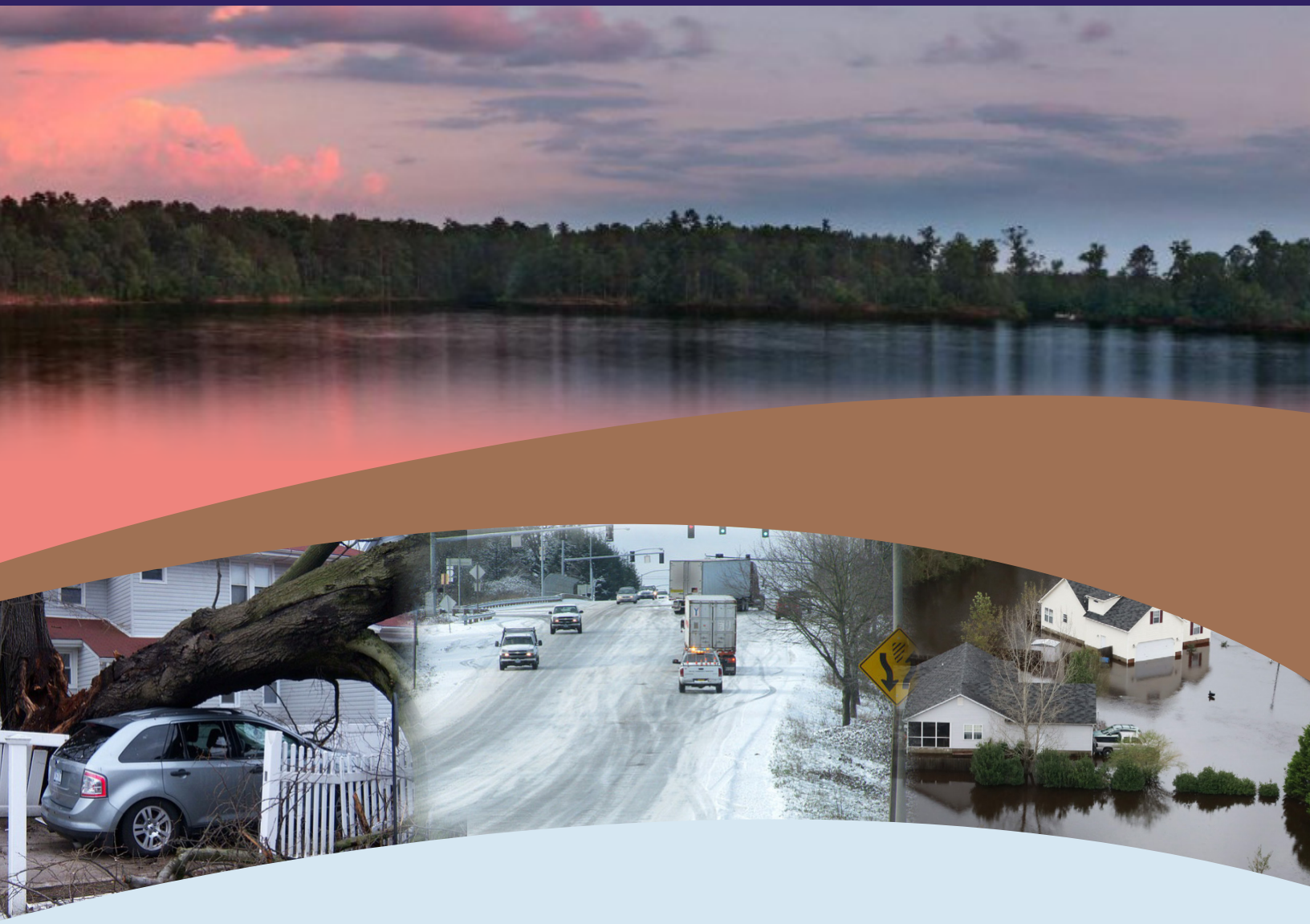
WAKE COUNTY
NORTH CAROLINA

WAKE COUNTY, NORTH CAROLINA

Multi-Jurisdictional Hazard Mitigation Plan

2024



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1 INTRODUCTION

Section 1 provides a general introduction to hazard mitigation and an introduction to the Wake County Multi-Jurisdictional Hazard Mitigation Plan. This section contains the following subsections:

- 1.1 Background
- 1.2 Purpose and Authority
- 1.3 Scope
- 1.4 References
- 1.5 Plan Organization

1.1 BACKGROUND

This document comprises a Hazard Mitigation Plan for Wake County, North Carolina and its incorporated municipalities.

Each year in the United States, natural and human-caused hazards take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters because additional expenses incurred by insurance companies and non-governmental organizations are not reimbursed by tax dollars. Many natural hazards are predictable, and much of the damage caused by hazard events can be reduced or even eliminated.

Hazards are a natural part of the environment that will inevitably continue to occur, but there is much we can do to minimize their impacts on our communities and prevent them from resulting in disasters. Every community faces different hazards, has different resources to draw upon in combating problems, and has different interests that influence the solutions to those problems. Because there are many ways to deal with hazards and many agencies that can help, there is no one solution for managing or mitigating their effects. Planning is one of the best ways to develop a customized program that will mitigate the impacts of hazards while accounting for the unique character of a community.

A well-prepared hazard mitigation plan will ensure that all possible activities are reviewed and implemented so that the problem is addressed by the most appropriate and efficient solutions. It can also ensure that activities are coordinated with each other and with other goals and activities, preventing conflicts and reducing the costs of implementing each individual activity. This plan provides a framework for all interested parties to work together toward mitigation. It establishes the vision and guiding principles for reducing hazard risk and proposes specific mitigation actions to eliminate or reduce identified vulnerabilities.

In an effort to reduce the nation's mounting natural disaster losses, the U.S. Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) to invoke new and revitalized approaches to mitigation planning. Section 322 of DMA 2000 emphasizes the need for state and local government entities to closely coordinate on mitigation planning activities and makes the development of a hazard mitigation plan a specific eligibility requirement for any local government applying for federal mitigation grant funds. These funds include the Hazard Mitigation Grant Program (HMGP), the Building Resilient Infrastructure & Communities (BRIC) program, and the Flood Mitigation Assistance (FMA) Program, all of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security. Communities with an adopted and federally approved hazard mitigation plan thereby

become pre-positioned and more apt to receive available mitigation funds before and after the next disaster strikes.

This plan was prepared in coordination with FEMA Region 4 and the North Carolina Division of Emergency Management (NCEM) to ensure that it meets all applicable federal and state planning requirements. A Local Mitigation Plan Review Tool, found in Appendix A, provides a summary of FEMA's current minimum standards of acceptability and notes the location within this plan where each planning requirement is met.

1.2 PURPOSE AND AUTHORITY

This plan was developed in a joint and cooperative manner by members of a Hazard Mitigation Planning Committee (HMPC) which included representatives of County, City, and Town departments, federal and state agencies, citizens, and other stakeholders. This plan will ensure Wake County and its incorporated municipalities remain eligible for federal disaster assistance including FEMA's HMGP, BRIC, and FMA programs.

This plan has been prepared in compliance with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act or the Act), 42 U.S.C. 5165, enacted under Section 104 of the Disaster Mitigation Act of 2000, (DMA 2000) Public Law 106-390 of October 30, 2000, as implemented at CFR 201.6 and 201.7 dated October 2007.

This plan will be adopted by each participating jurisdiction in accordance with standard local procedures. Copies of adoption resolutions are provided in Section 9 Plan Adoption.

1.3 SCOPE

This document comprises a Multi-Jurisdictional Hazard Mitigation Plan for Wake County. The planning areas includes all of Wake County's incorporated municipalities and unincorporated areas. All participating jurisdictions are listed in Table 1.1.

Table 1.1 – Participating Jurisdictions in the Wake County Multi-Jurisdictional Hazard Mitigation Plan

Wake County	
Apex	Morrisville
Cary	Raleigh
Fuquay-Varina	Rolesville
Garner	Wake Forest
Holly Springs	Wendell
Knightdale	Zebulon

Wake County followed the planning process prescribed by FEMA, and this plan was developed under the guidance of a planning committee comprised of representatives of County, City, and Town departments; citizens; and other stakeholders. The HMPC conducted a risk assessment that identified and profiled hazards that pose a risk to the planning area, assessed the planning area's vulnerability to these hazards, and examined each participating jurisdiction's capabilities in place to mitigate them. The plan evaluates and prioritizes hazards for the planning area using a Priority Risk Index, as determined through the risk and vulnerability assessments. Hazards are categorized as "low," "moderate," or "high" priority, however, mitigation strategies are identified for all profiled hazards. The hazards profiled in this plan include:

- Dam Failure
- Drought
- Earthquake
- Extreme Heat
- Flood
- Hurricane and Tropical Storm
- Infectious Disease
- Landslide
- Severe Weather (Thunderstorm Winds, Hail, and Lightning)
- Severe Winter Storm
- Tornado
- Wildfire
- Cyber Threat
- Hazardous Materials Incident
- Radiological Incident
- Terrorism

1.4 REFERENCES

The following FEMA guides and reference documents were used to prepare this document:

- FEMA 386-1: Getting Started. September 2002.
- FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001.
- FEMA 386-3: Developing the Mitigation Plan. April 2003.
- FEMA 386-4: Bringing the Plan to Life. August 2003.
- FEMA 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007.
- FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005.
- FEMA 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003.
- FEMA 386-8: Multijurisdictional Mitigation Planning. August 2006.
- FEMA 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008.
- FEMA. Local Mitigation Planning Handbook. March 2013.
- FEMA. Local Mitigation Plan Review Guide. October 1, 2011.
- FEMA National Fire Incident Reporting System 5.0: Complete Reference Guide. January, 2008.
- FEMA Hazard Mitigation Assistance Unified Guidance. June 1, 2010.
- FEMA. Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials. March 1, 2013.
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.

Additional sources used in the development of this plan, including data compiled for the Hazard Identification and Risk Assessment, are listed in Appendix D.

1.5 PLAN ORGANIZATION

The Wake County Multi-Jurisdictional Hazard Mitigation Plan is organized into the following sections:

- Section 2: Planning Process
- Section 3: Planning Area Profile
- Section 4: Hazard Identification & Risk Assessment
- Section 5: Capability Assessment
- Section 6: Mitigation Strategy
- Section 7: Mitigation Action Plans
- Section 8: Plan Implementation and Maintenance
- Section 9: Plan Adoption
- Appendix A: Local Plan Review Tool
- Appendix B: Planning Process Documentation
- Appendix C: Mitigation Alternatives
- Appendix D: References

2 PLANNING PROCESS

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan. To develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and
3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): The plan shall include the following:

1) Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

This section provides a review of the planning process followed for the development of the Wake County Multi-Jurisdictional Hazard Mitigation Plan. It consists of the following sub-sections:

- 2.1 Purpose and Vision
- 2.2 What's Changed in the Plan
- 2.3 Preparing the Plan
- 2.4 Hazard Mitigation Planning Committee
- 2.5 Meetings and Workshops
- 2.6 Involving the Public
- 2.7 Outreach Efforts
- 2.8 Involving the Stakeholders
- 2.9 Documentation of Plan Progress

2.1 PURPOSE AND VISION

As defined by FEMA, "hazard mitigation" means any sustained action taken to reduce or eliminate the long-term risk to life and property from a hazard event. Hazard mitigation planning is the process through which hazards are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies determined, prioritized, and implemented.

The purpose of the Wake County Multi-Jurisdictional Hazard Mitigation Plan is to identify, assess, and mitigate hazard risk to better protect the people and property within Wake County from the effects of natural and human-caused hazards. This plan documents progress on existing hazard mitigation planning efforts, updates the previous plan to reflect current conditions in the County including relevant hazards and vulnerabilities, increases public education and awareness about the plan and planning process, maintains grant eligibility for participating jurisdictions, maintains compliance with state and federal requirements for local hazard mitigation plans, and identifies and outlines strategies the County and participating jurisdictions will use to decrease vulnerability and increase resiliency.

During the previous plan update cycle in 2019, the Wake County Hazard Mitigation Planning Committee (HMPC) met in working groups to discuss their vision for Wake County in terms of hazard mitigation planning. The committee was asked to consider what the successful implementation of the plan would achieve, what outcomes the plan would generate, and what Wake County could look like in the following five years to brainstorm a vision statement for the plan. The previous HMPC developed and discussed a list of ideas that were consolidated into the following statement and set of key principles that they agreed

should define and guide the planning process and the County's approach to hazard mitigation. These statements and principles are carried forward in the current update.

Wake County will build upon the success of its past efforts to become more resilient and adaptable to hazards, embrace the need to manage growth with sustainable practices, and make intentional, coordinated decisions that maximize long-term and shared benefits for all.

The following key principles underpin this vision and describe how the HMPC of the current plan update cycle hopes to characterize the future of Wake County. In many cases, the County and its incorporated jurisdictions already operate with these same principles in mind.

Resilient & Adaptable: Wake County will be able to quickly react to and recover from hazard events and will use both the development and post-disaster redevelopment processes to reduce existing vulnerabilities and future potential risk, including through identification and planning for vulnerable populations.

Sustainable: From an environmental mindset, Wake County will protect key ecological resources, and from a resource and efficiency perspective, the county will use administrative and financial resources in ways that maximize and share benefits.

Intentional: Wake County will address growth and development decisions by considering long-term outcomes, seeking opportunities for mitigation, minimizing risk and vulnerability, and implementing mitigation projects that can be scaled up or shared with other jurisdictions, if successful.

Coordinated: Wake County will integrate planning efforts across departments and across incorporated jurisdictions to ensure that goals and decisions reinforce each other. Additionally, jurisdictions will work together to address issues on larger scales, such as a watershed or ecosystem level.

2.2 WHAT'S CHANGED IN THE PLAN

This plan is an update to the 2019 Wake County Multi-Jurisdictional Hazard Mitigation Plan, which included participation from all jurisdictions involved in this plan update. The previous plan was approved by FEMA on December 3, 2019.

This hazard mitigation plan update involved a comprehensive review and update of each section of the existing plan and an assessment of the success of the County and participating municipalities in evaluating, monitoring, and implementing the mitigation strategy outlined in their existing plans. Only the information and data still valid from the existing plans was carried forward as applicable into this update. The following requirements were addressed during the development of this regional plan:

- Consider changes in vulnerability due to action implementation
- Consider social vulnerability of participating municipalities
- Document success stories where mitigation efforts have proven effective
- Document areas where mitigation actions were not effective
- Document any new hazards that may arise or were previously overlooked
- Incorporate new data or studies on hazards and risks
- Incorporate changing future conditions related to hazards and risks
- Incorporate new capabilities or changes in capabilities
- Incorporate growth and development-related changes to inventories
- Incorporate new action recommendations or changes in action prioritization

Section 4.2 provides a comparison of the hazards addressed in the 2023 State of North Carolina Hazard Mitigation Plan and the existing Wake County plan and provides the final decision made by the HMPC as to which hazards should be included in the updated 2024 Wake County Multi-Jurisdictional Plan.

In addition to the specific changes in hazard analyses identified in Section 4.2, the following items were also addressed in this plan update:

- GIS was used, to the extent data allowed, to analyze the priority hazards as part of the vulnerability assessment
- Assets at risk for identified hazards were identified by property type and values of properties based on the North Carolina Emergency Management (NCEM) IRISK Database
- A discussion on climate change and its projected effect on specific hazards was included in each hazard profile in the risk assessment
- The discussion on social vulnerability in addition to growth and development trends was enhanced utilizing 2022 American Community Survey (ACS) and Centers for Disease Control (CDC) data
- Enhanced public outreach and agency coordination efforts were conducted throughout the plan update process to meet the more rigorous requirements of the 2017 CRS Coordinator's Manual, in addition to Disaster Mitigation Act of 2000 (DMA) requirements

2.3 PREPARING THE PLAN

The planning process for preparing the Wake County Multi-jurisdictional Hazard Mitigation Plan was based on DMA planning requirements and FEMA's associated guidance. This guidance is structured around a four-phase process:

1) Planning Process
2) Risk Assessment
3) Mitigation Strategy
4) Plan Maintenance

In the context of this process, the planning consultant team integrated a more detailed 10-step planning process used for FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. Thus, the modified 10-step process used for this plan update meets the requirements of six major programs: (1) FEMA's Hazard Mitigation Grant Program, (2) Pre-Disaster Mitigation Program, (3) Community Rating System, (4) Flood Mitigation Assistance Program, (5) Severe Repetitive Loss Program, and (6) new flood control projects authorized by the U.S. Army Corps of Engineers.

Table 2.1 shows how the 10-step CRS planning process aligns with the four phases of hazard mitigation planning pursuant to the Disaster Mitigation Act of 2000.

Table 2.1 – Mitigation Planning and CRS 10-Step Process Reference Table

DMA Process	CRS Process
Phase I – Planning Process	
§201.6(c)(1)	Step 1. Organize to Prepare the Plan
§201.6(b)(1)	Step 2. Involve the Public
§201.6(b)(2) & (3)	Step 3. Coordinate
Phase II – Risk Assessment	
§201.6(c)(2)(i)	Step 4. Assess the Hazard
§201.6(c)(2)(ii) & (iii)	Step 5. Assess the Problem

DMA Process	CRS Process
Phase III – Mitigation Strategy	
§201.6(c)(3)(i)	Step 6. Set Goals
§201.6(c)(3)(ii)	Step 7. Review Possible Activities
§201.6(c)(3)(iii)	Step 8. Draft an Action Plan
Phase IV – Plan Maintenance	
§201.6(c)(5)	Step 9. Adopt the Plan
§201.6(c)(4)	Step 10. Implement, Evaluate and Revise the Plan

In addition to meeting DMA and CRS requirements, this plan also meets the recommended steps for developing a Community Wildfire Protection Plan (CWPP). Table 2.2 below outlines the recommended CWPP process and the CRS step and sections of this plan that meet each step.

Table 2.2 – Community Wildfire Protection Plan Process Reference

CWPP Process	CRS Step	Fulfilling Plan Section
Convene decision makers	Step 1	Section 2 – HMPC
Involve Federal agencies	Step 3	Section 2 – Involving Stakeholders
Engage interested parties (such as community representatives)	Step 1, 2, and 3	Section 2 – HMPC, Involving the Public, Involving Stakeholders
Establish a community base map		Section 4 – Wildfire
Develop a community risk assessment, including fuel hazards, risk of wildfire occurrence, homes, business and essential infrastructure at risk, other community values at risk, local preparedness, and firefighting capability	Step 4 and 5	Section 4 – Wildfire Section 5 – Capability
Establish community hazard reduction priorities and recommendations to reduce structural ignitability	Step 6, 7, and 8	Section 6 – Mitigation Strategy Section 7 – Mitigation Action Plans
Develop an action plan and assessment strategy	Step 8 and 10	Section 7 – Mitigation Action Plans Section 8 – Plan Maintenance
Finalize the CWPP	Step 9	Section 9 – Plan Adoption

The process followed for the preparation of this plan, as outlined in Table 2.1 above, is as follows:

2.3.1 PHASE I – PLANNING PROCESS

Planning Step 1: Organize to Prepare the Plan

With the County's commitment to participate in the DMA planning process, community officials worked to establish the framework and organization for development of the plan. An initial meeting was held with key community representatives to discuss the organizational aspects of the plan development process. Wake County Emergency Management led the County's effort to reorganize and coordinate for the plan update. Consultants from WSP and ESP Associates assisted by leading the County through the planning process and preparing the plan document.

Planning Step 2: Involve the Public

Public involvement in the development of the plan was sought using various methods, as detailed in Section 2.6.

Planning Step 3: Coordinate

The HMPC formed for development of the 2019 Plan was reconvened to the extent possible for this plan update. More details on the HMPC are provided in Section 2.4. Stakeholder coordination was incorporated into the formation of the HMPC and was sought through additional outreach methods. These efforts are detailed in Section 2.8.

Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

In addition to stakeholder involvement, coordination with other community planning efforts was also seen as paramount to the success of this plan. Mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. Wake County and its participating jurisdictions use a variety of planning mechanisms, such as Comprehensive Plans, subdivision regulations, building codes, and ordinances to guide growth and development. Integrating existing planning efforts, mitigation policies, and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. As detailed in Table 2.3, the development of this plan incorporated information from existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions.

These and other documents were reviewed and considered, as appropriate, during the collection of data to support the planning process and plan development, including the hazard identification, vulnerability assessment, and capability assessment. Data from these sources was incorporated into the risk assessment and hazard vulnerability sections of the plan as appropriate. The data was also used in determining the capability of each jurisdiction to implement certain mitigation strategies. The Capability Assessment can be found in Section 5.

Table 2.3 – Summary of Existing Studies and Plans Reviewed

Resource Referenced	Use in this Plan
Local Comprehensive Plans (Wake County Comprehensive Plan, City of Raleigh 2030 Comprehensive Plan, etc.)	The PLANWake Comprehensive Plan, City of Raleigh Comprehensive Plan, and other key planning resources were referenced in the Planning Area Profile in Section 3. Local comprehensive plans were also incorporated into Section 3, Mitigation Action Plans where applicable in Section 7, and referenced in the Capability Assessment in Section 6.
Local Ordinances (Flood Damage Prevention Ordinances, Subdivision Ordinances, Zoning Ordinances, etc.)	Local ordinances were referenced in the Capability Assessment in Section 6 and where applicable for updates or enforcement in Mitigation Action Plans in Section 7.
Triangle Regional Resilience Partnership Resilience Assessment	The Technical Report was used in the preparation of the HIRA and referenced in hazard profiles in Section 4.
Wake County and Incorporated Areas Flood Insurance Study (FIS), Revised 7/19/2022	The FIS was referenced in the preparation of flood hazard profile in Section 4.
Wake County Multi-Jurisdictional Hazard Mitigation Plan, 2019	The previous plan was referenced in the Community Profile in Section 3, Hazard Identification and Risk Assessment in Section 4, and for reporting on implementation status and developing the Mitigation Action Plans in Section 2 and Section 7, respectively.

