensible data necessary to analyze future flood hazards: future land use, climate, and other relevant data	(Subtask 2.5) *Future Flood Hazards Gap Analysis*
Gap Analysis	Nature Based Solutions Gap Analysis	10 Research & Planning Initiatives 7 Federal Datasets 13 State Datasets 4 State Policies 6 Federal Policies	Assess existing datasets and methods for identifying natural infrastructure and estimating their functions	(Subtask 2.8) *Nature Based Solutions Gap Analysis*
Literature Review	Plans & Strategies	48 Sources	Resources meeting three inclusion criteria: statewide geographic scope, credible and vetted, latest version	(Subtask 1.1) *Literature Review*, (Subtask 1.7) *Recommendations from*

Research Type	Title	# of Occurrences or Sources	Description	Source Document
				Existing Plans, and (Subtask 2.3) *Neuse Expansion*
Literature Review	Technical Reports & Memos	14 Sources	Resources meeting three inclusion criteria: statewide geographic scope, credible & vetted, latest version	(Subtask 1.1) *Literature Review*, (Subtask 1.7) *Recommendations from Existing Plans*, and (Subtask 2.3) *Neuse Expansion*
Literature Review	State Laws & Policies	3 Sources	Resources meeting three inclusion criteria: statewide geographic scope, credible & vetted, latest version	(Subtask 1.1) *Literature Review*
Literature Review	Research Projects & Studies	10 Sources	Resources meeting three inclusion criteria: statewide geographic scope, credible & vetted, latest version	(Subtask 1.1) *Literature Review*, (Subtask 1.7) *Recommendations from Existing Plans*, and (Subtask 2.3) *Neuse Expansion*
Literature Review	Programs	6 Sources	Resources meeting three inclusion criteria: statewide geographic scope, credible & vetted, latest version	(Subtask 1.1) *Literature Review*, (Subtask 1.7) *Recommendations from Existing Plans*, and (Subtask 2.3) *Neuse Expansion*
Stakeholder Outreach & Engagement	Advisory Group	37 Meetings	Meetings with over 150 Technical Advisory Group members, who were identified from individuals who had worked on the planning documents suggested by NCDEQ, state agency staff, federal partners, local floodplain administrators and engineers, non-profit organizations, and university flooding modelers	North Carolina subject matter experts (Subtask 3.8, *Addressing Challenges* and Subtask 1.3, *Stakeholder Engagement Plan*)
Stakeholder Outreach & Engagement	Community Engagement	14 Meetings	Open house-style public meetings and workshops including councils of government, municipal and county leaders, private interest, non-governmental entities, tribal representatives, and representatives of under-resourced and underserved populations, including populations protected by Title VI of the Civil Rights Act	General public (Subtask 3.8, *Addressing Challenges* and Subtask 1.3, *Stakeholder Engagement Plan*)

7.3 Appendix C: Stakeholder Engagement Meetings

This appendix may not include all presentations to conferences, symposia, board meetings, etc. made by Blueprint staff and associates. Meetings that are planned but have not yet occurred are not included but may be found on the Blueprint website when scheduled.

Date	Location	Stakeholder Group(s)
03/15/2023	Goldsboro	Kickoff Meeting Neuse Basin Advisory Group Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting
03/22/2023	Raleigh	Principal Advisory Group Meeting
05/03/2023	Raleigh	Neuse Basin Advisory Group Meeting Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting
06/01/2023	New Bern	New Bern Local Officials Meeting New Bern Community Engagement Meeting Neuse Basin Community Workshop
06/08/2023	Lumberton	Lumberton Local Officials Meeting Lumberton Community Engagement Meeting
06/09/2023	Wilmington	Wilmington Local Officials Meeting Wilmington Community Engagement Meeting
06/22/2023	Clyde	Haywood County Local Officials Meeting
06/22/2023	Canton	Haywood County Community Engagement Meeting
06/30/2023	Raleigh	Neuse Basin Advisory Group Meeting Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting
07/18/2023	Raleigh	Principal Advisory Group Meeting
07/25/2023	Raleigh	Neuse Basin Advisory Group Meeting

Date	Location	Stakeholder Group(s)
		Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting
09/13/2023	Virtual	Neuse Basin Advisory Group Workshop
10/06/2023	Raleigh	Neuse Riverine Modeling with TAG
11/02/2023	Raleigh	Neuse Basin Advisory Group Meeting Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting
11/08/2023	Raleigh	Principal Advisory Group Meeting
12/06/2023	Raleigh	Principal Advisory Group Meeting Neuse Basin Advisory Group Meeting Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting
12/19/2023	Raleigh	Principal Advisory Group Meeting Neuse Basin Advisory Group Meeting Governance TAG Meeting Partnership TAG Meeting Hazard ID TAG Meeting Vulnerability TAG Meeting Resilience TAG Meeting Tools TAG Meeting

7.4 Appendix D: River Basin Flood Resiliency Strategies Procedures Manual – Forthcoming

A detailed procedures document is being developed and will be available in a subsequent version of this Blueprint document.