2.3.2 PHASE II – RISK ASSESSMENT

Planning Steps 4 and 5: Identify/Assess the Hazard and Assess the Problem

The HMPC completed a comprehensive effort to identify, document, and profile all hazards that have, or could have, an impact on the planning area. Geographic information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities.

The HMPC also conducted a capability assessment to review and document the planning area's current capabilities to mitigate risk from and vulnerability to hazards. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the HMPC could assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. A more detailed description of the risk assessment process and the results are included in Section 4 Risk Assessment.

2.3.3 PHASE III – MITIGATION STRATEGY

Planning Steps 6 and 7: Set Goals and Review Possible Activities

ESP Associates facilitated brainstorming and discussion sessions with the HMPC that described the purpose and process of developing a vision for the planning process and setting planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in Section 6 Mitigation.

Planning Step 8: Draft an Action Plan

A complete first draft of the plan was prepared based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7. This draft was shared for HMPC, stakeholder, and public review and comment via the plan website. HMPC, public, and stakeholder comments were integrated into the final draft for the North Carolina Division of Emergency Management (NCEM) and FEMA Region IV to review and approve, contingent upon final adoption by the County and its participating jurisdictions.

2.3.4 PHASE IV – PLAN MAINTENANCE

Planning Step 9: Adopt the Plan

To secure buy-in and officially implement the plan, the plan will be reviewed and adopted by all participating jurisdictions. Resolutions will be provided in Section 9.

Planning Step 10: Implement, Evaluate and Revise the Plan

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. Up to this point in the planning process, the HMPC's efforts have been directed at researching data, coordinating input from participating entities, and developing appropriate mitigation actions. Section 8 Plan Maintenance provides an overview of the overall strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. The Section also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

2.4 HAZARD MITIGATION PLANNING COMMITTEE

As with the previous plan, this Hazard Mitigation Plan was developed under the guidance of a Hazard Mitigation Planning Committee (HMPC). The Committee's representatives included representatives of Town departments, federal and state agencies, citizens, and other stakeholders.

To reconvene the planning committee, a letter was sent via email to all County, City, and Town Hazard Mitigation Planning Committee (HMPC) contacts from the previous planning effort. Each community was asked to designate a primary and secondary contact for the HMPC. Communities were also asked to identify local stakeholder representatives to participate in the HMPC processes alongside the County, City, and Town officials to improve the integration of stakeholder input into the plan. Table 2.4 details the HMPC members and the agencies and jurisdictions they represented.

The formal HMPC meetings followed the 10 CRS Planning Steps. Agendas, minutes, and sign-in sheets for the HMPC meetings are included in Appendix B. The meeting dates and topics discussed are summarized in Section 2.5 Meetings and Workshops. All HMPC meetings were open to the public.

The DMA planning regulations and guidance stress that to satisfy multi-jurisdictional participation requirements, each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC
- Detail where within the planning area the risk differs from that facing the entire area
- Identify potential mitigation actions
- Formally adopt the plan

For the Wake County HMPC, "participation" meant the following:

— Providing facilities for meetings
— Attending and participating in the HMPC meetings
— Collecting and providing requested data (as available)
— Completing the Local Capability Self-Assessment
— Providing an update on previously adopted mitigation actions
— Managing administrative details
— Making decisions on plan process and content
— Identifying mitigation actions for the plan
— Reviewing and providing comments on plan drafts
— Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan
— Coordinating and participating in the public input process
— Coordinating the formal adoption of the plan by local governing bodies

Detailed summaries of HMPC meetings are provided under Meetings and Workshops, including meeting dates, locations, and topics discussed. During the planning process, the HMPC members communicated through face-to-face meetings, email, and telephone conversations. This continued communication ensured that coordination was ongoing throughout the entire planning process even though not all HMPC members could be present at every meeting.

Table 2.4 – HMPC Members

Jurisdiction	Agency	Representative	Position/Title or *Stakeholder	HMPC Meeting Attendance			
				Mtg.1	Mtg.2	Mtg.3	Mtg.4
Raleigh	Fire Dept.	Satwana Hurdle	Assistant Director of Emergency Management	✓			
Raleigh	City Manager's Office	Megan Anderson	Sustainability Manager				
Raleigh	Stormwater Dept.	Wayne Miles	Stormwater Program Manager	✓			
Raleigh	Stormwater Dept.	Ben Brown	Stormwater Manager	✓	✓	✓	✓
Raleigh	Stormwater Dept.	Allison Bryan	Senior Floodplain Engineer	✓	✓	✓	✓
Raleigh	Stormwater Dept.	Seamus Riley	Floodplain Management Supervisor			✓	✓
Raleigh	Emergency Management	Jessica Leins	Emergency Management Analyst		✓	✓	✓
Raleigh	N/A	Kellie Bradley	Citizen Stakeholder*				
Apex	Planning Dept.	Shelly Mayo	Planner II	✓	✓	✓	
Apex	Planning Dept.	Dianne Khin	Planning Director	✓		✓	✓
Apex	Current Planning	Amanda Bunce	Current Planning Manager		✓		
Apex	N/A	Suzanne Mason	Citizen Stakeholder*		✓		
Cary	Fire Dept.	Matt Jacoby	Assistant Fire Chief	✓	✓	✓	✓
Cary	Town Manager's Office	Eric Kulz	Environmental Specialist	✓	✓	✓	✓
Cary	N/A	Tom Hegele	Citizen Stakeholder*				
Fuquay-Varina	Planning Dept.	Allyssa Holman	Senior Planner	✓	✓	✓	
Fuquay-Varina	Planning Dept.	Pam Davison	Planning Director	✓	✓	✓	✓
Fuquay-Varina	N/A	Ed Ridpath	Citizen Stakeholder*	✓	✓		✓
Garner	Planning Dept.	Jeff Triezenberg	Planning Director	✓			
Garner	Planning Dept.	Reginald Buie	Zoning Administrator	✓	✓		✓
Garner	Planning Dept.	Erin Joseph	Assistant Planning Director		✓		✓
Garner	N/A	Michael Voiland	Citizen Stakeholder*	✓			
Holly Springs	Office of Budget, Innovation, & Strategy	MaryBeth Spoehr	Budget & Strategy Analyst	✓	✓	✓	✓
Holly Springs	Utilities & Infrastructure Dept.	Daniel Colavito	Environmental Control Supervisor	✓	✓		
Holly Springs	Police Dept.	Jennifer Mathis	Emergency Management Specialist				✓
Holly Springs	N/A	Jeff Parker	Citizen Stakeholder*		✓	✓	
Knightdale	Development Services Dept.	Jason Brown	Development Services Director		✓	✓	✓
Knightdale	Development Services Dept.	Donna Goodman	Senior Planner	✓	✓	✓	✓
Knightdale	Fire Dept.	Loren Cone	Fire Chief	✓	✓	✓	✓
Knightdale	N/A	Ben McDonald	Citizen Stakeholder*	✓	✓	✓	✓
Morrisville	Fire/Rescue Dept.	Nathan Lozinsky	Fire Chief		✓		

Jurisdiction	Agency	Representative	Position/Title or *Stakeholder	HMPC Meeting Attendance			
				Mtg.1	Mtg.2	Mtg.3	Mtg.4
Morrisville	Engineering Dept.	Ben Mills	Stormwater Engineering Manager	✓	✓	✓	
Morrisville	Public Works Dept.	Steven Spruill	Assistant Public Works Director	✓			
Rolesville	Planning Dept.	Meredith Gruber	Planning Director			✓	✓
Rolesville	Town Management Dept.	Eric Marsh	Assistant Town Manager		✓	✓	
Rolesville	N/A	Robin Peyton	Citizen Stakeholder*				
Wake Forest	Planning Dept.	Antione Jordan	Planner I		✓		
Wake Forest	Planning Dept.	Brad West	Long Range Planning Manager	✓			
Wake Forest	N/A	Grif Bond	Citizen Stakeholder*	✓	✓	✓	
Wendell	Planning Dept.	Bryan Coates	Planning Director				✓
Wendell	Planning Dept.	Stacy Griffin	Assistant Planning Director		✓	✓	✓
Wendell	N/A	Jon Olson	Citizen Stakeholder*	✓			✓
Zebulon	Planning Dept.	Michael Clark	Planning Director	✓	✓	✓	✓
Zebulon	Administration Dept	Joe Moore	Town Manager			✓	✓
Zebulon	Planning Dept	Adam Culpepper	Senior Planner	✓	✓		
Wake County	Planning, Development & Inspections Dept.	Terry Nolan	Planner III				
Wake County	Planning, Development & Inspections Dept.	Sharon Peterson	Long Range Planning Administrator			✓	✓
Wake County	Wake County Emergency Management	Sasha Godwin	Emergency Management Specialist	✓	✓	✓	✓
Wake County	Wake County Emergency Management	Joshua Creighton	Deputy Director	✓	✓	✓	
Wake County	Soil and Water Conservation District	Winifred Dorer	Conservation Specialist	✓	✓	✓	
Wake County	Soil and Water Conservation District	Emily Bateman	Natural Resource Conservationist	✓			
Wake County	Soil and Water Conservation District	Teresa Furr	District Director	✓			
Wake County	Soil and Water Conservation District	Mikayla Renn	Natural Resource Conservationist		✓	✓	✓
Wake County	RDU International Airport	Delia Chi	Vice President, Planning & Sustainability*		✓		
Wake County	RDU International Airport	Jordan Brummal	Planning and Environmental Officer*		✓		✓
Wake County	Wake County Farm Service Agency (USDA)	Larry Adams	County Executive Director*			✓	
Wake County	North Carolina Emergency Management	Chris Crew	Mitigation Plans Manager - Stakeholder*	✓		✓	
Wake County	North Carolina Emergency Management	Carl Baker	Hazard Mitigation Planner - Stakeholder*			✓	
Wake County	North Carolina Emergency Management	John Mello	Hazard Mitigation Planner - Stakeholder*				
Wake County	North Carolina Emergency Management	Dennis Hancock	Central Branch Manager - Stakeholder*		✓		
Wake County	North Carolina Emergency Management	Mark Schell	Area 7 Coordinator - Stakeholder*				✓

*Asterisk indicates that the representative is a citizen or outside stakeholder not affiliated with the local government.

2.5 MEETINGS AND WORKSHOPS

The preparation of this plan update required a series of meetings for facilitating discussion, gaining consensus, and initiating data collection efforts with local government staff, community officials, and other identified stakeholders. More importantly, the meetings and workshops prompted continuous input and feedback from relevant participants throughout the drafting stages of the Plan.

Table 2.5 summarizes the key meetings and workshops held by the HMPC during the development of the plan. In many cases, routine discussions and additional meetings were held by local staff to accomplish planning tasks specific to their department or agency. For example, seeking approval of specific mitigation actions for their department or agency to undertake and include in their Mitigation Action Plan. These meetings were informal and are not documented here.

Public meetings are summarized in subsection 2.6.

Table 2.5 – Summary of HMPC Meetings

Meeting Title	Meeting Topic	Meeting Date	Meeting Location
HMPC Mtg. #1 – Project Kick-Off	1) Introduction to DMA requirements and the planning process 2) Review of HMPC responsibilities and the project schedule.	January 11, 2024	Wake County Office Building 337 S Salisbury St, Raleigh, NC
HMPC Mtg. #2 – HIRA Review	1) Review Draft Hazard Identification & Risk Assessment (HIRA) 2) Review asset inventory and discuss critical facilities	April 24, 2024	Wake County Office Building 337 S Salisbury St, Raleigh, NC
HMPC Mtg. #3 – Mitigation Strategy	1) Review Capability Assessment and Mitigation Strategies 2) Solicit comments and feedback	May 30, 2024	Wake County Office Building 337 S Salisbury St, Raleigh, NC
HMPC Mtg. #4 – Draft Plan Review	1) Review draft Hazard Mitigation Plan	July 31, 2024	Virtual

2.6 INVOLVING THE PUBLIC

An important component of any mitigation planning process is public participation. Individual citizen and community-based input provides the entire planning team with a greater understanding of local concerns and increases the likelihood of successfully implementing mitigation actions by developing community "buy-in" from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of any community's overall mitigation strategy aimed at making a home, neighborhood, school, business, or entire planning area safer from the potential effects of hazards.

Public involvement in the development of the plan was sought using various methods including open public meetings, providing online notices, a public participation survey hosted online and in-person, and by making the draft plan available online for public review. Additionally, all HMPC meetings were made open to the public.

The public meetings were advertised on the plan webpage and on local community websites and social media accounts where possible. Copies of meeting announcements are provided in Appendix B. Details about the public meetings are summarized in Table 2.6.

Table 2.6 – Summary of Public Meetings

Meeting Title	Meeting Topic	Meeting Date	Meeting Location
Public Kickoff Meeting	1) Introduction to DMA, CRS, and FMA requirements and the planning process 2) Review of identified hazards and mitigation project possibilities. 3) Promotion of the public survey and ways to get involved in the planning process.	February 28, 2024	Lions Park 516 Dennis Ave, Raleigh, NC
Public Draft Review Meeting	1) Review draft Hazard Mitigation Plan	August 21, 2024	Virtual

2.7 OUTREACH EFFORTS

To encourage public and stakeholder participation in the plan update, the HMPC employed a variety of public outreach methods including established public information mechanisms and resources within the community. Public involvement activities for this plan update included press releases, creation of a webpage for the plan, a public survey, and the collection of public and stakeholder comments on the draft plan. Table 2.7 details public outreach efforts employed during the preparation of this plan.

Table 2.7 – Public Outreach Efforts

Media	Duration	Event/Message
Wake County/Plan webpage	Ongoing throughout plan update	Press releases, meeting announcements, survey link, contact information provided to request additional information and/or provide comments
Local community websites	Ongoing throughout plan update	Link to the plan survey and the plan webpage
Local community social media accounts	Ongoing throughout plan update	Link to the plan survey and the plan webpage
Public survey	Ongoing throughout plan update	Survey hosted online and made available via shareable link
Meeting outreach flyer	February 2024	Flyer to promote the first public meeting and describe opportunities for involvement in the planning process
Draft plan for public review	July 2024	Draft plan posted online for public and stakeholder review and feedback

In addition to general public outreach and engagement efforts, a specific effort was made to provide an opportunity for underserved communities and vulnerable populations to be involved in the planning process. To improve accessibility to the public meetings, the meeting was hosted at the Lions Park Community Center in Raleigh, which is one of the largest metro parks in the city and is located close to areas prone to flooding from Crabtree Creek and Bridges Branch. Members of the public were also able to join the meeting virtually via Zoom, which reduced time commitment and travel barriers to access.

Additionally, stakeholders who could represent the interests and viewpoints of underserved communities and vulnerable populations were invited to HMPC meetings and contacted for input and feedback on the draft plan. Stakeholders invited to participate in the planning process included the following:

- Wake Social & Economic Vitality
- Wake Health & Human Services Department
- Wake County Public School System
- North Carolina Office of Recovery and Resiliency
- American Red Cross Triangle Area Chapter
- Urban League of Central Carolinas
- Habitat for Humanity of Wake County

2.7.1 PUBLIC SURVEY RESULTS

The public outreach survey was made available on February 28, 2024, and remained open for response until July 10, 2024. The public survey requested public input into the Hazard Mitigation Plan planning process and the identification of mitigation activities to lessen the risk and impact of future hazard events. The survey is shown in Appendix B. The survey was available in hard copy at the first public meeting and online on the plan website. In total, 110 survey responses were received.

The following is a list of high-level summary results and analysis derived from survey responses:

- 50% of respondents indicated they have been impacted by a hazard or disaster in Wake County.
- Respondents are moderately concerned about the possibility of their community being impacted by a hazard event with an average score of 3.27 based on a 1-5 scale (1 being the lowest, 5 being the highest).
- Severe weather (thunderstorms, lightning, and hail) was rated the highest risk hazard, followed by extreme heat, hurricanes, and flooding. Earthquakes were rated the lowest risk hazard with “no risk” according to respondents, followed by landslides and wildfires.
- 45% of respondents who reported having taken steps to mitigate risk at home including elevation and waterproofing assets.
- A large majority of respondents (75%) indicated they do not know what government office to contact to learn more about hazard risk and approaches to reduce vulnerability.
- Respondents largely favored preventative measures and emergency services for mitigation.

Detailed survey results are provided in Appendix B.

2.8 INVOLVING THE STAKEHOLDERS

In addition to staff representatives of each participating jurisdiction, the HMPC included a variety of stakeholders, including citizen representatives from 11 of the participating communities as well as representatives from RDU International Airport, Wake County Farm Service Agency, and North Carolina Emergency Management. Input from additional stakeholders, including neighboring communities and representatives of underserved communities and vulnerable populations, was solicited through invitations to the open public meetings, HMPC meetings, and distribution of the public survey. If any additional stakeholders representing other agencies and organizations participated in the public survey, that information would be unknown due to the anonymous nature of the survey.

2.9 DOCUMENTATION OF PLAN PROGRESS

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table 2.8 below details the status of mitigation actions from the previous plan. More detail on actions being carried forward is provided in Section 7: Mitigation Action Plans.

Table 2.8 – Status of Previous Mitigation Actions

Jurisdiction	Completed	Deleted	Carried Forward
Wake County	3	1	8
City of Raleigh	7	3	11
Town of Apex	26	0	19
Town of Cary	9	0	15
Town of Fuquay-Varina	7	0	37
Town of Garner	5	0	9
Town of Holly Springs	3	1	27
Town of Knightdale	1	0	9
Town of Morrisville	15	2	10
Town of Rolesville	0	0	5
Town of Wake Forest	4	2	10
Town of Wendell	8	0	13
Town of Zebulon	6	0	3
Total	**94**	**9**	**176**

Table 2.9 on the following pages details all completed and deleted actions from the 2019 plan.

Community capability continues to improve with the implementation of new plans, policies, and programs that help to promote hazard mitigation at the local level. The current state of local capabilities for the participating jurisdictions is captured in Section 5: Capability Assessment. The participating jurisdictions continue to demonstrate their commitment to hazard mitigation and have proven this by reconvening the HMPC to update this multi-jurisdictional plan and by continuing to involve the public in the hazard mitigation planning process.

Moving forward, information in this plan will be used to help guide and coordinate mitigation activities and decisions for local plans and policies in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. This plan identifies activities that can be undertaken by both the public and the private sectors to reduce safety hazards, health hazards, and property damage.

Table 2.9 – Completed and Deleted Actions from the 2019 Wake County Hazard Mitigation Plan

2019 Action #	Description	2024 Status	Status Comments/Explanation
Wake County			
P-2	Oversee completion of planned reclaimed water projects per the County's approved Community Improvement Program (CIP).	Completed	n/a
PP-1	Identify road network segments no longer maintained by NCDOT and provide funding and planning resources for mitigation and recovery efforts to communities to ensure infrastructure and transportation resiliency. Assist in reinstating water and sewer services post disaster.	Delete	Replaced with alternate project.
SP-2	Construction of a new Emergency Operations Center adequate for the size and complexity of the jurisdiction	Completed	n/a
PEA-1	Emergency Planning and Community Right-to-Know Act (EPCRA) High Hazard Chemicals Awareness. Identify chem facilities, potential impact zones, and potentially affected communities. Inform public and provide resources and education.	Completed	n/a
Raleigh			
P-1	Establish a Lake Preservation Policy that encourages private property owners to preserve existing lakes and ponds, and in certain circumstances provides for public assistance.	Completed	n/a
P-3	Planning Commission to consider program to develop future conditions floodplain mapping for all FEMA mapped areas (this is already done for non-FEMA mapped areas). The program would consist of a multi-year capital program for mapping for all FEMA streams in the ETJ and consideration of changes to development regulations in these areas. Future conditions would be based on expected development per the Comprehensive Plan and zoning maps.	Completed	n/a
P-4	Reallocation of Falls Lake water conservation pool; increased available storage for water supply by 4.1B gallons	Completed	Completed as of 2020
P-5	Implementation of a regional mutual aid contract between local water utilities which would describe how the utilities would provide assistance if a partner utility experienced a water shortage	Completed	n/a
P-6	Develop a written Resiliency Plan for City of Raleigh operations and services, including infrastructure resilience, community resilience, ecosystem resilience and governance resilience.	Completed	Action is complete, and further work on resilience planning will continue through the NOAA grant work that is reflected in the additional action added below.

2019 Action #	Description	2024 Status	Status Comments/Explanation
P-7	Water Shortage Response Plan which uses a hydrologic model (OASIS) to establish risk based drought triggers that are designed to reduce water demand before severe drought conditions and also when to exit drought triggers when conditions improve.	Completed	n/a
PP-2	Develop an ongoing program designed to utilize Federal grant resources to assist private property owners in elevating existing structures located within flood hazard zones. (CRS 510/530)	Delete	The City has established a Floodplain Management team to manage mitigation projects going forward. A prioritization model has also been developed to score and evaluate potential mitigation properties.
PP-3	Develop an ongoing program designed to utilize Federal grant resources to assist private property owners in renovating and retrofitting existing structures in flood hazard zones to reduce vulnerability to flooding damage.	Delete	The City has established a Floodplain Management team to manage mitigation projects going forward. A prioritization model has also been developed to score and evaluate potential mitigation properties.
ES-4	Design GIS programming capable of providing real-time data to emergency managers and historic data for future emergency response planning.	Completed	n/a
PEA-1	Utilize existing Everbridge advisory software to issue Heat Advisory Alerts targeted to vulnerable neighborhoods	Delete	Heat is an active vulnerability to the community that we are actively working on. We are working on various communications with the community. However, we'd like to redraft this action to better reflect the work happening to communicate with the community. Our NOAA grant (mentioned below) will reflect this work moving forward.
Apex			
P-1	Ensure all new development projects comply with FEMA floodplain regulations. Require flood studies per the UDO.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-2	Maintain a citizen's Environmental Advisory Board that meets regularly to discuss issues and recommend projects.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-3	Encourage the use of Low Impact Development techniques.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-4	Use system development fees (capital reimbursement fees) to help fund public projects.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-5	Update the UDO & Design and Development Manual to incorporate proper species selection and practices for planting and maintenance into the landscape ordinance.	Completed	Completed
P-6	Incorporate GIS data and risk analysis into the development review process.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-7	Implement the Stormwater Utility Fee & program.	Completed	Completed

2019 Action #	Description	2024 Status	Status Comments/Explanation
P-8	Continue to use "Neighbors Helping Neighbors" program to help low-income Apex Utility customers pay their utility bills.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-9	Salt & brine local roads before Severe Winter Storm & plow after snow and ice fall.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-10	Tree Trimming of all electric lines in the event of Tornado or Hurricane	Completed	This is an established capability of the town that is implemented on an ongoing basis.
P-11	Update the UDO to add separation standards between daycares and hazardous uses.	Completed	Completed
P-12	Update the UDO to add separation standards for the use “gas and fuel, wholesale”	Completed	Completed
PP-1	Enforce the Fire Prevention Code.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
PP-2	Annually update the comprehensive occupancy pre-plan program with local data for use in risk analysis.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
NRP-5	During development review, ensure new development complies with floodplain development restrictions listed in UDO Section 6.2 Flood Damage Prevention Overlay District.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
NRP-6	During development review, ensure new development complies with UDO stream buffer standards.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
NRP-7	During development review, ensure SCMs are designed in accordance with State criteria to safely pass 100-year storm.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
ES-1	Construct Public Safety Station #6	Completed	Completed
ES-4	Keep Town website updated with information about Shearon Harris Siren Testing.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
ES-5	Send quarterly 5-mile radius customer list to Duke Energy for Tone Alert Radios to be delivered to customers.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
ES-6	Create a situational awareness dashboard in the Emergency Operations Center.	Completed	Completed
PEA-1	Town website and other digital content announcing National Preparedness Month (September) reminding citizens to have a plan and be prepared.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
PEA-4	Hand out hazard educational materials at Apex festivals.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
PEA-5	Use social media to inform residents about local hazards.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
PEA-6	Stormwater educational booth at Peakfest and Earthfest.	Completed	This is an established capability of the town that is implemented on an ongoing basis.

2019 Action #	Description	2024 Status	Status Comments/Explanation
PEA-7	Water and Sewer education materials on Town Website, including "What not to flush" and system reports.	Completed	This is an established capability of the town that is implemented on an ongoing basis.
Cary			
P-5	Develop flood model for Symphony Lake	Completed	Incorporated into upper Swift Creek modeling effort.
P-6	Engineering evaluation of Tryon Road dam	Completed	Completed
P-8	Conduct flood study on Town-owned lake/dam, including breach analysis	Completed	Completed
P-9	Triangle Regional Resiliency Partnership	Completed	Completed
PP-1	Culvert Replacement - Arbor Brook	Completed	Completed
PP-2	Culvert Replacement - Two Creeks	Completed	Completed
NRP-1	Downtown Park	Completed	Project completed. Regional stormwater pond plus two GIS bioretention features built to retain/treat park SW plus existing street drainage.
SP-1	Infrastructure improvements on Summer Lakes Dr.	Completed	Completed
SP-2	Infrastructure improvements on Vincrest Ct	Completed	Completed
Fuquay-Varina			
P-5	Review and update of drought policy for water conservation	Completed	Plan is updated every five years, originally adopted Feb 2024
P-6	Review and update requirements for mast arms to be installed over strain poles	Completed	Complete; All projects inside Judd Pkwy required to have mast arms
P-7	Review and update the 2014 Comprehensive Systemwide Parks, Recreation & Cultural Resources Master Plan for inclusion of hazard safety information at facilities	Completed	PRCR Master Plan updated in 2023
NRP-5	Install low flow/high efficiency toilets at new town hall	Completed	Complete in 2019
S-1	Install a generator at the new town hall	Completed	Complete in 2019
S-2	Install security cameras on new town hall	Completed	Complete in 2019
ES-8	Finalize implementation of new/updated radio communication equipment.	Completed	Completed
Garner			
P-2	UDO: Continue to provide stream and creek buffers, and floodplain and wetland protection.	Completed	Completed with updates to UDO.
P-5	Develop for public dissemination building inspections brochures regarding high winds, water damage prevention, and tie downs for accessory structures.	Completed	We do this annually - seasonal brochures based on weather threats
P-7	In the upcoming zoning and development ordinance update / re-write (UDO), look for ways discourage and steer high density residential and other at-risk populations (daycares, schools, and retirement facilities as examples)	Completed	Completed with updates to UDO.

2019 Action #	Description	2024 Status	Status Comments/Explanation
NRP-1	Develop and adopt a conservation subdivision ordinance to help preserve significant natural features.	Completed	Completed with updates to UDO.
PEA-3	Website - The Town maintains its own website which is able to provide up to date information for the public. Town continuously updates the site with additional resources.	Completed	Completed the initial effort; it is in place and on-going
Holly Springs			
ES-2	GIS Programming - Design GIS programming capable of providing real-time data to emergency managers and historic data for future emergency response planning.	Completed	Our dispatch CAD system is the same system as the county. GIS capabilities are built into the system. Will be deleted on next update.
ES-3	ECC Notifications by NOAA for possible severe weather (tornados, ice, etc.). ECC is notified by both agencies when weather alerts are issued. Information is then broadcast over police radios. This information is generated by the State and Wake County and is obtained through the use of DC message, radio, fax and Nextel.	Completed	This is maintained by the county and we do not send these alerts at the local level. All weather alerts are sent out by NOAA. Will be deleted on next update.
ES-4	Purchase ACU 1000 Communications Unit – System should allow all agencies on ACU 1000 to communicate using own radios and frequencies.	Delete	The system is now contracted with Wake County.
ES-6	Counseling – Police psychologist and Critical Incident Stress Debriefing Team training to provide debriefing sessions for personnel.	Completed	Currently the Town police department has a contract for services. The need will be continuous as mental health services and peer support expand with various sensitive incidents. Will be deleted on next update.
Knightdale			
SP-1	Dredging, new riser and plunge pool for pond restoration at Environmental Park	Completed	Completed
Morrisville			
P-2	Establish a Municipal Service District (MSD) in order to convert private roads in Carpenter Park neighborhood to public roads with a higher design, safety, and maintenance standard.	Completed	One time project that has been completed.
P-3	Coordinate with Duke Power to draft Electric Utility Master Plan, which seeks to identify areas feasible for utility line burial.	Delete	On hold - no plans to revisit at this time. However, map developed for staff use identifying what line segments Duke Energy would like to bury at the same time to maintain the integrity and reliability of system. Map has been used as starting point in determining likelihood of burial with various development projects.
P-4	Update Land Use Plan to ensure protection of natural resources, strengthen existing development to resist hazards, and guide future development away from hazard prone areas.	Completed	Good reference in terms of making sure plan recommendations are followed.

2019 Action #	Description	2024 Status	Status Comments/Explanation
P-5	Obtain frequently updated, high-resolution aerial photography to assist with land use decisions, emergency response planning, and code enforcement.	Completed	Good reference information of decision making and should continue to be a priority
P-6	Working through the Triangle Water Supply Partnership, update the Water Resources Plan to ensure water supply is sufficient for Town's future needs.	Completed	Original water supply plan was updated and completed in 2014. However, the item should be carried forward since the plan is currently being updated again.
P-7	Working through the Triangle Water Supply Partnership, draft a Drought Management Plan to ensure water resources are properly managed during drought conditions.	Completed	Completed in 2016
P-8	Working through the Triangle Water Supply Partnership, draft an Emergency Spill Response and Mitigation Plan to protect watersheds and other water resources from hazardous spills.	Completed	Completed
P-9	Transition Wake County's sedimentation and erosion control permitting and monitoring to Town of Morrisville for better increased processing efficiency and faster incident response.	Delete	Town decided to go in a different direction
P-10	Conduct a complete review and update to the Town's stormwater management program, which helps mitigate effects of stormwater runoff and flooding.	Completed	Town adopted a new stormwater management plan in 2023
PP-2	Seek Federal, State, and County funding opportunities to purchase property located completely or partially in FEMA designated floodplains in order to mitigate potential property damage and protect natural resources.	Completed	Project Finished
SP-1	Construct Green Drive and Fairview Road Flood Reduction Drainage Project to mitigate potential flood hazards.	Completed	Project was completed in 2021
ES-1	Monitor the status of backup generators, communications and vehicles for all Morrisville owned critical public facilities.	Completed	Ongoing effort that needs to continue
ES-2	Install new generators for Town Hall and Police Station to ensure continuity of critical operations during a power outage.	Completed	One time project and has been completed
ES-3	Construct new fire station in Morrisville in order to improve fire protection coverage and emergency response times.	Completed	Initial project is complete, but it can migrate to the relocation of Fire Station 2
ES-4	Update Town's Emergency Operations Plan to ensure best processes and procedures for the most likely and applicable emergency scenarios.	Completed	Continuous project.
PEA-1	Implement Wake County's Everbridge text alert system to notify citizens and Town staff of potential safety hazards or concerns.	Completed	Completed
PEA-3	Utilize volunteer citizen committees, such as CERT or Public Safety Committee, to educate residents in preparing for natural hazards.	Completed	Completed
Rolesville			
no completed or deleted actions			

2019 Action #	Description	2024 Status	Status Comments/Explanation
Wake Forest			
P-4	Explore the use of Stormwater Utility Fees	Completed	Storm Utility has been approved and finished.
PP-1	Document each historic structure in Wake Forest town limits and ETJ	Completed	Completed
NRP-1	Manage the Wake Forest Reservoir for hazard mitigation	Completed	Completed
ES-1	Investigate methods of encouraging gas stations to acquire backup generators.	Delete	From the standpoint of the Inspections department, Town code does not require generators in these types of facilities, and we cannot encourage the installation of generators.
ES-3	Require, in the contract, that fuel suppliers have backup generators.	Delete	The Town of Wake Forest is no longer under contract with fuel suppliers. Previously contracted fuel suppliers refused to commit to future contracts for unknown reasons.
ES-4	Adopt and Implement an Emergency Operations Plan	Completed	EOP was adopted April 2019
Wendell			
P-1	Install generators as needed at lift stations.	Completed	Ongoing - Raleigh has installed emergency generators on all lift stations within the Town and intends to do so going forward.
P-3	Add environmentally sensitive and hazard areas to the Future Land Use Map and adopt updated Comprehensive Plan, which will allow environmental conditions and hazard areas to guide zoning and density decisions.	Completed	Areas added during Comp Plan update and we calculate gross density which gives credit for environmentally-sensitive areas without disturbing them
P-6	Consider regulations to regulate clear-cutting to help control erosion from construction sites	Completed	UDO is being interpreted now such that buffers are not allowed to be graded in and buffers must be supplemented to meet standards
SP-1	Perform improvements to existing open drainage device near intersection of 1st St & Pine St. to increase total water volume & flow	Completed	New pipe and culvert improvements and installation
ES-1	Make electrical improvements in the downtown in order to help ensure continuity of service during extreme weather	Completed	New electrical at Third/Main Streets to decrease load by approximately 40% on previously the sole circuit. Conversion to LED lamps to decrease load.
ES-3	Evaluate potential locations for a future Public Works debris site, to accommodate debris associated with natural hazards	Completed	Disaster Debris designated site (town park)
ES-5	Secure and utilize visual warning barricades for vehicular and pedestrian traffic to block properties, roadways, etc. for public safety during or following hazard events	Completed	Ongoing as town grows. At this time more than $100,000 spent on class 3 barricades, message boards, light towers, etc.
ES-6	Conduct periodic training exercises, related to higher-risk hazard threats identified by the Hazard Mitigation Plan	Completed	Ongoing and required for police accreditation and also best practices.
Zebulon			
P-2	Enforce subdivision standards for development in flood hazard areas.	Completed	Updated in UDO Revisions.

2019 Action #	Description	2024 Status	Status Comments/Explanation
P-3	Further restrict development in floodplain by prohibiting development or requiring 2 feet of freeboard.	Completed	Updated in UDO Revisions.
P-4	Revise floodplain ordinance.	Completed	Updated in UDO Revisions.
P-5	Require burial of power lines for new developments.	Completed	Updated in UDO Revisions.
SP-1	Resolve localized flooding issue that occurs in/around West Sycamore Streets, Gannon Avenue, and North Arendell Avenue during heavy rainfall events.	Completed	The town has completed design and permitting of project improvements and is currently acquiring easements.
PEA-2	Develop a public education program to provide hazard risk and preparedness education via social media	Completed	The Town is currently using social media for some public education but will formalize a program for hazards awareness.

3 PLANNING AREA PROFILE

This section provides a general overview of the current conditions in Wake County and its participating municipalities. It consists of the following sub-sections:

- 3.1 Geography and Environment
- 3.2 Population and Demographics
- 3.3 Parcels and Buildings
- 3.4 Historic Properties
- 3.5 Housing
- 3.6 Infrastructure
- 3.7 Current and Future Land Use
- 3.8 Employment and Industry
- 3.9 Social Vulnerability
- 3.10 Jurisdiction Information

3.1 GEOGRAPHY AND ENVIRONMENT

Wake County is located in the eastern portion of the Piedmont of North Carolina. It is part of the Raleigh, NC Metropolitan Statistical Area, which falls within the larger Raleigh-Durham-Chapel Hill, NC Combined Statistical Area. The Planning Area includes Wake County unincorporated areas, Town of Apex, Town of Cary, Town of Fuquay-Varina, Town of Garner, Town of Holly Springs, Town of Knightdale, Town of Morrisville, City of Raleigh, Town of Rolesville, Town of Wake Forest, Town of Wendell, and Town of Zebulon. A location map is provided in Figure 3.1.

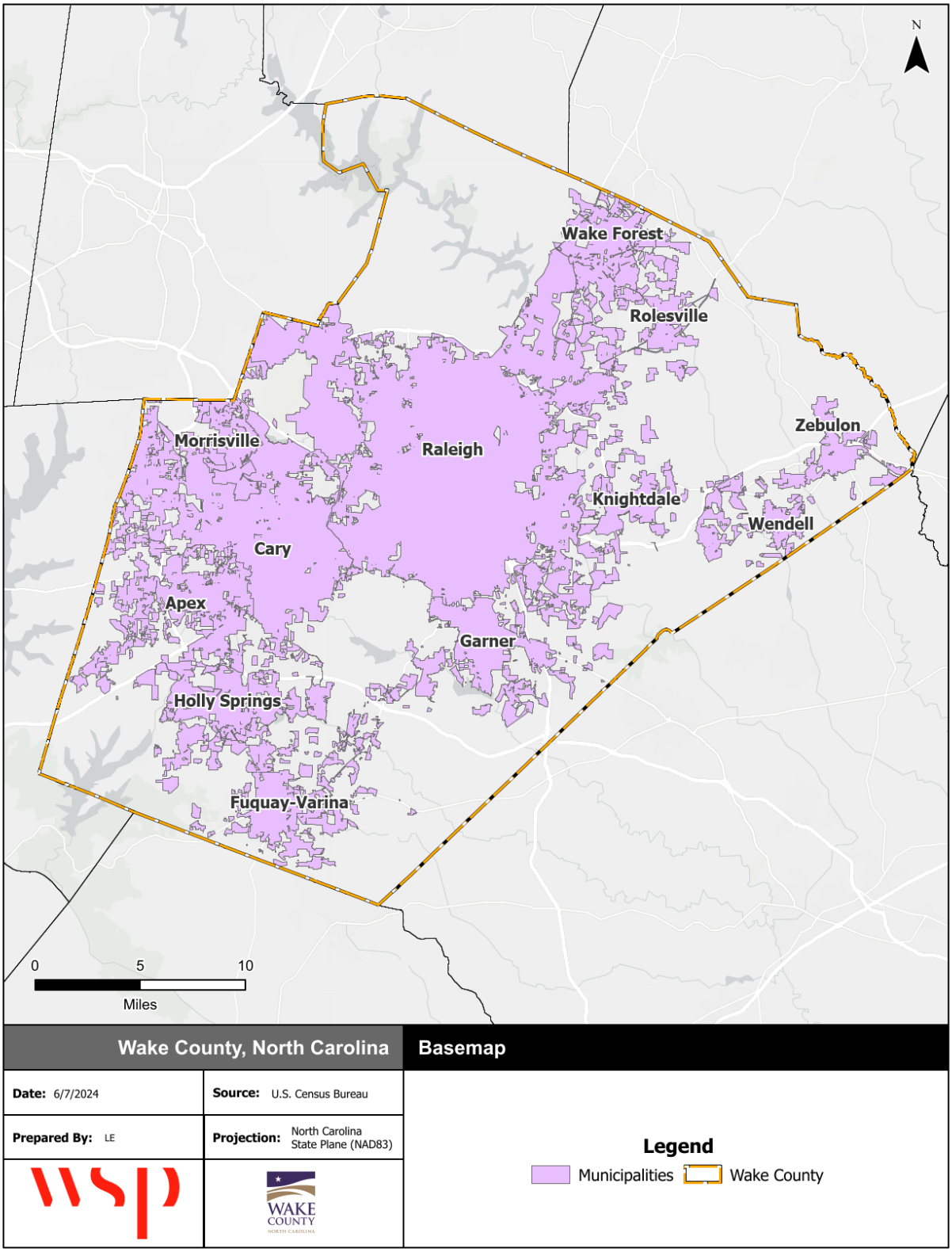
Wake County comprises a total land area of over 834 square miles. The total land area reported for each participating jurisdiction is listed in Table 3.1.

Table 3.1 – Total Land Area of Participating Jurisdictions

Jurisdiction	Total Land Area
Wake County	**834.59 square miles**
Unincorporated areas	504.00 square miles
Apex	21.99 square miles
Cary	59.23 square miles
Fuquay-Varina	17.62 square miles
Garner	16.56 square miles
Holly Springs	17.35 square miles
Knightdale	7.95 square miles
Morrisville	8.83 square miles
Raleigh	147.12 square miles
Rolesville	4.88 square miles
Wake Forest	18.05 square miles
Wendell	5.76 square miles
Zebulon	5.25 square miles

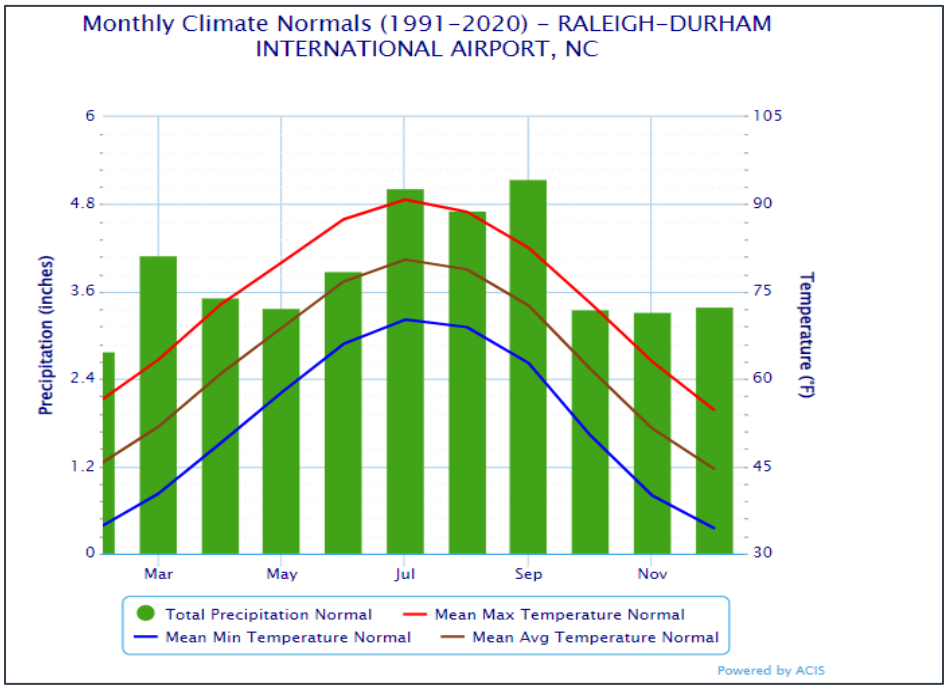
Source: US Census Bureau

Figure 3.1 – Wake County and Participating Jurisdictions Location Map



According to the Köppen climate classification system, Wake County has a humid subtropical climate characterized by mild winters and hot humid summers with significant precipitation even during the driest month. According to annual climatological reports from the National Weather Service, the county experiences an average annual high temperature of 72.0°F and an average annual low of 50.5°F. Average annual rainfall is approximately 46.07 inches and average annual snowfall is 5.2 inches. Figure 3.2 shows the average monthly climate normals for the Raleigh-Durham Airport weather station, which approximates temperature and precipitation of the surrounding County.

Figure 3.2 – Average Monthly Precipitation



Source: Northeast RCC CLIMOD 2

As shown in the map of HUC-8 watersheds in Figure 3.3, most of Wake County falls within the Upper Neuse River watershed. Portions of the west and south of the county are in the Haw River watershed and the Upper Cape Fear River watershed, respectively; an area in the northeast of the county falls in the Contentnea Creek watershed. The Neuse River runs through the county from the northwest border to the southeast central border.

WETLANDS

According to data from the U.S. Fish and Wildlife Service's National Wetlands Inventory, there are approximately 42,543 acres of wetlands in Wake County. Wetlands areas are shown by type in Figure 3.4.

Natural and Beneficial Wetland Functions: The benefits of wetlands are hard to overestimate. They provide critical habitat for many plant and animal species that could not survive in other habitats. They are also critical for water management as they absorb and store vast quantities of storm water, helping reduce floods and recharge aquifers. Not only do wetlands store water like sponges, but they also filter and clean water as well, absorbing toxins and other pollutants.

PARKS, PRESERVES, AND CONSERVATION

Wake County is home to three state parks: Falls Lake State Recreation Area, William B. Umstead State Park, and Jordan Lake State Recreation Area. There are also multiple county-operated parks (8) and

preserves (3) in addition to many other municipal parks located throughout the various jurisdictions. Several greenways traverse the County and provide connectivity to surrounding regions as well.

THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service maintains a regular listing of threatened species, endangered species, species of concern, and candidate species for counties across the United States. As of 2024 records, Wake County has 16 species that are listed with the U.S. Fish and Wildlife Services. Table 3.2 below lists the species identified as threatened, endangered, or other classification.

Table 3.2 – Threatened and Endangered Species

Group	Common Name	Scientific Name	Federal Status
Amphibians	Neuse River waterdog	Necturus lewisi	Threatened
Birds	Red-cockaded woodpecker	Picoides borealis	Endangered
Clams	Green floater	Lasmigona subviridis	Proposed Threatened
Clams	Dwarf wedgemussel	Alasmidonta heterodon	Endangered
Clams	Yellow lance	Elliptio lanceolata	Threatened
Clams	Atlantic pigtoe	Fusconaia masoni	Threatened
Fishes	Cape Fear shiner	Notropis mekistocholas	Endangered
Fishes	Carolina madtom	Noturus furiosus	Endangered
Flowering Plants	Michaux's sumac	Rhus michauxii	Endangered
Flowering Plants	Rough-leaved loosestrife	Lysimachia asperulaefolia	Endangered
Flowering Plants	Harperella	Ptilimnium nodosum	Endangered
Flowering Plants	Smooth coneflower	Echinacea laevigata	Threatened
Insects	Monarch butterfly	Danaus plexippus	Candidate
Mammals	Tricolored bat	Perimyotis subflavus	Proposed Endangered
Mammals	Little brown bat	Myotis lucifugus	Under Review
Reptiles	American alligator	Alligator mississippiensis	Similarity of Appearance (Threatened)

Source: U.S. Fish & Wildlife Service, Environmental Conservation Online System (ECOS)

Figure 3.3 – HUC-8 Drainage Basins

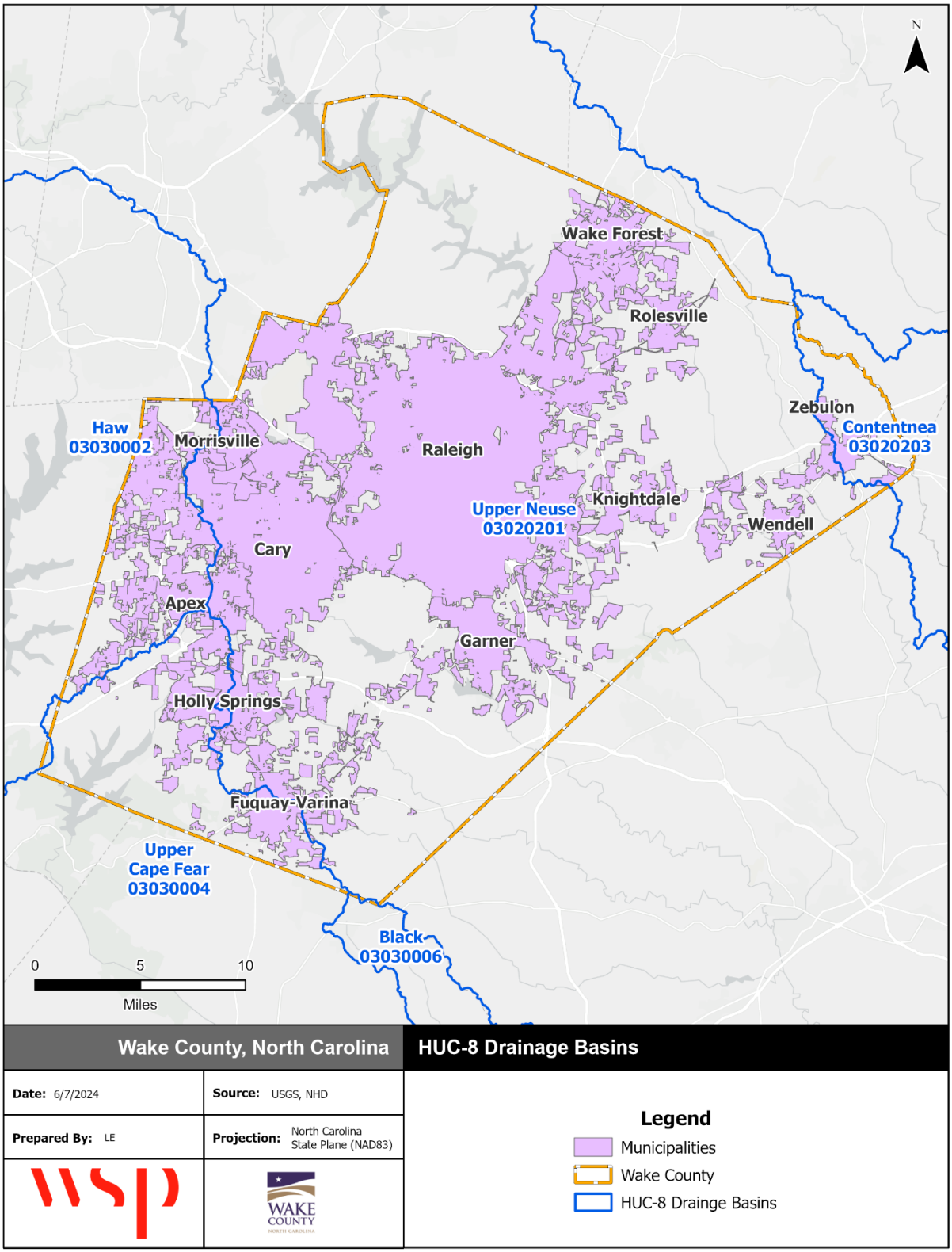
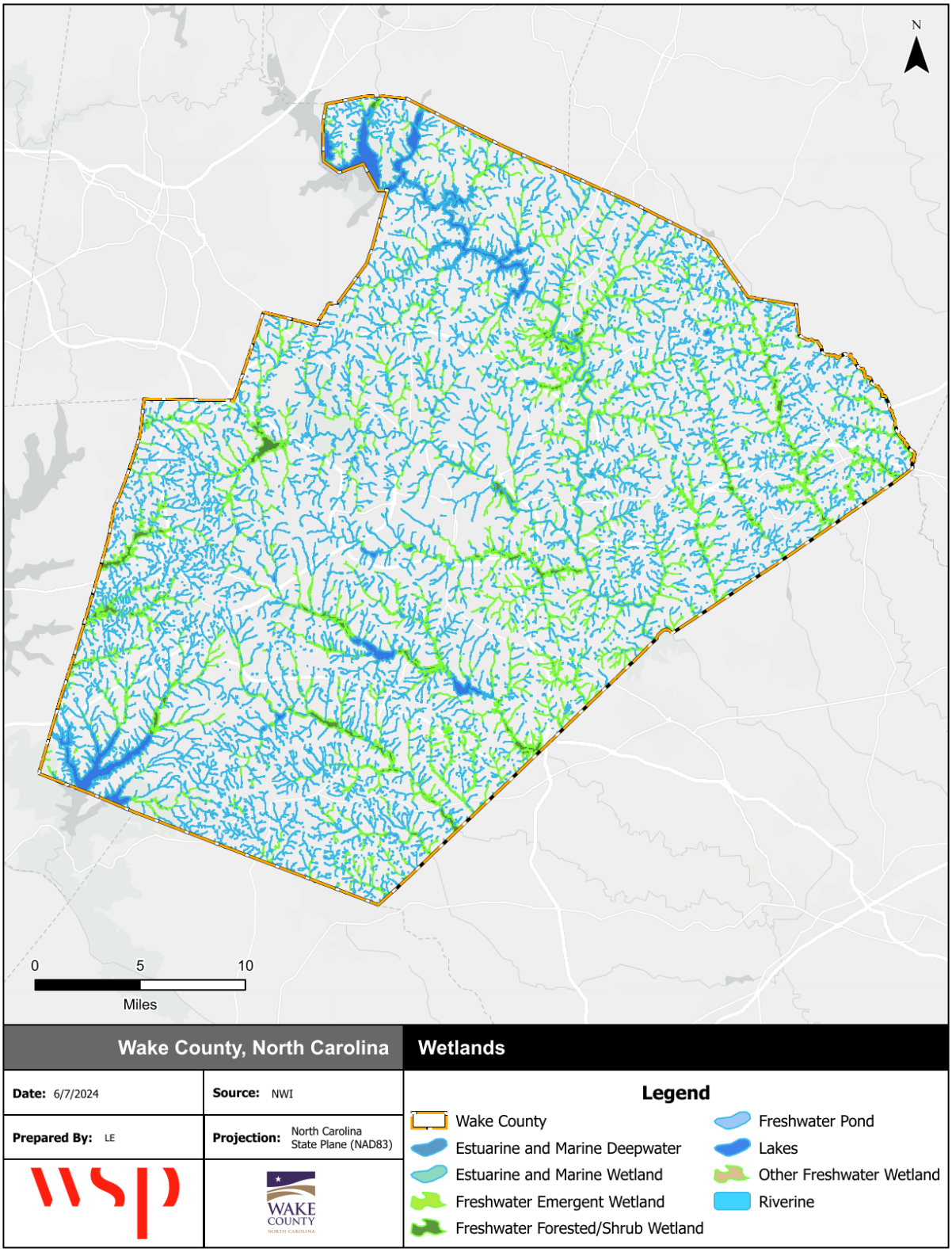


Figure 3.4 – Wetlands by Type in Wake County



3.2 POPULATION AND DEMOGRAPHICS

Wake County and its municipalities have experienced significant population growth over the last several decades. From 2010 to 2020, Wake County's population grew by over 25 percent, which translates to an annual growth rate of roughly 2.5%. Overall population density in the County increased from 1,078.8 persons per square mile in 2010 to 1,353.3 persons per square mile in 2020. Trends suggest that this number is likely to continue growing. All jurisdictions experienced growth between 2010 and 2020. The Towns of Apex, Fuquay-Varina, Holly Springs, Knightdale, Morrisville, Rolesville, Wake Forest, Wendell, and Zebulon all experienced greater than a 50 percent change in their population during this time. Table 3.3 provides population counts from 2010 (Decennial), 2020 (Decennial), and 2022 (ACS 5-year estimates) for each of the participating jurisdictions. Figure 3.5 on the following page shows recently reported population density by census tract in persons per square mile.

Table 3.3 – Wake County Population Counts

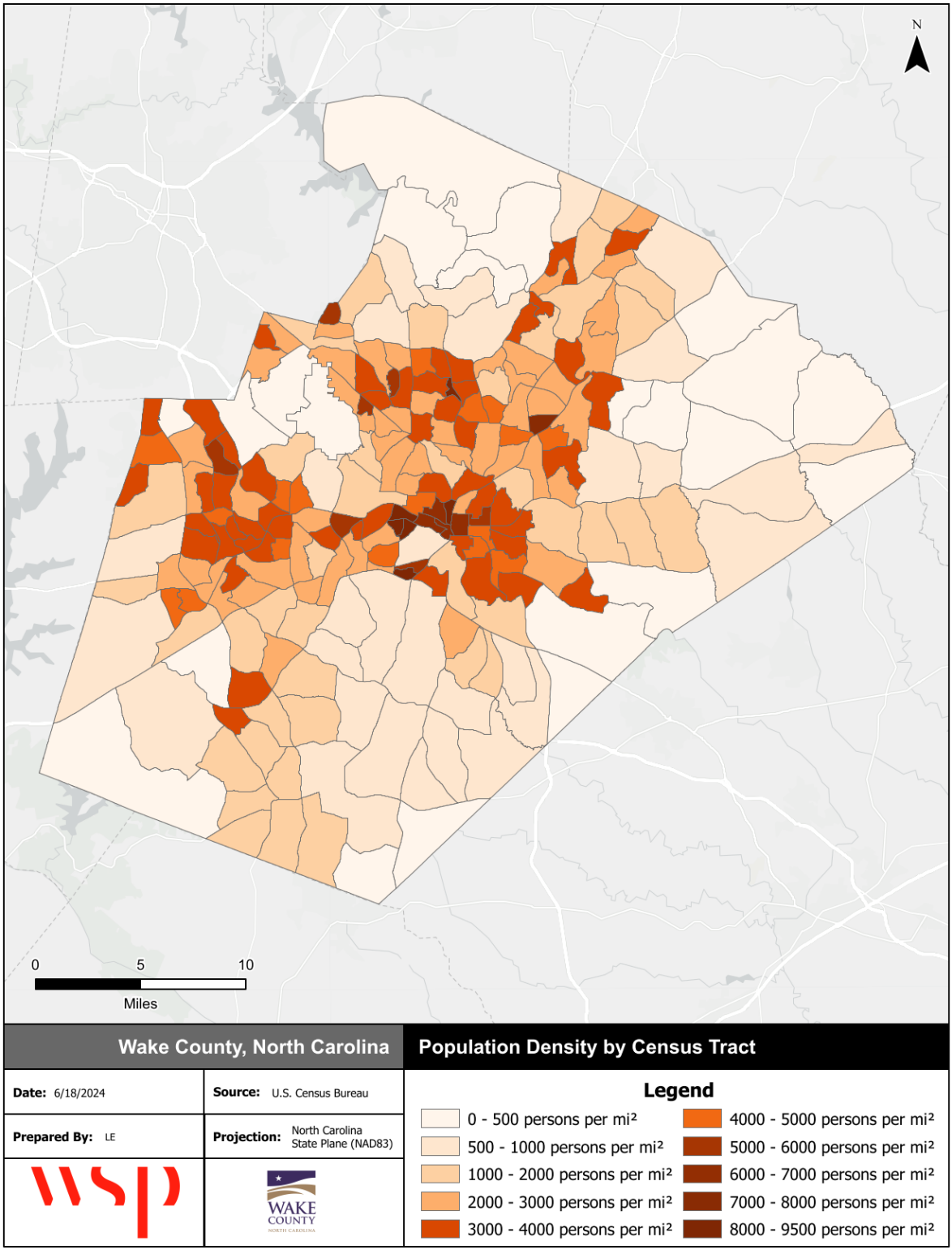
Jurisdiction	2010 Census Population	2020 Census Population	2022 ACS Population Estimate	Total Change 2010-2020	% Change 2010-2020
Wake County	**900,993**	**1,129,410**	**1,132,103**	**228,417**	**25.4%**
Unincorporated areas	181,890	198,857	192,408	16,967	9.3%
Apex	37,476	58,780*	65,541	21,304	56.8%
Cary	135,234	174,721	174,880	39,487	29.2%
Fuquay-Varina	17,937	34,152	35,428	16,215	90.4%
Garner	25,745	31,159	31,684	5,414	21.0%
Holly Springs	24,661	41,239	42,023	16,578	67.2%
Knightdale	11,401	19,435	19,127	8,034	70.5%
Morrisville	18,576	29,630	29,756	11,054	59.5%
Raleigh	403,892	467,665	465,517	63,773	15.8%
Rolesville	3,786	9,475	9,696	5,689	150.3%
Wake Forest	30,117	47,601	48,047	17,484	58.1%
Wendell	5,845	9,793	10,575	3,948	67.5%
Zebulon	4,433	6,903	7,421	2,470	55.7%

Source: US Census Bureau Decennial Census 2010, Decennial Census 2020; American Community Survey 2022 5-Year Estimates

Note: The total population of Cary, Raleigh, and Wake Forest includes population residing in adjacent counties.

*Apex's 2020 Census population estimate was corrected in 2022. Per the Town of Apex Planning Department, the town's 2020 population estimate was 64,180. A portion of the town's population was incorrectly attributed to Wake County.

Figure 3.5 – Population Density, 2022



Source: 2022 U.S. Census Bureau

According to 2022 American Community Survey 5-Year Estimates, the median age in Wake County was 37.0. Of the population aged 25 years and over, 94.0 percent have a high school degree or higher and 55.7 percent have a bachelor's degree or higher. Approximately 17.9 percent of Wake County residents speak a language other than English at home; of those, 68.0 percent also speak English "very well". The racial characteristics of the participating jurisdictions are presented in Table 3.4. Generally, white persons make up the majority of the population in the county, accounting for over 58 percent of the population in Wake County overall. However, several jurisdictions have much higher minority populations than others including Garner, Knightdale, Morrisville, Raleigh, and Zebulon.

Table 3.4 – Racial Demographics of Wake County Jurisdictions, 2022

Jurisdiction	White, %	Black, %	Asian, %	Other Race, %	Two or More Races, %	Persons of Hispanic or Latino Origin*, %
Wake County	**58.6%**	**19.1%**	**8.6%**	**4.5%**	**9.0%**	**10.6%**
Apex	68.7%	7.9%	14.8%	1.7%	6.6%	6.4%
Cary	61.5%	8.3%	20.9%	3.0%	6.1%	7.8%
Fuquay-Varina	71.4%	15.7%	2.0%	1.8%	8.7%	9.1%
Garner	62.0%	24.7%	1.7%	3.2%	7.9%	11.1%
Holly Springs	75.3%	9.6%	6.2%	2.6%	6.1%	6.2%
Knightdale	37.5%	47.2%	2.7%	4.0%	8.3%	8.6%
Morrisville	38.3%	11.5%	42.6%	1.5%	6.0%	4.1%
Raleigh	55.5%	28.1%	4.5%	4.7%	6.9%	11.6%
Rolesville	63.3%	25.2%	0.4%	2.7%	8.4%	5.0%
Wake Forest	69.5%	18.0%	2.3%	2.9%	7.3%	7.9%
Wendell	54.9%	28.7%	0.0%	9.9%	6.4%	21.8%
Zebulon	43.5%	35.0%	0.4%	10.1%	11.0%	19.9%

Source: US Census Bureau, American Community Survey 2022 5-Year Estimates

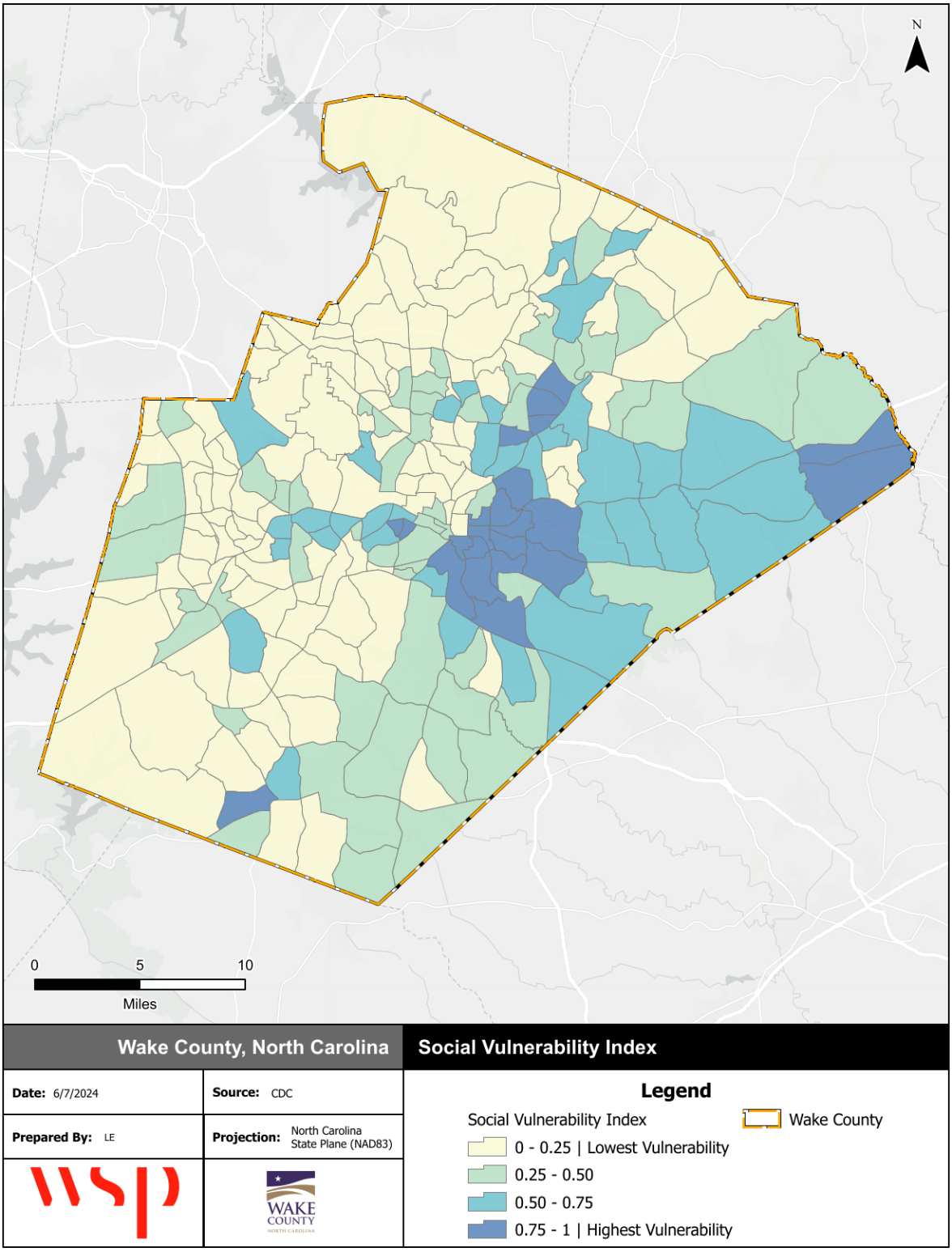
*Persons of Hispanic origin may be of any race, so also are included in applicable race categories

SOCIAL VULNERABILITY

Figure 3.6 displays social vulnerability information for Wake County by census tract according to 2020 data and analysis by the Centers for Disease Control and Prevention (CDC). The CDC's Social Vulnerability Index (SVI) indicates the relative vulnerability within census tracts based on 16 social factors recorded as unique census variables: poverty, unemployment, income, education, age, disability, household composition, minority status, language, housing type, and transportation access. Additional information and documentation can be found through the official CDC website[1]. Higher social vulnerability is an indicator that a community may be limited in its ability to respond to and recover from hazard events. Therefore, using this SVI information can help the County and jurisdictions to prioritize pre-disaster aid, allocate emergency preparedness and response resources, and plan for the provision of recovery support.

[1] CDC/ATSDR Social Vulnerability Index. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

Figure 3.6 – Social Vulnerability Index by Census Tract, 2016



Source: Centers for Disease Control and Prevention (CDC) / Agency for Toxic Substances and Disease Registry (ATSDR) / Geospatial Research, Analysis, and Services Program (GRASP).

3.3 PARCELS AND BUILDINGS

Table 3.5 provides a count of the undeveloped and developed parcels in Wake County by jurisdiction. Parcels are considered undeveloped according to the Land-Based Classification Standards (LBCS) published by the American Planning Association (APA).

Table 3.5 – Parcel Count by Jurisdiction

Jurisdiction	Developed Parcels	Undeveloped Parcels
City of Raleigh	130,082	6,422
Town of Apex	25,155	2,399
Town of Cary	53,891	2,500
Town of Fuquay-Varina	17,404	2,324
Town of Garner	13,067	1,786
Town of Holly Springs	15,979	1,745
Town of Knightdale	6,406	1,203
Town of Morrisville	7,306	439
Town of Rolesville	3,942	771
Town of Wake Forest	17,448	1,642
Town of Wendell	5,676	2,463
Town of Zebulon	4,079	1,219
Wake County	79,418	10,633
Total	**379,853**	**35,546**

Source: Wake County GIS Open Data, 2024

3.4 HISTORIC PROPERTIES

As of May 2024, Wake County had 227 listings in the National Register of Historic Places, detailed in Table 3.6. This list includes 65 Historic Districts. Listing on the National Register signifies that these structures, sites, and districts have been determined to be worthy of preservation for their historical or cultural values. In addition to these properties, there are four National Historic Landmarks in Wake County; all four are located in the City of Raleigh.

Table 3.6 – National Register of Historic Places Listings in Wake County

Ref#	Property Name	Status Date	Category	City
85003077	Apex City Hall	12/5/1985	Building	Apex
94000185	Apex Historic District	3/17/1994	District	Apex
07001502	Apex Historic District (Boundary Increase II)	1/31/2008	District	Apex
02000016	Apex Historic District (Boundary Increase)	2/14/2002	District	Apex
95000210	Apex Historic District (Boundary Increase)	3/10/1995	District	Apex
88002697	Apex Union Depot	12/1/1988	Building	Apex
08000937	Lawrence, Calvin Wray, House	9/23/2008	Building	Apex

Ref#	Property Name	Status Date	Category	City
02000498	Utley-Council House	5/16/2002	Building	Apex
03000967	Poole, Wayland E., House	9/25/2003	Building	Auburn
00000549	Carpenter Historic District	5/26/2000	District	Cary
01000425	Cary Historic District	4/25/2001	District	Cary
01000340	Green Level Historic District	4/5/2001	District	Cary
08000414	Ivey-Ellington House	5/15/2008	Building	Cary
84002540	Jones, Nancy, House	5/20/2022	Building	Cary
79003339	Page-Walker Hotel	5/29/1979	Building	Cary
01000424	Cannady-Brogden Farm	4/25/2001	Building	Creedmoor
74001379	Mangum, James, House	11/18/1974	Building	Creedmoor
99000509	Hood-Anderson Farm	4/29/1999	District	Eagle Rock
83001921	Falls of the Neuse Manufacturing Company	9/19/1983	Building	Falls
14000230	Fuquay Springs Historic District (Boundary Increase)	5/19/2014	District	Fuquay Varina
14001023	Stevens, Wayland H. and Mamie Burt, House	12/10/2014	Building	Fuquay Varina
97000195	Ben-Wiley Hotel	2/27/1997	Building	Fuquay-Varina
86003457	Fuquay Mineral Spring	12/4/1986	Site	Fuquay-Varina
02000495	Fuquay Springs High School	5/16/2002	Building	Fuquay-Varina
07000352	Fuquay-Varina Woman's Club Clubhouse	4/24/2007	Building	Fuquay-Varina
91001375	Johnson, J. Beale, House	9/5/1991	Building	Fuquay-Varina
89002352	Jones-Johnson-Ballentine Historic District	1/26/1990	District	Fuquay-Varina
89002351	Varina Commercial Historic District	1/31/1990	District	Fuquay-Varina
96001398	Fuquay Springs Historic District	11/29/1996	District	Fuquay--Varina
05001448	Fuquay Springs Teacherage	12/23/2005	Building	Fuquay--Varina
05001028	Johnson, Kemp B., House	9/15/2005	Building	Fuquay--Varina
89002157	Downtown Garner Historic District	12/21/1989	District	Garner
93000544	Edenwood	7/2/1993	Building	Garner
09001106	Meadowbrook Country Club	12/16/2009	District	Garner
10000164	Holly Springs Masonic Lodge	4/7/2010	Building	Holly Springs
97000218	Leslie-Alford-Mims House	3/8/1997	Building	Holly Springs
86003529	Beaver Dam	1/6/1987	Building	Knightdale
87002234	Knight, Henry H. and Bettie S., Farm	1/12/1988	District	Knightdale
07000543	Midway Plantation House and OutBuildings	6/15/2007	Building	Knightdale
86001631	Walnut Hill Cotton Gin	8/14/1986	Building	Knightdale
00001183	Walnut Hill Historic District	10/6/2000	District	Knightdale
12000913	Morrisville Christian Church	11/6/2012	Building	Morrisville

Ref#	Property Name	Status Date	Category	City
12000218	Page, Williamson, House	4/16/2012	Building	Morrisville
14000334	Pugh House	6/19/2014	Building	Morrisville
07001503	Holleman, Samuel Bartley, House	1/30/2008	Building	New Hill
01000426	New Hill Historic District	4/25/2001	District	New Hill
06001109	Adams-Edwards House	12/6/2006	Building	Raleigh
76001341	Agriculture Building	6/16/1976	Building	Raleigh
72000998	Andrews-Duncan House	1/20/1972	Building	Raleigh
11000892	Arndt, G. Dewey and Elma, House	12/7/2011	Building	Raleigh
10001111	Battery Heights Historic District	1/3/2011	District	Raleigh
05001449	Blalock, Dr. Nathan M., House	12/23/2005	Building	Raleigh
02000497	Bloomsbury Historic District	5/16/2002	District	Raleigh
07000902	Boylan Apartments	9/5/2007	Building	Raleigh
85001671	Boylan Heights	7/29/1985	District	Raleigh
73001372	Briggs Hardware Building	10/25/1973	Building	Raleigh
85001673	Cameron Park (Additional Documentation)	1/3/2023	District	Raleigh
11000956	Cameron Village Historic District	12/22/2011	District	Raleigh
75001293	Capehart House	1/17/1975	Building	Raleigh
85003076	Capital Club Building	12/5/1985	Building	Raleigh
78001978	Capitol Area Historic District	4/15/1978	District	Raleigh
10001112	Capitol Heights Historic District	1/3/2011	District	Raleigh
01000557	Caraleigh Mills	5/25/2001	Building	Raleigh
09000661	Carolina Coach Garage and Shop	8/27/2009	Building	Raleigh
97001304	Carolina Power and Light Company Car Barn and Automobile Garage	10/30/1997	Building	Raleigh
16000188	Chavis, John, Memorial Park	4/19/2016	District	Raleigh
70000469	Christ Church	7/28/1970	Building	Raleigh
87002597	Christ Episcopal Church	12/23/1987	Building	Raleigh
08000889	City Cemetery	9/12/2008	District	Raleigh
95000783	Crabtree Creek Recreational Demonstration Area	6/30/1995	District	Raleigh
08000939	Curtis, William A., House	9/24/2008	Building	Raleigh
76001342	Daniels, Josephus, House	12/8/1976	Building	Raleigh
02000946	Depot Historic District	9/6/2002	District	Raleigh
100001634	Depot Historic District (Boundary Increase)	9/21/2017	District	Raleigh
90001638	Dix Hill	11/7/1990	District	Raleigh
71000623	Dodd-Hinsdale House	11/12/1971	Building	Raleigh
90001527	East Raleigh-South Park Historic District	10/11/1990	District	Raleigh
75001294	Elmwood	10/29/1975	Building	Raleigh

Ref#	Property Name	Status Date	Category	City
73001373	Estey Hall	5/25/1973	Building	Raleigh
93000440	Fadum House	6/10/1993	Building	Raleigh
07001412	Fayetteville Street Historic District	2/27/2008	District	Raleigh
71000624	Federal Building	5/6/1971	Building	Raleigh
08000888	Free Church of the Good Shepherd	9/10/2008	Building	Raleigh
85001672	Glenwood	7/29/1985	District	Raleigh
02000058	Glenwood-Brooklyn Historic District (Boundary Increase and Decrease)	2/20/2002	District	Raleigh
100006810	Graves-Fields House	8/20/2021	Building	Raleigh
03000930	Green, Herman, House	9/11/2003	Building	Raleigh
92001602	Grosvenor Gardens Apartments	11/12/1992	Building	Raleigh
02000501	Hall, Rev. Plummer T., House	5/16/2002	Building	Raleigh
10001098	Harris, Harwell Hamilton and Jean Bangs, House and Office	12/28/2010	Building	Raleigh
72000999	Hawkins-Hartness House	2/1/1972	Building	Raleigh
02000496	Hayes Barton Historic District	5/28/2019	District	Raleigh
70000470	Haywood Hall	7/28/1970	Building	Raleigh
95001440	Haywood, Dr. Hubert Benbury and Marguerite Manor, House (Additional Documentation)	5/7/2021	Building	Raleigh
70000471	Haywood, Richard B., House	7/28/1970	Building	Raleigh
72001000	Heck-Andrews House	1/20/1972	Building	Raleigh
73001374	Heck-Lee, Heck-Wynne, and Heck-Pool Houses	4/13/1973	Building	Raleigh
89001049	Henderson, Isabelle Bowen, House and Gardens	8/7/1989	District	Raleigh
11000484	Hi-Mount Historic District	7/29/2011	District	Raleigh
06000223	Ivey, Rufus J., House	4/5/2006	Building	Raleigh
73001375	J. S. Dorton Arena	4/11/1973	Building	Raleigh
73001376	Jones Jr., Nathaniel, House	6/4/1973	Building	Raleigh
75001295	Jones, Alpheus, House	7/7/1975	Building	Raleigh
96000197	Kamphoefner, Henry L., House	3/12/1996	Building	Raleigh
70000472	Lane, Joel, House	7/28/1970	Building	Raleigh
77001011	Lane-Bennett House	6/30/1983	Building	Raleigh
02000502	Latta, Rev. M.L., House	5/16/2002	Building	Raleigh
05000320	Lawrence, Dr. Elmo N., House	4/20/2005	Building	Raleigh
72001001	Lewis-Smith House	12/11/1972	Building	Raleigh
10001113	Longview Gardens Historic District (Additional Documentation)	4/10/2020	District	Raleigh
83001923	Lumsden-Boone Building	9/8/1983	Building	Raleigh
10000632	Madonna Acres Historic District	9/1/2010	District	Raleigh

Ref#	Property Name	Status Date	Category	City
00000457	Mahler and Carolina Trust Buildings	11/29/2000	Building	Raleigh
06000338	Maiden Lane Historic District	5/3/2006	District	Raleigh
86000403	Marshall-Harris-Richardson House	3/5/1986	Building	Raleigh
08001415	Mary Elizabeth Hospital	2/5/2009	Building	Raleigh
79003341	Masonic Temple Building	9/17/1979	Building	Raleigh
84002533	Masonic Temple Building	5/3/1984	Building	Raleigh
94001089	Matsumoto House	9/21/1994	Building	Raleigh
14000523	Merrimon-Wynne House	8/25/2014	Building	Raleigh
78001979	Montford Hall	3/8/1978	Building	Raleigh
83001924	Moore Square Historic District	8/3/1983	District	Raleigh
70000474	Mordecai House	7/1/1970	Building	Raleigh
97001668	Mordecai Place Historic District	2/4/1998	District	Raleigh
00001570	Mordecai Place Historic District (Boundary Increase)	12/28/2000	Building	Raleigh
08001292	Mount Hope Cemetery	1/8/2009	District	Raleigh
80002902	Norburn Terrace	2/1/1980	Building	Raleigh
01001112	North Carolina Agricultural Experiment Station Cottage	10/15/2001	Building	Raleigh
70000475	North Carolina Executive Mansion	2/26/1970	Building	Raleigh
76001343	North Carolina School for the Blind and Deaf Dormitory	8/11/1976	Building	Raleigh
70000476	North Carolina State Capitol	2/26/1970	Building	Raleigh
87000855	North Carolina State Fair Commercial & Education Buildings	6/5/1987	Building	Raleigh
100002930	Oak Grove Cemetery	9/14/2018	Site	Raleigh
91000359	Oak View	4/3/1991	District	Raleigh
74001380	Oakwood Historic District	6/25/1974	District	Raleigh
87002235	Oakwood Historic District (Boundary Increase II)	1/6/1988	District	Raleigh
88003044	Oakwood Historic District (Boundary Increase III)	1/9/1989	District	Raleigh
87001787	Oakwood Historic District (Boundary Increase)	10/21/1987	District	Raleigh
100002931	Oberlin Cemetery	9/14/2018	Site	Raleigh
03000929	Occidental Life Insurance Company Building	9/11/2003	Building	Raleigh
97001498	Odd Fellows Building	12/1/1997	Building	Raleigh
100000941	O'Kelly, Berry, Historic District	5/11/2017	District	Raleigh
01000421	Panther Branch School	5/8/2001	Building	Raleigh
94001088	Paschal House	9/21/1994	Building	Raleigh
73001377	Peace College Main Building	6/19/1973	Building	Raleigh
02000165	Penny, Jesse, House and OutBuildings	3/13/2002	Building	Raleigh

Ref#	Property Name	Status Date	Category	City
89000441	Pilot Mill	6/5/1989	District	Raleigh
06000789	Pine Hall	9/6/2006	Building	Raleigh
97001499	Pine Street Creamery, (Former)	12/1/1997	Building	Raleigh
77001012	Polk, Leonidas L., House	4/13/1977	Building	Raleigh
99001392	Pope, Dr. M.T., House	11/22/1999	Building	Raleigh
83001925	Professional Building	9/8/1983	Building	Raleigh
76001344	Pullen Park Carousel	9/8/1976	Structure	Raleigh
93000543	Raleigh Banking and Trust Company Building	6/17/1993	Building	Raleigh
06000790	Raleigh Bonded Warehouse	8/24/2006	Building	Raleigh
97001305	Raleigh Electric Company Power House	10/30/1997	Building	Raleigh
97000022	Raleigh National Cemetery	1/31/1997	Site	Raleigh
71000625	Raleigh Water Tower	12/16/1971	Building	Raleigh
99001452	Raleigh Water Works and E.B. Bain Water Treatment Plant	11/22/1999	Building	Raleigh
78001980	Raleigh, Sir Walter, Hotel	8/11/1978	Building	Raleigh
94001087	Ritcher House	9/21/1994	Building	Raleigh
03000389	Roanoke Park Historic District	5/9/2003	District	Raleigh
11000893	Rochester Heights Historic District	12/7/2011	District	Raleigh
79001759	Rogers-Bagley-Daniels-Pegues House	3/21/1979	Building	Raleigh
05000321	Rothstein, Mae and Philip, House	4/15/2005	Building	Raleigh
97001593	Royal Baking Company	12/30/1997	Building	Raleigh
71000626	Seaboard Coast Line Railroad Company Office Building	5/6/1971	Building	Raleigh
94001086	Small House	9/21/1994	Building	Raleigh
94001085	Small, G. Milton, and Associates, Office Building	9/21/1994	Building	Raleigh
83004003	Spring Hill	12/29/1983	Building	Raleigh
100004791	St. Ambrose Episcopal Church	12/23/2019	Building	Raleigh
80002903	St. Augustine's College Campus (Additional Documentation)	8/20/2021	District	Raleigh
70000477	St. Mary's Chapel	11/20/1970	Building	Raleigh
78001981	St. Mary's College	12/19/1978	District	Raleigh
01000416	St. Matthews School	4/25/2001	Building	Raleigh
80004607	St. Paul A.M.E. Church	11/5/1987	Building	Raleigh
70000478	State Bank of North Carolina	7/1/1970	Building	Raleigh
75001297	Tucker Carriage House	2/13/1975	Building	Raleigh
14001024	Tucker, Garland Scott and Toler Moore, House	12/10/2014	Building	Raleigh
02000499	Turner, John T. and Mary, House	5/16/2002	Building	Raleigh
03000391	Vanguard Park Historic District	5/9/2003	District	Raleigh

Ref#	Property Name	Status Date	Category	City
14001025	Wachovia Building Company Contemporary Ranch House	12/10/2014	Building	Raleigh
04001584	Washington Graded and High School	2/2/2005	Building	Raleigh
08001388	Welles, Paul and Ellen, House	1/29/2009	Building	Raleigh
03001300	West Raleigh Historic District	12/18/2003	District	Raleigh
71000627	White-Holman House	4/16/1971	Building	Raleigh
90001030	Wyatt, Leonidas R., House	7/5/1990	Building	Raleigh
70000479	Yates Mill	2/26/1970	Building	Raleigh
94001025	Perry Farm	8/26/1994	Building	Riley Hill
89002158	Green-Hartsfield House	12/21/1989	Building	Rolesville
02001728	Heartsfield-Perry Farm	1/23/2003	Building	Rolesville
03000966	Young, Dr. Lawrence Branch, House	9/25/2003	Building	Rolesville
93001021	Oaky Grove	9/30/1993	Building	Shotwell
85002418	Rogers-Whitaker-Haywood House	9/19/1985	Building	Wake Crossroads
10001097	Bailey-Estes House	12/28/2010	Building	Wake Forest
02000059	Downtown Wake Forest Historic District	2/20/2002	District	Wake Forest
93000998	DuBois, W. E. B., School	10/5/1993	Building	Wake Forest
84000118	Forestville Baptist Church	10/25/1984	Building	Wake Forest
99001046	Glen Royall Mill Village Historic District	8/27/1999	District	Wake Forest
16000880	Jones, Dr. Calvin, House	12/22/2016	Building	Wake Forest
75001298	Lea Laboratory	5/29/1975	Building	Wake Forest
100008854	Mutschler, William and Barbara, House	4/21/2023	Building	Wake Forest
98000689	Oakforest	6/11/1998	Building	Wake Forest
74001381	Powell House	10/15/1974	Building	Wake Forest
08001016	Purefoy-Chappell House and OutBuildings	10/22/2008	Building	Wake Forest
88000238	Purefoy-Dunn Plantation	3/24/1988	District	Wake Forest
97000788	Purefoy-Dunn Plantation (Boundary Decrease)	7/25/1997	District	Wake Forest
07000879	Rock Cliff Farm	8/29/2007	District	Wake Forest
91001504	Royall Cotton Mill Commissary	10/16/1991	Building	Wake Forest
14000265	South Brick House	5/27/2014	Building	Wake Forest
05001030	William Thompson House	9/15/2005	Building	Wake Forest
03001301	Wake Forest Historic District	12/18/2003	District	Wake Forest
02001719	Wakefield Dairy Complex	1/15/2003	Building	Wake Forest
74001378	Wakefields	10/16/1974	Building	Wake Forest
03000928	Avera, Dr. Thomas H., House	9/11/2003	Building	Wendell
07001504	Harmony Plantation	1/29/2008	Building	Wendell
01000415	Riley Hill School	4/25/2001	Building	Wendell

Ref#	Property Name	Status Date	Category	City
01001113	Sunnyside	10/15/2001	Building	Wendell
09000382	Wendell Boulevard Historic District	6/3/2009	District	Wendell
98000947	Wendell Commercial Historic District	7/31/1998	District	Wendell
06000788	Davis-Adcock Store	9/6/2006	Building	Wilbon
03000931	Smith, Frank and Mary, House	9/11/2003	Building	Willow Spring
05000549	Smith, Turner and Amelia, House	6/10/2005	Building	Willow Spring
07000881	Barbee, George and Neva, House	8/28/2007	Building	Zebulon
86000157	Bunn, Bennett, Plantation	2/4/1986	Building	Zebulon
76001345	Wakelon School	5/13/1976	Building	Zebulon
100007603	Zebulon Historic District	8/26/2022	District	Zebulon

Source: National Parks Service, National Register of Historic Places, May 2024

The Historic Resilience Project, supported by the North Carolina State Historic Preservation Office, the North Carolina Department of Natural and Cultural Resources, North Carolina State University, and the University of North Carolina at Chapel Hill, provides information and resources related to historic structure resilience, including an introduction to resilience for North Carolina communities, a planning handbook, model design standards for historic resilience, and training modules on mitigation and recovery.

3.5 HOUSING

According to the 2022 ACS 5-Year Estimates, there are 466,760 housing units in Wake County, of which 92.2 percent are occupied. Approximately 35.7% of occupied units are renter-occupied. A high percentage of renters is an indicator of higher pre- and post-disaster vulnerability because, according to Cutter et al. (2003), renters often do not have the financial resources of homeowners, are more transient, are less likely to have information about or access to recovery aid following a disaster and are more likely to require temporary shelter following a disaster[2]. Higher rates of home ownership in some jurisdictions, including Fuquay-Varina, Holly Springs, Rolesville, and Wake Forest may indicate that more residents in these areas are able to implement certain mitigation actions in and around their properties.

Table 3.7 provides housing characteristics for each jurisdiction. The median home value in Wake County is $385,700. Of the County's owner-occupied housing units, 74.4 percent have a mortgage. Nearly 67.9 percent of householders moved into their current homes since the year 2010, and another 18.3 percent moved in between 2000 and 2009, which is indicative of the extreme growth the area has been experiencing and could indicate that many residents may be new to the area they live in. Householders of 4.0 percent of occupied housing units have no vehicle available to them; these residents may face significant difficulty in the event of an emergency evacuation. Roughly 59 percent of housing units in Wake County are detached single family homes, and another 10.8 percent are attached single family homes. Approximately 2.7 percent of units are mobile homes, which can be more vulnerable to certain hazards like tornadoes and windstorms, especially if they aren't properly secured.

The County's housing stock is relatively new, with over 45 percent of all units built since 2000. Age can indicate the potential vulnerability of a structure to certain hazards. For example, Wake County first entered the National Flood Insurance Program in 1978. Therefore, based on housing age estimates at least 19 percent of housing in the County was built before any floodplain development restrictions were

[2] Cutter et al. (2003). https://www.jstor.org/stable/42955868

required. Several jurisdictions did not enter the NFIP until years later; therefore, the actual percentage of housing built without floodplain development restrictions may be higher.

Table 3.7 – Housing Characteristics

Jurisdiction	Housing Units (2020)	Housing Units (2022)	Housing Units Percent Change (2020-2022)	Owner-Occupied, Percent (2022)	Vacant Units, Percent (2022)	Median Home Value (2022)
Wake County	**462,582**	**466,760**	**0.9%**	**64.3%**	**7.8%**	**$385,700**
Apex	22,151	24,318	9.8%	75.3%	5.6%	$458,200
Cary	70,171	70,780	0.9%	66.8%	6.6%	$477,400
Fuquay-Varina	13,204	13,028	-1.3%	71.9%	4.4%	$364,200
Garner	13,779	13,367	-3.0%	63.9%	7.5%	$288,900
Holly Springs	14,237	14,364	0.9%	82.2%	5.3%	$449,600
Knightdale	7,635	7,714	1.0%	64.8%	3.6%	$305,500
Morrisville	11,757	12,305	4.7%	50.4%	9.4%	$429,600
Raleigh	208,114	211,412	1.6%	51.1%	10.2%	$347,000
Rolesville	3,086	3,152	2.1%	91.1%	3.3%	$422,000
Wake Forest	17,828	17,754	-0.4%	73.5%	5.3%	$397,300
Wendell	3,868	3,962	2.4%	73.6%	5.1%	$306,800
Zebulon	2,682	2,804	4.5%	60.3%	6.1%	$213,100

Source: U.S. Census Bureau, 2020 Decennial Census, American Community Survey 2022 5-Year Estimates
Note: Owner-Occupied and vacant-unit measures are reported as a percent of the total number of housing units.

3.6 INFRASTRUCTURE

3.6.1 TRANSPORTATION

There are several major roadways that cross Wake County. The most prominent is Interstate 40 which runs through the county on an east-west track. It has two spurs that encompass a large area near the City of Raleigh and provide access to many of the outlying municipalities. In conjunction with I-40, I-440 makes up the "Beltline" that encircles most of central Raleigh. Additionally, I-540/NC-540 is a partly completed loop that is outside the beltline that currently connects many of the northern and western municipalities. In addition to the Interstate, there are many major highways that traverse the county. Federal highways of note are US-1, US-64, US-264, US-70, and US-401, while state highways in the county include NC-39, NC-42, NC-50, NC-54, NC-55, NC-96, NC-98, and NC-231.

Raleigh-Durham International Airport (RDU) is the primary commercial airport in the region. It is one of the largest airports in the state and serves more than 35 international and domestic locations and over 14.5 million passengers a year (highest annual traffic on record) as of 2023.

There are two Amtrak railway facilities in Wake County, located in Cary and Raleigh respectively. The Cary station and Raleigh Union station both serve the Carolinian, Piedmont, and Silver Star routes. The Research Triangle Regional Public Transit Authority (GoTriangle) already operates a bus system connecting the areas between Raleigh, Durham, and Chapel-Hill, with proposed plans to connect more municipalities in Wake, Durham, and Johnston counties through a future commuter rail project. Proposed development of the S-Line rail corridor through the Southeast, recently awarded to North Carolina in late

2023 in the form of a $1.09 billion discretionary federal grant, would also include direct stops through multiple municipalities of Wake County and could subsequently generate many promising economic and development opportunities in the future. There are also several intra-county bus lines that provide service between Wake County municipalities.

3.6.2 UTILITIES

Electric power for the county is provided by Duke Energy and Wake Electric Membership Corporation, with Duke Energy providing service to a majority of the county. Water and sewer service is provided by the City of Raleigh Public Utilities, Western Wake Partners, and various municipal public works departments. Natural gas is provided by Dominion Energy (formerly PSNC Energy).

3.7 CURRENT AND FUTURE LAND USE

Current and future land uses in Wake County are predominantly regulated at the jurisdictional level. The Wake County Planning Department provides public planning services to the unincorporated areas of Wake County. The department plans for general land use classifications, water supply watersheds, and development of small area land use plans. Figure 3.7 below shows these general classifications along with the areas planned for in more detail as part of the PLANWake Comprehensive Plan. Further information on land use planning in Wake County is available on the department website[3].

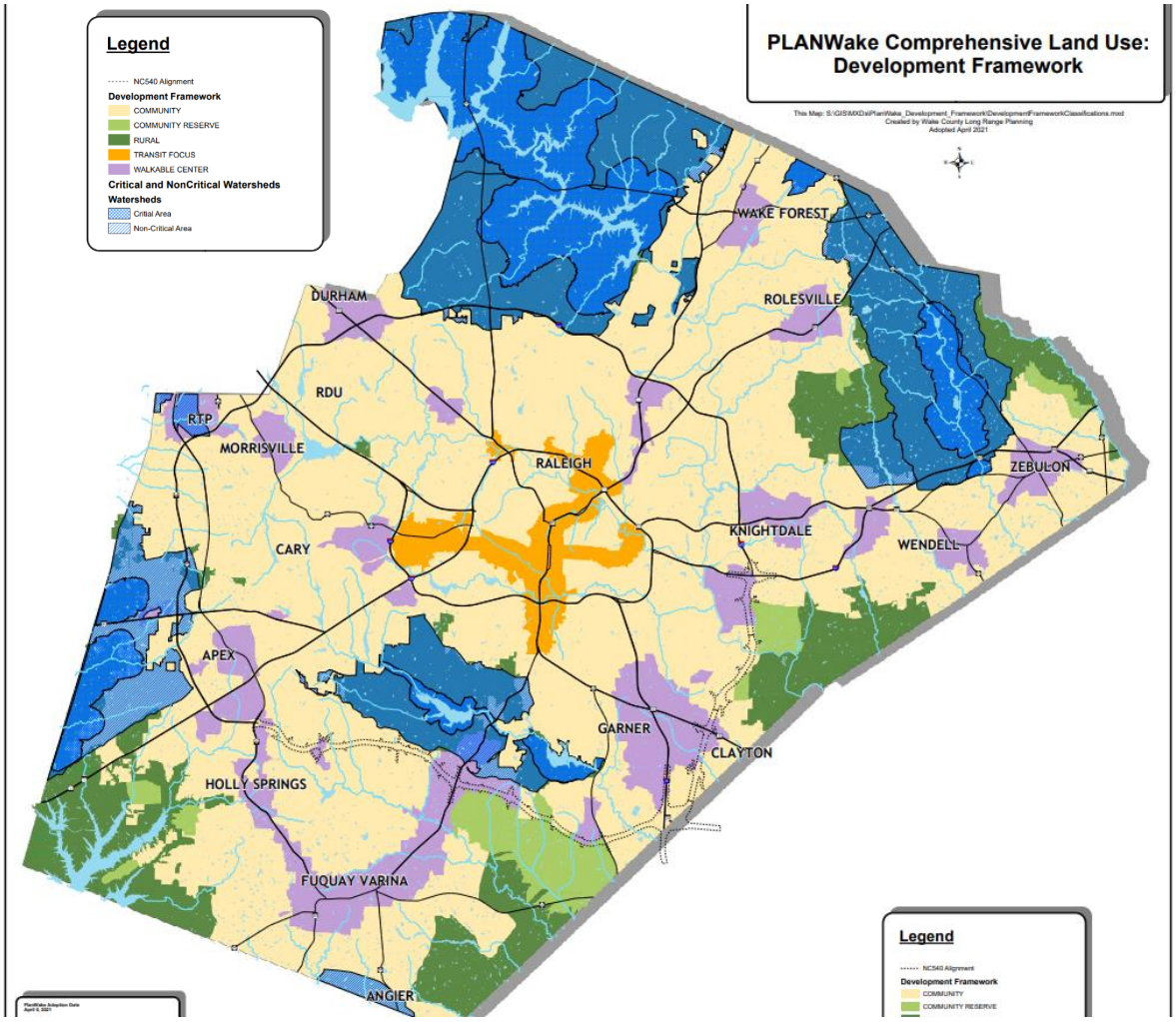
As shown in Figure 3.8 and Figure 3.9, the City of Raleigh has a significant land use footprint in Wake County seeing as it represents nearly 17.6 percent of the County's total land area. Its position as a large financial and industrial hub means that its land use policies may have far-reaching implications both in and around its jurisdictional boundaries.

GROWTH AND DEVELOPMENT TRENDS

According to the North Carolina Office of State Budget and Management (OSBM), Wake County is projected to reach a population of 1,489,610 by 2035, which represents a 31 percent increase from the 2020 population estimate. The PLANWake Comprehensive Plan, adopted April 2021, contains a broad development framework map as shown below to help identify targeted areas of growth planned throughout Wake County. This includes areas specifically identified as a transit focus, walkable center, community, community reserve, rural, and water supply watershed in addition to proposed commuter rail and BRT corridors for an idea of anticipated development trends. Multiple area-specific plans have also received updates in recent years and now serve to steer future growth and development throughout the unincorporated parts of the County.

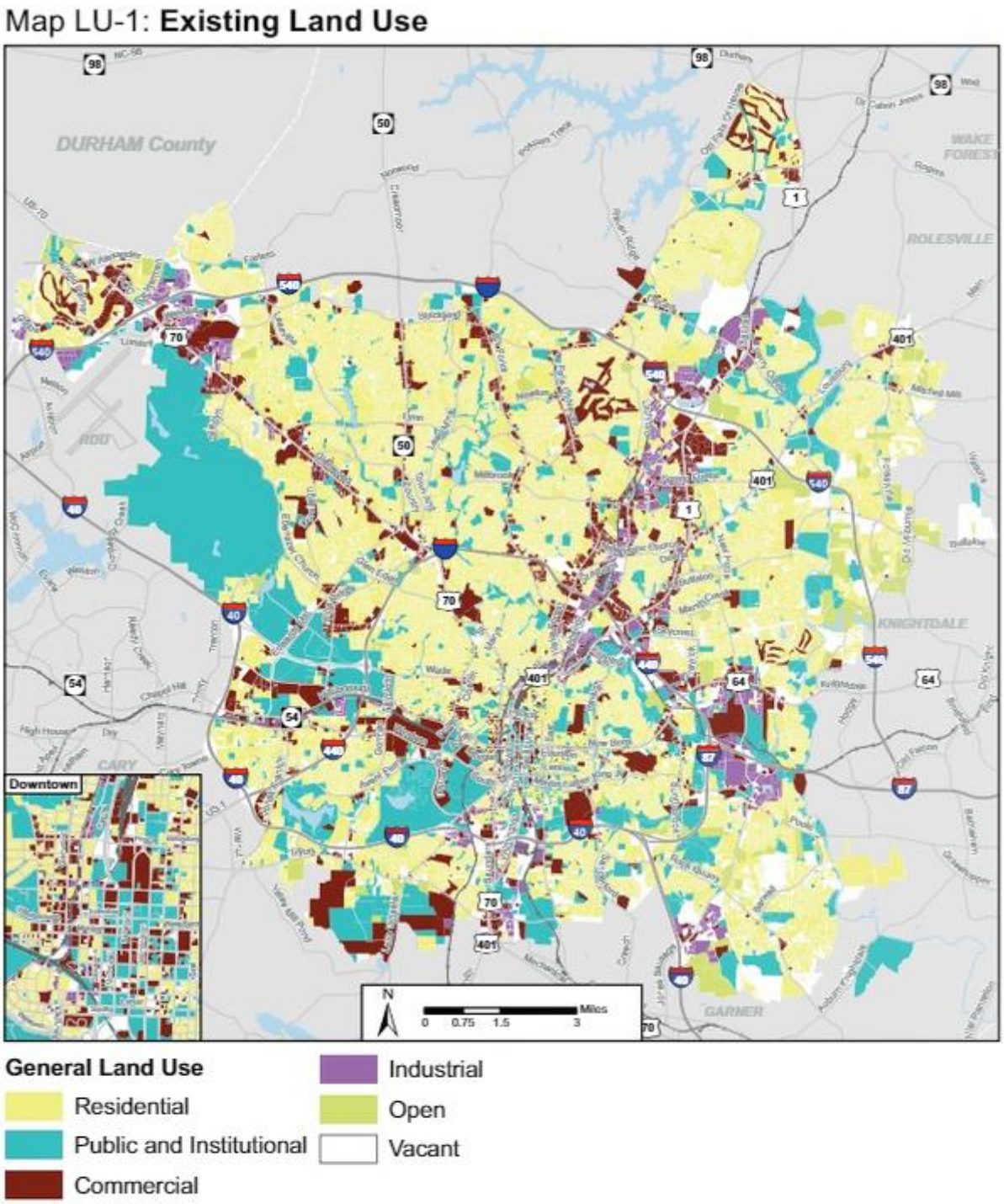
[3] Wake County Planning. https://www.wake.gov/departments-government/planning-development-inspections/planning

Figure 3.7 – Wake County Development Framework (Adopted April 2021)



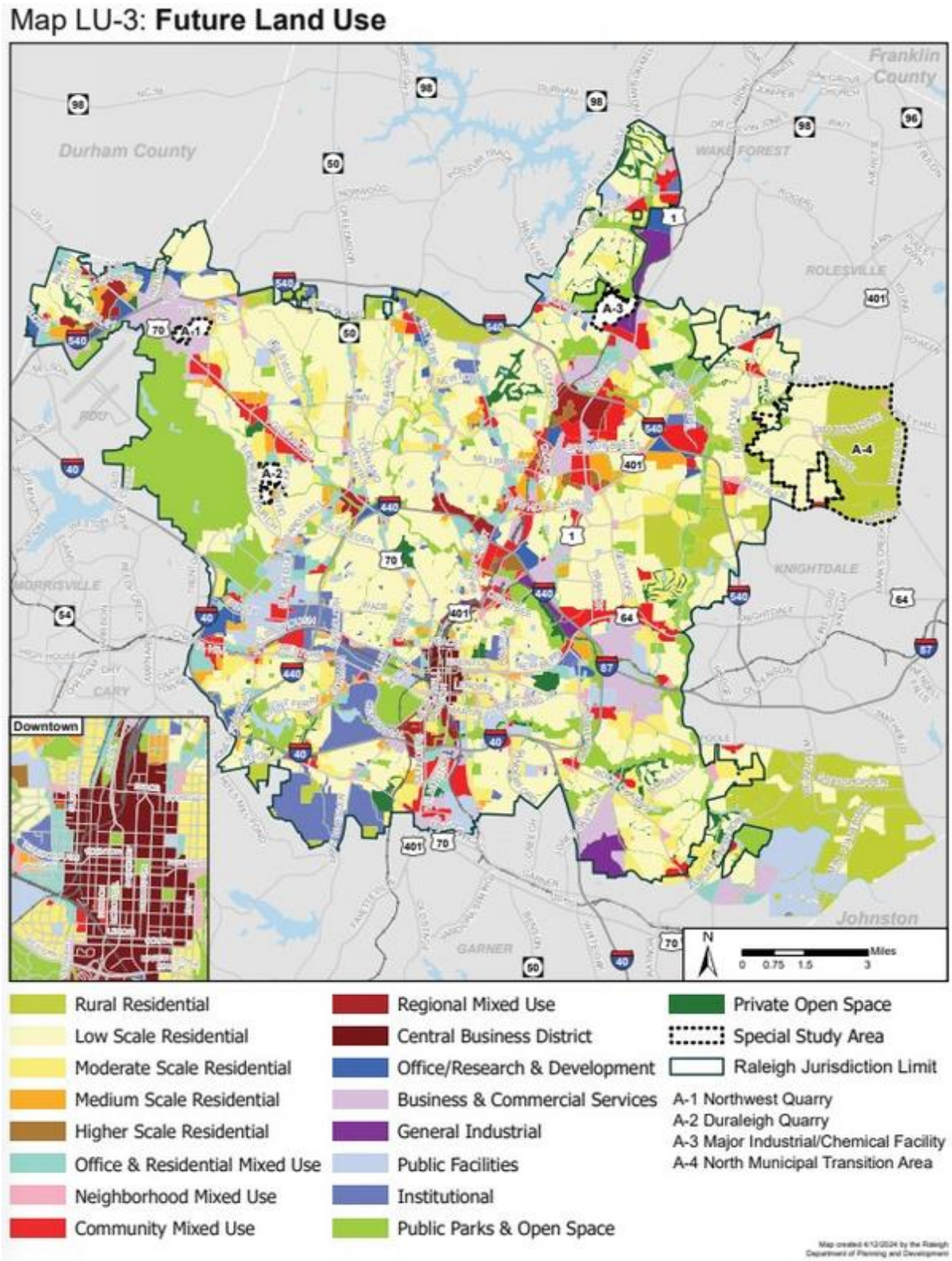
Source: Wake County Planning Department

Figure 3.8 – City of Raleigh Land Use (Updated April 2024)



Source: City of Raleigh 2030 Comprehensive Plan

Figure 3.9 – City of Raleigh Future Land Use (Updated April 2024)



Source: City of Raleigh 2030 Comprehensive Plan

3.8 EMPLOYMENT AND INDUSTRY

Wake County is best known as being home of the capital of North Carolina, Raleigh, and is home to many government agencies and functions. Many state agencies are located in Wake County as are many federal agencies. Wake County is also one of three counties that comprise the Research Triangle metropolitan region, named for the Research Triangle Park (RTP) which encompasses the three major metropolitan areas of Chapel-Hill, Durham, and Raleigh. Each of these metropolitan areas is home to a major research university (UNC-Chapel Hill, Duke, and NC State University, respectively) and RTP draws on these universities for its workforce. The Research Triangle Park is a hub of high-tech and biotech research and is a defining feature of the economy in Wake County. As of 2024, it is reportedly home to over 375 companies and 60,000 employees.

The early modern economy Wake County was built around agriculture and government, as the state capital of Raleigh was established in 1793. Since that time, much of the growth and economic well-being of the county has been linked to the county's status as a hub of government. While the county's position as home to the state capital remains important, in recent decades, the county's economic focus has shifted closer towards the rapidly developing fields of information technology and healthcare. Specifically, the four target industries currently highlighted by Wake County Economic Development include life sciences, IT/technology, clean tech/smart grid, and advanced manufacturing[4].

3.8.1 WAGES AND EMPLOYMENT

As per the 2018-2022 American Community Survey 5-Year Estimates, the median household income for the Wake County was $96,734 which is over 46 percent higher than the state's median household income ($66,186). However, approximately 8.2 percent of the population is reported as living below the poverty level. Moreover, approximately 9.6 percent of people under 18 years of age are living below the poverty level.

Table 3.8 shows employment statistics for all participating jurisdictions. Table 3.9 shows occupation statistics for all participating jurisdictions.

Table 3.8 – Employment Statistics for Wake County

Jurisdiction	Population in Labor Force	Percent Employed* (%)	Percent Unemployed* (%)	Percent Not in Labor Force* (%)	Unemployment Rate (%)
Wake County	**628,298**	**66.9**	**2.9**	**30.1**	**4.2**
Apex	35,845	70.6	3.0	26.3	4.1
Cary	96,589	67.7	2.4	29.9	3.4
Fuquay-Varina	17,820	65.5	2.3	31.9	3.4
Garner	17,849	65.1	4.0	30.8	5.8
Holly Springs	21,786	70.7	2.6	26.4	3.5
Knightdale	14,647	72.5	4.5	23.0	5.9
Morrisville	17,611	71.7	2.7	25.4	3.6
Raleigh	267,849	66.6	3.2	30.2	4.5
Rolesville	4,566	65.2	2.5	32.3	3.7
Wake Forest	25,523	66.8	3.0	29.9	4.3
Wendell	6,111	71.9	0.3	27.6	0.4

[4] Wake County Economic Development. (2024). https://raleigh-wake.org/target-industries

Jurisdiction	Population in Labor Force	Percent Employed* (%)	Percent Unemployed* (%)	Percent Not in Labor Force* (%)	Unemployment Rate (%)
Zebulon	3,503	55.0	5.5	39.5	9.0

Source: U.S. Census Bureau, American Community Survey 2022 5-Year Estimates
Note: This table reports only the civilian labor force. The labor force in armed services accounted for 0.3% or less of the population 16 and over in all jurisdictions. *Population employed, population unemployed, and population not in labor force are reported as a percent of the total population aged 16 years and older.

Table 3.9 – Percent of Employed Population by Occupation for Wake County

Occupation	Management, business, science and arts (%)	Service (%)	Sales and Office (%)	Natural Resources, Construction, and Maintenance (%)	Production, transportation, and material moving (%)
Wake County	**55.7**	**12.2**	**19.0**	**5.3**	**7.8**
Apex	63.5	8.4	20.2	3.6	4.3
Cary	67.4	8.8	15.1	2.9	5.7
Fuquay-Varina	52.8	15.9	17.7	5.1	8.5
Garner	48.1	12.8	21.0	9.3	8.8
Holly Springs	61.9	9.2	18.7	2.6	7.5
Knightdale	49.6	14.2	21.1	3.9	11.1
Morrisville	69.5	9.0	13.7	2.1	5.6
Raleigh	51.7	13.7	20.6	5.5	8.6
Rolesville	63.5	5.0	22.8	4.3	4.5
Wake Forest	62.4	9.8	17.6	3.4	6.9
Wendell	40.3	17.3	23.2	11.5	7.8
Zebulon	36.0	12.2	18.4	14.5	18.8

Source: U.S. Census Bureau, American Community Survey 2022 5-Year Estimates

Across the County as a whole, major industry sectors include educational services, and health care and social assistance (20.7 percent of employment in 2022); professional, scientific, and management, and administrative and waste management services (21.5 percent of employment in 2022); and retail trade (9.5 percent of employment in 2022). Wake County accounts for the majority of its own employment, as approximately 85.3 percent of workers worked in their county of residence as of 2022. Much of the employment outside the County is likely accounted for by the other cities of the Research Triangle including Durham (Durham County) and Chapel Hill (Orange County).

Table 3.10 summarizes the major employers with 5,000 employees or more in Wake County according to Wake County Economic Development.

Table 3.10 – Major Employers in Wake County

Employer	Estimated Employee Count
Duke University and Health System	43,108
State of North Carolina	24,083
Wake County Public School System	17,000
Wal-Mart	16,800
University of North Carolina at Chapel Hill	12,204
WakeMed Health and Hospitals	10,307
Food Lion	9,037

Employer	Estimated Employee Count
North Carolina State University	9,019
IBM (International Business Machines)	9,000
Target Stores	8,400
UNC Rex Healthcare System	7,700
Fidelity Investments	5,968
Harris Teeter	5,300
Lenovo	5,100
Cisco Systems	5,000

Source: Wake County Economic Development

3.9 SOCIAL VULNERABILITY ASSESSMENT

Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human caused threats, such as toxic chemical spills. That is to say that even if different groups share similar exposure to a hazard, some groups may have a greater capacity to anticipate, cope, and recover from a disaster than others. Social vulnerability often refers to the population characteristics that have historically put certain groups of people at varying risk when they are exposed to the impacts of a hazard event (Cutter, 2003; Berke et al., 2019). Common and determining characteristics include age, gender, income, race, and ethnicity, and language capacity (Cutter et al., 2003; Berke et al., 2015). However, additional characteristics can include social networks, education, cultural knowledge, and political power (Otto et al., 2017). Social vulnerability considerations were included in this plan update to identify areas across the County that might be more vulnerable to hazard impacts based on a number of factors.

As discussed in the Population and Demographics section, the Centers for Disease Control and Prevention (CDC) has developed a social vulnerability index (SVI) to measure the resilience of communities when confronted by external stresses such as natural or human-caused disasters or disease outbreaks. Results are presented via a score ranging from 0 (lowest vulnerability) to 1 (highest vulnerability). The overall SVI score reported for Wake County as of 2020 is 0.1313 which indicates a low level of vulnerability. Figure 3.6 provides an overview by census tract. Within the limits of Wake County, the most vulnerable residents live near the central and eastern portions, predominantly in and around the City of Raleigh according to 2022 SVI data.

NON-ENGLISH-SPEAKING POPULATION

According to the American Community Survey 2022 5-year estimates, roughly 17.9 percent of the Wake County population over the age of five speaks a language other than English. Of that population, approximately 32 percent speak English "less than very well." The most prominent language spoken other than English is Spanish, with 7.8 percent of the non-English speaking population speaking Spanish.

In its justification of SVI indicators, the CDC explains that disaster communication is made increasingly difficult for those with limited English proficiency. This difficulty is especially true in communities whose first language is neither English nor Spanish, and for whom translators and/or accurate translations of advisories may be scarce.

SPECIAL NEEDS POPULATION

Approximately 99,399 residents or 8.8 percent of Wake County's population identify as having some form of disability including hearing, vision, cognitive, ambulatory, self-care, and/or independent living

difficulties. Lack of public transportation options could pose significant issues for special needs populations during an emergency or disaster.

HOMELESS POPULATION

In 2018, for the first time, HUD's Annual Homeless Assessment Report included the number of people experiencing homelessness who were sheltering in locations specifically for people displaced by presidentially declared natural disasters. The report found 3,864 displaced and homeless individuals. Additionally, the National Low Income Housing Coalition explains that people experiencing homelessness are particularly vulnerable during natural disasters and are often subject to discrimination during recovery. Resources are often prioritized for those displaced during disasters, despite the case that there is no difference between those that were made homeless by a hazard event and those who otherwise lack stable housing.

According to the most recent 2023 Point-In-Time Count conducted by the Wake County Continuum of Care (CoC), roughly 683 households and 916 persons experienced homelessness, with 354 persons facing chronic homelessness. The Wake County Network of Care lists five access sites for a coordinated entry assessment of homelessness: Oak City Cares (adult individuals and families), Haven House (youth and young adults aged 18-24), St. John's Metropolitan Community Church (adult individuals), Women's Center of Wake County (single women), and Salvation Army of Wake County (families with children).

INMATES

The Wake County Sheriff's Office inmate search application indicates that there are approximately 1,433 inmates in the Wake County Jail System between two detention facilities as of 2024. This incarcerated population could require special planning during a hazard event depending on the location of jail facilities in the county. Additional planning for food, water, and health care may need to be considered.

POVERTY

According to the American Community Survey 2022 5-year estimates, 8.2 percent of the total population in Wake County was below the poverty level. In its justification of SVI indicators, the CDC explains that economically disadvantaged populations are disproportionately affected by disasters. Low-income residents are less likely to have the income or assets necessary to prepare for a possible disaster or to recover after a disaster (Cutter et al., 2003). For low-income households, lost or damaged property is proportionately more expensive to replace, especially without homeowner's or renter's insurance. Unemployed individuals may also not have access to benefits plans that provide income and health cost assistance in the event of injury. Additionally, housing quality and access is closely tied to socio-economic status. Low-income households may live in less structurally sound houses or mobile homes, which are particularly vulnerable to strong storms or earthquakes.

MINORITY STATUS

The CDC indicates that, "social and economic marginalization of certain racial and ethnic groups, including real estate discrimination, has rendered minority populations more vulnerable at all stages of disaster and hazard events." Similarly, the Urban Sustainability Network explains that, in the U.S., race is a major determinant of life outcomes. Like housing, it is inextricably tied to income and wealth. Further, race is a reliable predictor of hazard risk, including vulnerability to many of the hazards projected to intensify under changing climate conditions.

Historical and current discriminatory practices have resulted in the inequitable distribution of resources and access to opportunities for many lower-income populations and communities of color. The result is that social inequities can increase disproportionate risk and vulnerability in these communities.

It should be noted that approximately 7.3 percent of the County's population includes non-U.S. citizens, however, this number is likely under-reported. Immigrants and undocumented residents often face increased vulnerability during and after hazard events. Challenges include limited language proficiency; limited knowledge of local environmental conditions, including natural hazards, legal framework and institutions, and markets; limited social networks; lack of trust in authorities; restrictions on mobility; and discrimination. All these challenges can make it difficult for immigrant communities to access necessary information, resources, and opportunities to prepare, cope with, and recover from hazard events.

3.10 JURISDICTION INFORMATION

The following information pertains to social vulnerability, growth and development, and land use trends observed among the unique jurisdictions located in Wake County. Social vulnerability data comes from sources such as the Social Vulnerability Index (SVI) and Environmental Justice Index[5] (EJI) published by the Centers for Disease Control Agency for Toxic Substances and Disease Registry (CDC/ATSDR) as well as statistics from the United States Census Bureau. Growth and development trends along with supporting land use information are identified from municipal planning resources where available[6].

3.10.1 TOWN OF APEX

3.10.1.1 SOCIAL VULNERABILITY

Several census tracts near the central Apex area are rated as a low-medium and medium-high level of social vulnerability based on 2022 SVI data. These tracts have higher ratings in the housing type & transportation vulnerability theme and the household characteristics theme, which covers age, disability status, household composition, and language. One census tract around the Apex area is rated as low to moderate impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Apex also note that approximately 4 percent of people over the age of five have limited English proficiency, 6.3 percent have a disability, and 2.6 percent live below the poverty level.

3.10.1.2 GROWTH AND DEVELOPMENT TRENDS

The population of Apex grew by approximately 56.8 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Advance Apex: The 2045 Plan documentation as of 2019, three guiding principles of the updated 2045 Land Use Map include preservation of rural character in its western areas, creation of walkable mixed-use areas, and further investment in key corridors and emerging activity centers. Additionally, major factors expected to drive future development include (1) readily available water and sewer infrastructure, (2) completion of NC 540 and other roadway improvements, (3) completion of the Apex Peakway, (4) Pleasant Park surrounding areas, (5) rural preservation and mixed-use investment initiatives, and (6) draws of high-quality schools and the local park system. Proposed development of the S-Line rail corridor through the Southeast, recently awarded to North Carolina in late 2023 in the form of a $1.09 billion discretionary federal grant, could eventually include Apex as a direct stop as a future phase and could generate many promising economic and development opportunities in the future.

[5] CDC/ATSDR Environmental Justice Index. https://www.atsdr.cdc.gov/placeandhealth/eji/index.html

[6] Please note that the information used in this section comes from officially adopted plans and data at the time of this Wake County plan update. As municipalities update their own plans and associated resources, please refer to the most recent and/or official version.

3.10.1.3 LAND USE

Documentation for the Advance Apex: The 2045 Plan indicates that the existing development/land use status (definitions included in planning documentation) of Apex is as follows in Table 3.11:

Table 3.11 – Apex Development Status

Development Category	Area (acres)	Percent of Planning Area
Developed	13,606	41.9%
Undeveloped	5,228	16.1%
Underdeveloped, Large Parcel	3,969	12.2%
Underdeveloped, Small Parcel	2,618	8.1%
Conserved Open Space	3,853	11.8%
Transportation Right-of-Way	3,162	9.7%

Source: Advance Apex: The 2045 Plan

3.10.2 TOWN OF CARY

3.10.2.1 SOCIAL VULNERABILITY

Multiple census tracts around the central Cary area are rated as low-medium and medium-high levels of social vulnerability, with some surrounding areas rated as low based on 2022 SVI data. Two census tracts around the central Cary area are rated as moderate to high impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Cary also note that approximately 24.9 percent of people over the age of five speak a language other than English, 7.2 percent have a disability, and 5.2 percent live below the poverty level.

3.10.2.2 GROWTH AND DEVELOPMENT TRENDS

The population of Cary grew by approximately 29.2 percent between the 2010 Decennial Census and 2020 Decennial Census. As noted in the Cary 2040 Community Plan amended in 2021, key growth and development trends include planning for an aging and diversifying population, limited land for development (18% of land in Town's jurisdiction available for development), increasing transportation demands, and demand for 21st century development options. Additionally, the proposed development of the S-Line rail corridor through the Southeast, recently awarded to North Carolina in late 2023 in the form of a $1.09 billion discretionary federal grant, would include Cary as a direct stop and could generate many promising economic and development opportunities in the future.

3.10.2.3 LAND USE

Land uses in Cary are guided by the Future Growth Framework as part of the Cary 2040 Community Plan which includes 15 distinct uses under the broad categories of live, engage, work, shop, and shape to classify the planning area of nearly 53,000 acres. Five special planning areas of note also include (1) Eastern Cary Gateway, (2) Downtown (with 6 subareas), (3) Historic Carpenter, (4) Green Level, and (5) Chatham County-Town of Cary Joint Planning Area.

3.10.3 TOWN OF FUQUAY-VARINA

3.10.3.1 SOCIAL VULNERABILITY

Census tracts around the Fuquay-Varina area have a variable rating of social vulnerability ranging from low, low-medium, and medium-high levels based on 2022 CDC SVI data. One census tract around the Fuquay-Varina area is rated as low to moderate impacts of environmental burden and one is rated as moderate to high impacts based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Fuquay-Varina also note that approximately 9.6 percent of people over the age of five speak a language other than English, 10.4 percent have a disability, and 10.6 percent live below the poverty level.

3.10.3.2 GROWTH AND DEVELOPMENT TRENDS

The population of Fuquay-Varina grew by approximately 90.4 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the 2040 Community Vision Land Use Plan adopted in 2022, development in Fuquay-Varina is driven by five identified growth factors including (1) market demand, (2) local economies and growth outlooks, (3) property owners' willingness to participate, (4) government regulations and policies, and (5) the availability and capacity of infrastructure. Analysis of twenty-year market potential in this plan also indicates that the ratio of for-sale to rental housing in Fuquay-Varina is roughly 4:1 with long-term potential for residential growth and that an extra 35,000 square feet of industrial land use may be demanded through 2035.

3.10.3.3 LAND USE

As seen in Table 3.12, the 2040 Community Vision Land Use Plan notes the share of land that is developed in the Fuquay-Varina planning area. The plan also describes ten guiding principles as part of the Fuquay-Varina Land Use Plan, which includes the Future Land Use Map (FLUM) and its associated character areas.

Table 3.12 – Fuquay-Varina Development Status

Development Category	Percent of Planning Area
Developed	39%
Undeveloped	48%
Underdeveloped	6%
Preserved	7%

Source: 2040 Community Vision Land Use Plan

3.10.4 TOWN OF GARNER

3.10.4.1 SOCIAL VULNERABILITY

Census tracts around the Garner area have a variable rating of social vulnerability ranging from low, low-medium, medium-high, and high levels based on 2022 SVI data. Multiple census tracts across the Garner area are rated as both low to moderate and moderate to high impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Garner also note that approximately 12.8 percent of people over the age of five speak a language other than English, 11.5 percent have a disability, and 5.4 percent live below the poverty level.

3.10.4.2 GROWTH AND DEVELOPMENT TRENDS

The population of Garner grew by approximately 21.0 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Garner Forward Comprehensive Plan adopted in 2023, development in Garner is driven by five identified growth factors including (1) market demand, (2) local economies and growth outlooks, (3) property owners' willingness to participate, (4) government regulations and policies, and (5) the availability and capacity of infrastructure. Analysis of twenty-year market potential in this plan also indicates that by 2040 Garner could have another 16,000 residential units added to its housing stock and 10 million square feet of industrial land use demands.

3.10.4.3 LAND USE

Land use in Garner is guided by the collective contents of the General Framework Map, Character Typology Map, and Development Change and Intensity Map included in the Garner Forward Comprehensive Plan. The General Framework Map is supported by nine major initiatives and includes eight classes to provide a general understanding of growth and conservation priorities. The Character Typology contains seven area categories that resemble a standard land use map, and the Development Change and Intensity Map contains multiple "levels" identified on a spectrum of development intensity.

3.10.5 TOWN OF HOLLY SPRINGS

3.10.5.1 SOCIAL VULNERABILITY

Several census tracts near the Holly Springs area are rated as a low-medium level of social vulnerability, with surrounding areas rated as low based on 2022 SVI data. Census tracts around the Holly Springs area are rated as low impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Holly Springs also note that approximately 12.8 percent of people over the age of five speak a language other than English, 4.8 percent have a disability, and 4.9 percent live below the poverty level.

3.10.5.2 GROWTH AND DEVELOPMENT TRENDS

The population of Holly Springs grew by approximately 67.2 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Vision Holly Springs Comprehensive Plan, the well-educated and stable workforce of the Town is anticipated to drive further industry expansion. As of 2019, multiple slated projects for the Town were projected to create roughly 100,000 square feet of new retail, restaurants, and office space. Recent growth of the UNC Rex Healthcare system could also have significant impacts on future investment, development, and employment around Holly Springs.

3.10.5.3 LAND USE

Land use in Holly Springs is guided by the Growth Strategy Map and Future Land Use Map (FLUM) included in the Vision Holly Springs Comprehensive Plan. The Growth Strategy Map identifies three key categories of places based on specific (1) places to preserve, (2) places to enhance, and (3) places to transform. The FLUM includes 12 distinct character area classes in addition to water bodies and high lake levels.

3.10.6 TOWN OF KNIGHTDALE

3.10.6.1 SOCIAL VULNERABILITY

Most census tracts around the Knightdale area have been rated at a social vulnerability level of medium-high and high based on 2022 SVI data. Several census tracts around the Knightdale area are rated as low to moderate impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Knightdale also note that approximately 11.9 percent of people over the age of five speak a language other than English, 8.7 percent have a disability, and 6.9 percent live below the poverty level.

3.10.6.2 GROWTH AND DEVELOPMENT TRENDS

The population of Knightdale grew by approximately 70.5 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the KnightdaleNext 2035 Comprehensive Plan adopted in 2018, Knightdale is one of the fastest growing towns within the fastest growing county of North Carolina (Wake). For instance, it has previously ranked 11th among the growth rates of all of North Carolina's 553 incorporated municipalities. Infill development and redevelopment are specifically identified as guiding principles for future planning efforts of the Town.

3.10.6.3 LAND USE

Land use in Knightdale is guided by a series of three maps included in the KnightdaleNext V.2 2035 Comprehensive Plan. The Intentional Growth Areas Map presents expectations for level of change and development intensity across the jurisdiction. The Urban Small Town Framework Map assigns future development into broad categories such as mixed-use, transit, or trail oriented. The Future Place Type Map refines designations into thirteen place types such as preserved open space, mixed use neighborhoods, and innovation centers.

3.10.7 TOWN OF MORRISVILLE

3.10.7.1 SOCIAL VULNERABILITY

Most census tracts around the Morrisville area have been rated at a social vulnerability level of low aside from one low-medium tract and one medium-high tract based on 2022 SVI data. One census tract around the Morrisville area is rated as moderate to high impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Morrisville also note that approximately 43.5 percent of people over the age of five speak a language other than English, 6.0 percent have a disability, and 5.8 percent live below the poverty level.

3.10.7.2 GROWTH AND DEVELOPMENT TRENDS

The population of Morrisville grew by approximately 59.5 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Morrisville Land Use Plan adopted in 2021, significant population and employment growth of Morrisville suggests that future development will be needed to properly accommodate it. However, local land availability is a primary concern in this context as discussed below. The proximity of the Town to both Raleigh-Durham International Airport and the rapidly expanding Research Triangle Park also positions it for intensified development in the coming years.

3.10.7.3 LAND USE

According to the Morrisville Land Use Plan, all land parcels within the Town's planning jurisdiction are assigned to 13 different future land use categories on the Future Land Use Map (FLUM). Additionally, the Existing Land Use Map provides an overview of existing land use conditions and contains 14 land use categories. As of 2021, it was estimated that the Town had an estimated 870 acres of undeveloped land, although a large portion of this may remain limited for development due to overlay districting of Raleigh-Durham International Airport and conflicting use compatibilities. Conversely, three subarea plans created for the Town Center, McCrimmon Extension, and TOD East elaborate on potential land use opportunities in Morrisville.

3.10.8 CITY OF RALEIGH

3.10.8.1 SOCIAL VULNERABILITY

Within the limits of Wake County, the most vulnerable residents live near the central and eastern portions, predominantly in and around the City of Raleigh according to 2022 SVI data. Multiple census tract areas of eastern and southeastern Raleigh demonstrate a very high level of social vulnerability approaching the highest possible score of 1 (> 0.95). Other areas to the southwest are mostly rated as low-medium and medium-high, while low ratings are observed to the north of downtown Raleigh. A similar trend of these findings is observed for EJI data. Multiple census tract areas of eastern and southeastern Raleigh are rated as high impacts of environmental burden, in addition to ratings of low to moderate and moderate to high impacts of environmental burden among tract areas to the southwest based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Raleigh also note that approximately 17.7 percent of people over the age of five speak a language other than English, 9.5 percent have a disability, and 11.8 percent live below the poverty level.

3.10.8.2 GROWTH AND DEVELOPMENT TRENDS

The population of Raleigh grew by approximately 15.8 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the most recently published 2020 Data Book for Raleigh, the total number of housing units has increased from 176,124 with a density of 1.91 units per acre in 2010 to over 202,417 with a density of 2.13 units per acre as of 2019. The 2020 Data Book also notes that 376 acres were annexed and added to the city limits in 2020, bringing the jurisdiction's grand total to approximately 94,985 acres. Future growth and development potential of Raleigh can be summarized in terms of acreages as seen in Table 3.13.

Table 3.13 – Future Raleigh City Limits Growth Potential

Geography	Acres
Current City Limits	94,985
Potential ETJ Growth Area	21,196
Potential USA Growth Area	18,624
Total Future Annexation Potential	39,820
Total Potential City Limits	134,805

Source: City of Raleigh Department of City Planning, 2020

Additionally, the proposed development of the S-Line rail corridor through the Southeast, recently awarded to North Carolina in late 2023 in the form of a $1.09 billion discretionary federal grant, would include Raleigh as a direct stop and could generate many promising economic and development opportunities in the future.

3.10.8.3 LAND USE

The City of Raleigh is Wake County's largest municipality by far and can be accessed via multiple interstates and federal highways. The largest individual land use share of the City's acreage (34,409 acres or 34%) consists of single-family residential whereas the other top land use allocations include vacant (19,656 acres or 19.6%) and parks, greenways, or open space (12,539 acres or 12.5%) as of 2016 data. Total land use allocations by main category are shown in Table 3.14. Additionally, the 2020 Data Book notes that the generalized zoning allocation is 64 percent residential districts, 25 percent mixed-use districts, and 11 percent special districts.

Table 3.14 – Raleigh Land Use Allocation

Land Use Category	Parcels	Acreage	Percent of Area
Residential	117,517	44,349.90	44.3
Public and Institutional	3,690	18,238.70	18.2
Commercial	3,509	10,662.30	10.6
Industrial	1,421	5,637.70	5.6
Open	18	1473.90	1.5
Mixed Use	115	123.6	0.1
Vacant	8,990	19,655.90	19.6
Total	**135,260**	**100,142.00**	**100.0**

Source: City of Raleigh Department of City Planning, 2015

Figure 3.8 and Figure 3.9 above, from the updated 2030 Comprehensive Plan[7], show the existing land use of Raleigh in contrast to its future land use. The most updated plan for 2030 proposes 19 different future land use categories, including multiple mixed-use categories which propose increased density and walkability. Section 5 of the 2030 Comprehensive Plan also lays out the City's initiatives to protect natural resources (e.g., flood reduction and preparedness, open space preservation) among many others.

3.10.9 TOWN OF ROLESVILLE

3.10.9.1 SOCIAL VULNERABILITY

Most census tracts around the Rolesville area have been rated as a social vulnerability level of low aside from one at low-medium based on 2022 SVI data. Census tracts around the Rolesville area are rated as low impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Rolesville also note that approximately 8.1 percent of people over the age of five speak a language other than English, 5.9 percent have a disability, and 1.7 percent live below the poverty level.

3.10.9.2 GROWTH AND DEVELOPMENT TRENDS

The population of Rolesville grew by approximately 150.3 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Rolesville Comprehensive Plan adopted in 2017, it is predominantly a bedroom community that is growing at an extremely fast pace seeing as the Town's population ballooned by nearly 600 percent from 2000 to 2015. The Rolesville Bypass is noted as a significant addition that is expected to continue drawing in more highway-oriented development to the nearby area. It is also anticipated that demand will continue to grow for more multi-family housing across the Town, mirroring trends observed in the larger Triangle Region and beyond.

[7] City of Raleigh 2030 Comprehensive Plan. https://raleighnc.gov/planning/services/2030-comprehensive-plan

3.10.9.3 LAND USE

Land use in Rolesville is guided by the Future Land Use Map (FLUM) which has 12 use categories. According to the Rolesville Comprehensive Plan, the primary land use is residential and represents approximately 50 percent of the Town's entire developed land stock. A full breakdown of the Town's total land use allocation by category can be seen in Table 3.15.

Table 3.15 – Rolesville Land Use Allocation

Land Use Category	Percent of Planning Area
Residential	50.2
Commercial	5.4
Industrial	0.2
Institutional	3.9
Green Space	0.8
Vacant	39.5

Source: Rolesville Comprehensive Plan 2017

3.10.10 TOWN OF WAKE FOREST

3.10.10.1 SOCIAL VULNERABILITY

Census tracts around the Wake Forest area have a variable rating of social vulnerability ranging from low, low-medium, medium-high, and high levels based on 2022 SVI data. Several census tracts around the Wake Forest area are rated as low to moderate impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Wake Forest also note that approximately 9.3 percent of people over the age of five speak a language other than English, 9.2 percent have a disability, and 3.0 percent live below the poverty level.

3.10.10.2 GROWTH AND DEVELOPMENT TRENDS

The population of Wake Forest grew by approximately 58.1 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Wake Forest Community Plan updated as of 2023, Wake Forest is among the top 10 fastest growing municipalities in North Carolina with its population projected to double over two decades. Growth and development objectives set forth in the growth strategy of the plan include (1) prioritizing infill development and reinvestment, (2) focusing on development and redevelopment within Town limits along with any available unincorporated areas, and (3) encouraging development in areas without any annexation requirements of non-contiguous land. Additionally, the proposed development of the S-Line rail corridor through the Southeast, recently awarded to North Carolina in late 2023 in the form of a $1.09 billion discretionary federal grant, would include Wake Forest as a direct stop and could generate many promising economic and development opportunities in the future.

3.10.10.3 LAND USE

According to the Wake Forest Community Plan, the Land Use Plan is intended to guide the appearance, character, form, and function of the entire community through proper land use allocation and intentional development patterns. It specifically identifies 10 future land use categories to be applied through the Town's planning efforts. Further detail is also provided by the Residential, Commercial and Industrial, and Downtown Area Plans.

3.10.11 TOWN OF WENDELL

3.10.11.1 SOCIAL VULNERABILITY

Most census tracts around the Wendell area have been rated as a social vulnerability level of medium-high based on 2022 SVI data. Several census tracts around the Wendell area are rated as low to moderate and high impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Wendell also note that approximately 13.7 percent of people over the age of five speak a language other than English, 19.8 percent have a disability, and 5.7 percent live below the poverty level.

3.10.11.2 GROWTH AND DEVELOPMENT TRENDS

The population of Wendell grew by approximately 67.5 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Blueprint Wendell 2030 Plan adopted in 2022, the Town is growing rapidly as market forces, affordable land, and proximity to regional destinations like Research Triangle Park continue to drive its development. Residential building permits have increased year-over-year since 2014 whereas commercial and non-residential uses have not experienced this same level of growth. Recent work on US 64 as part of the Interstate 87 corridor between Raleigh and Virginia has improved overall accessibility to Wendell as two emerging hubs of activity, one near Wendell Falls Boulevard and one near the I-87 and Rolesville Road interchange, continue to take shape. For the most part, development activity in recent years has also been concentrated in the western portions of the planning area.

3.10.11.3 LAND USE

Land use in Wendell is guided by the Future Land Use Map (FLUM) included in the Blueprint 2030 Plan. The Blueprint Wendell 2030 Plan specifically notes that an estimated 13,500 acres in the planning area are vacant or could potentially be redeveloped into land uses of higher intensity. This translates to approximately 65 percent of land in the planning area (28 percent of total land classified as vacant). A full breakdown of existing land availability by category can be seen in Table 3.16.

Table 3.16 – Wendell Existing Land Availability

Land Availability Category	Acres
Vacant	2,888
Exempt	2,913
Firm	4,566
Potential	5,543
High Potential	5,074

Source: Blueprint Wendell 2030

3.10.12 TOWN OF ZEBULON

3.10.12.1 SOCIAL VULNERABILITY

Census tracts around the Zebulon area have a variable rating of social vulnerability ranging from low-medium, medium-high, and high levels based on 2022 SVI data. Several census tracts around the Zebulon area are rated as low to moderate and high impacts of environmental burden based on 2022 EJI data. The ACS 2022 5-year estimates for the total population of Zebulon also note that approximately 24.2 percent

of people over the age of five speak a language other than English, 12.9 percent have a disability, and 11.6 percent live below the poverty level.

3.10.12.2 GROWTH AND DEVELOPMENT TRENDS

The population of Zebulon grew by approximately 55.7 percent between the 2010 Decennial Census and 2020 Decennial Census. According to the Zebulon Comprehensive Land Use Plan (CLUP) adopted in 2021, the Town is identified as a growing hub community and employment base for relocating metro residents around eastern Wake County as it has been experiencing a boom in housing construction. Areas for potential development exist around the watersheds of Little Creek and Beaverdam Creek in addition to significant portions of eastern and southern Zebulon. Places where development has already created a footprint include north of Pippin Road from NC 96 to the west and Shepard School Road to the east in addition to newer projects taking place to the south near Old Bunn Road.

3.10.12.3 LAND USE

Land use in Zebulon is guided by the Future Land Use and Character Map included in the Zebulon CLUP. A full breakdown of the future land use and character allocation in the Town's planning area based on this map can be seen in Table 3.17 and Table 3.18.

Table 3.17 – Zebulon Future Land Use Allocation

Future Land Use Category	Percent of Planning Area
Residential	72.8
Commercial	6.8
Mixed Use	8.7
Industrial	9.8
Parks & Recreation	1.9

Source: Zebulon Comprehensive Land Use Plan

Table 3.18 – Zebulon Future Character Allocation

Future Character Category	Percent of Planning Area
Rural	2.4
Suburban	53.8
Auto Urban	33.1
Urban	5.1
Mixed Character	5.5

Source: Zebulon Comprehensive Land Use Plan

4 RISK ASSESSMENT

Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.
Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

44 CFR Subsection D §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. Plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;

(B): An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate; and

(C): Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

4.1 OVERVIEW

This section describes the Hazard Identification and Risk Assessment process for the development of the Wake County Multi-Jurisdictional Hazard Mitigation Plan. It describes how the County met the following requirements from the 10-step planning process:

- Planning Step 4: Assess the Hazard
- Planning Step 5: Assess the Problem

As defined by FEMA, risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

This hazard risk assessment covers all of Wake County, including the unincorporated County and all incorporated jurisdictions participating in this plan. It should be noted that the City of Durham, the Town of Clayton, and the Town of Angier each have a small area of land that crosses into Wake County; however, risk was not assessed for these communities as they are not participants of this plan. Population and building counts presented in this risk assessment do not include these communities. Instead, these communities are addressed in full in their own respective hazard mitigation plans.

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of the potential risk to natural hazards in the county and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events. This risk assessment followed the

methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (FEMA 386-2, 2002), which breaks the assessment down to a four-step process:

Data collected through this process has been incorporated into the following sections of this plan:

- **Section 4.2**: **Hazard Identification** identifies the natural and human-caused hazards that threaten the planning area.
- **Section 4.3: Risk Assessment Methodology and Assumptions**
- **Section 4.4: Asset Inventory** details the population, buildings, and critical facilities at risk within the planning area.
- **Section 4.5: Hazard Profiles, Analysis, and Vulnerability** discusses the threat to the planning area, describes previous occurrences of hazard events and the likelihood of future occurrences, and assesses the planning area's exposure to each hazard profiled; considering assets at risk, critical facilities, and future development trends.
- **Section 4.6: Conclusions on Hazard Risk** summarizes the results of the Priority Risk Index and defines each hazard as a Low, Medium, or High Risk hazard.

4.2 HAZARD IDENTIFICATION

To identify hazards relevant to the planning area, the HMPC began with a review of the list of hazards identified in the 2023 State Hazard Mitigation Plan and the 2019 Wake County Multi-Jurisdictional Hazard Mitigation Plan as summarized in Table 4.1. The HMPC used these lists to identify a full range of hazards for potential inclusion in this plan update and to ensure consistency across these planning efforts. All hazards on the below list were evaluated for inclusion in this plan update.

Table 4.1 – Full Range of Hazards Evaluated

Hazard	Included in 2023 State HMP?	Included in 2019 Wake County HMP?
Flooding	Yes	Yes
Hurricanes and Coastal Hazards	Yes	Yes
Severe Winter Weather (Freezing Rain, Snowstorms, Blizzards, Wind Chill, Extreme Cold)	Yes	Yes
Extreme Heat	Yes	Yes
Earthquake	Yes	Yes
Wildfire	Yes	Yes
Dam Failure	Yes	Yes
Levee Failure	No	No
Drought	Yes	Yes
Severe Thunderstorm (Tornado, Hailstorm, Torrential Rain, High Wind, Thunderstorm Wind, Lightning)	Yes	Yes
Landslide	Yes	Yes
Sinkholes	Yes	No
Erosion	No	No
Hazardous Materials Incident	Yes	Yes

Hazard	Included in 2023 State HMP?	Included in 2019 Wake County HMP?
Radiological Emergency	Yes	Yes
Terrorism	Yes	Yes
Infectious Disease	Yes	No
Cyber Threat	Yes	No
Electromagnetic Pulse	Yes	No

The HMPC evaluated the above list of hazards using existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2019 Wake County Plan to determine the significance of these hazards to the planning area. Significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries, as well as property and economic damage.

One significant resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI), which has been tracking various types of severe weather since 1950. The NCEI Storm Events Database contains an archive by county of destructive storm or weather data and information which includes local, intense and damaging events. NCEI receives storm data from the National Weather Service (NWS). The NWS receives their information from a variety of sources, which include but are not limited to: county, state and federal emergency management officials, local law enforcement officials, SkyWarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public, among others. The NCEI database contains 1,239 records of severe weather events that occurred in Wake County in the 25-year period from 1998 through 2023. Table 4.2 summarizes these events.

Table 4.2 – NCEI Severe Weather Reports for Wake County, 1998 – 2023

Type	# of Events	Property Damage	Crop Damage	Deaths	Injuries
Cold/Wind Chill	0	$0	$0	0	0
Drought	0	$0	$0	0	0
Excessive Heat	0	$0	$0	0	0
Extreme Cold/Wind Chill	0	$0	$0	0	0
Flash Flood	216	$70,091,500	$0	1	0
Flood	8	$5,060,000	$20,000,000	0	0
Hail	298	$110,000,000	$0	0	0
Heat	2	$0	$0	0	1
Heavy Rain	25	$0	$0	0	0
Heavy Snow	2	$0	$0	0	0
High Wind	5	$135,000	$0	0	0
Hurricane	4	$890,000	$0	0	0
Ice Storm	1	$0	$0	0	0
Lightning	41	$2,699,000	$0	4	1
Strong Wind	17	$2,543,000	$5,000	1	1
Thunderstorm Wind	540	$4,308,250	$4,000	2	14
Tornado	15	$117,228,000	$25,000	4	70
Tropical Storm	7	$2,471,500	$0	0	1
Wildfire	1	$1,000,000	$0	0	0
Winter Storm	28	$1,000,000	$0	0	0
Winter Weather	29	$40,000	$0	0	0
Total:	**1,239**	**$317,466,250**	**$20,034,000**	**12**	**88**

Source: National Center for Environmental Information, Storm Events Database, January 2024
Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Wake County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1964. Since then, Wake County has been designated in 12 major disaster declarations and 11 emergency declarations, as detailed in Table 4.3.

Table 4.3 – FEMA Emergency and Major Disaster Declarations, Wake County

Disaster #	Dec. Date	Incident Type	Event Title
DR-4285	10/10/2016	Hurricane	Hurricane Matthew
DR-1969	4/19/2011	Severe Storm(s)	Severe Storms, Tornadoes, And Flooding
DR-1490	9/18/2003	Hurricane	Hurricane Isabel
DR-1448	12/12/2002	Severe Ice Storm	Severe Ice Storm
DR-1312	1/31/2000	Severe Storm(s)	Severe Winter Storm
DR-1292	9/16/1999	Hurricane	Hurricane Floyd Major Disaster Declarations
DR-1211	3/22/1998	Severe Storm(s)	Severe Storms Tornadoes, And Flooding
DR-1134	9/6/1996	Hurricane	Hurricane Fran
DR-1087	1/13/1996	Snow	Blizzard Of 96
DR-818	12/2/1988	Tornado	Severe Storms & Tornadoes
DR-234	2/10/1968	Severe Ice Storm	Severe Ice Storm
DR-4487	3/25/2020	Biological	COVID-19 Pandemic
EM-3586	10/1/2022	Hurricane	Hurricane Ian
EM-3534	8/2/2020	Hurricane	Hurricane Isaias
EM-3401	9/10/2018	Hurricane	Hurricane Florence
EM-3380	10/7/2016	Hurricane	Hurricane Matthew
EM-3222	9/5/2005	Hurricane	Hurricane Katrina Evacuation
EM-3146	9/15/1999	Hurricane	Hurricane Floyd Emergency Declarations
EM-3110	3/17/1993	Snowstorm	Severe Snowfall & Winter Storm
EM-3049	8/11/1977	Drought	Drought
EM-3033	3/2/1977	Snowstorm	Drought & Freezing
EM-3471	3/13/2020	Biological	COVID-19
EM-3423	9/3/2019	Hurricane	Hurricane Dorian

Source: FEMA Disaster Declarations Summary, February 1, 2024

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Some hazard titles have been updated either to better encompass the full scope of a hazard or to assess closely related hazards together. Table 4.4 summaries the determination made for each hazard.

Table 4.4 – Hazard Evaluation Results

Hazard	Included in this plan update?	Explanation for Decision
Natural Hazards		
Dam Failure	Yes	The 2019 Wake County plan addressed this hazard. There are 206 high hazard dams in Wake County.
Drought	Yes	The 2019 Wake County plan addressed this hazard. The State Hazard Mitigation Plan lists drought as a hazard for the Piedmont region which includes Wake County.
Earthquake	Yes	The 2019 Wake County plan and the State HMP addressed this hazard. Wake County could be impacted by the New Madrid fault and the Charleston fault.
Extreme Heat	Yes	The 2019 Wake County plan and the State HMP address this hazard. NCEI reports 2 heat events for Wake County.
Flood	Yes	The 2019 Wake County plan addressed this hazard. Multiple disaster declarations for the County are related to flooding. NCEI reports 224 flooding related events.
Hurricane & Tropical Storm	Yes	Wake County is not exposed to coastal hazards; therefore storm surge, coastal flooding, and coastal erosion will not be assessed. However, past disaster declarations and NCEI storm reports indicate hurricane wind and rain are still a significant hazard for the County. The State HMP lists hurricane as a top hazard in the Piedmont region which includes Wake County. The 2019 Wake County plan addressed this hazard.
Infectious Disease	Yes	The State HMP reports the entire State is equally at risk, but vulnerability is low across all but two impact categories. The 2019 Wake County plan did not address this hazard, but the HMPC decided to evaluate it with this plan update.
Landslide	Yes	The 2019 Wake County plan and 2023 State HMP addressed this hazard.
Severe Winter Weather (Freezing Rain, Snowstorms, Blizzards, Wind Chill, Extreme Cold)	Yes	The 2019 Wake County plan and 2023 State plan addressed this hazard. Several past disaster and emergency declarations relate to this hazard.
Severe Weather (Thunderstorm Wind, Lightning, Hail)	Yes	The 2019 Wake County plan addressed this hazard. NCEI reports 562 wind related events, 41 lightning events, and 298 hail events in the past 25 years. Given this frequency, analysis is warranted.
Tornado	Yes	The 2019 Wake County plan addressed this hazard. NCEI reports 15 previous tornado events. Per the State HMP, vulnerability to tornado is high. Wake County has previously received a major disaster declaration for tornado.
Wildfire	Yes	The 2019 Wake County plan addressed this hazard. There are areas of the county with high burn probability and moderate potential fire intensity.

Hazard	Included in this plan update?	Explanation for Decision
Erosion	No	There are no known historical occurrences of major erosion and a low probability of future occurrence. The 2019 Wake County plan discussed erosion as a subset of wind and flood hazards. This approach will be carried forward.
Levee Failure	No	The USACE's National Levee Database does not identify any USACE or non-USACE levees in Wake County.
Sinkholes	No	The 2019 Wake County plan did not address this hazard. Per the State HMP, vulnerability to sinkhole is low in the Piedmont region.
Technological Hazards & Threats		
Hazardous Materials Incident	Yes	The 2019 Wake County plan addressed this hazard and found it to be a moderate priority hazard to the planning area.
Radiological Emergency	Yes	The 2019 Wake County plan addressed this hazard and found it to be a high priority hazard to the planning area.
Terrorism	Yes	The 2019 Wake County plan addressed this hazard and found it to be a moderate priority hazard to the planning area.
Cyber Threat	Yes	The 2019 Wake County plan did not address this threat. The HMPC decided to evaluated cyber threat in this plan update.
Electromagnetic Pulse	No	The 2019 Wake County plan did not address this threat. The HMPC considers this threat more appropriately addressed through emergency operations and response planning.

4.3 RISK ASSESSMENT METHODOLOGY AND ASSUMPTIONS

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine its probability of future occurrence and potential impact. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

Each hazard is profiled in the following format:

HAZARD DESCRIPTION

This section provides a description of the hazard, including discussion of its speed of onset and duration, as well as any secondary effects followed by details specific to the Wake County planning area.

LOCATION

This section includes information on the hazard's physical extent, with mapped boundaries where applicable.

EXTENT

This section includes information on the hazard extent in terms of magnitude, describe how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

HISTORICAL OCCURRENCES

This section contains information on historical events, including the location and consequences of all past events on record within or near the Wake County planning area.

PROBABILITY OF FUTURE OCCURRENCE

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

CLIMATE CHANGE

Where applicable, this section discusses how climate change may or may not influence the risk posed by the hazard on the planning area in the future.

VULNERABILITY ASSESSMENT

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). The vulnerability assessment first describes the total vulnerability and values at risk and then discusses vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including building footprints, topography, aerial photography, and transportation layers;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the State Hazard Mitigation Plan; and
- Written descriptions of inventory and risks provided by the previous Wake County Multi-Jurisdictional Hazard Mitigation Plan.
- Exposure and vulnerability estimates provided by the North Carolina Emergency Management (NCEM) IRISK database.
- Crop insurance claims by cause from USDA's Risk Management Agency

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment: a quantitative analysis that relies upon best available data and technology, and a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Where hazard risk cannot be distinctly quantified and modeled, other information can be collected in regard to the hazard area, such as the location of critical facilities, historic structures, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard. The quantitative analyses for this plan involved the use of FEMA's Hazus software, which provides modeled loss estimates for flood, earthquake, and hurricane wind, and NCEM's IRISK database, which provides modeled damage estimates for earthquake, flood, hurricane wind, thunderstorm wind, tornado, and

wildfire hazards.

NCEM's IRISK database incorporates county building footprint and parcel data. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, the building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. Parcel data provided building value and year built. Building value was used to determine the value of buildings at risk. Year built was used to determine if the building was constructed prior to or after the community had joined the NFIP and had an effective FIRM and building codes enforced.

Census blocks and Summary File 1 from the 2010 Census were used to determine population at risk. This included the total population, as well as the vulnerable elderly and children age groups. To determine population at risk, the census blocks were intersected with the hazard area. To better determine the actual number of people at risk, the intersecting area of the census block was calculated and divided by the total area of the census block to determine a ratio of area at risk. This ratio was applied to the population of the census block. For example, a census block has a population of 400 people. Five percent of the census block intersects the 1%-annual-chance flood hazard area. The ratio estimates that 20 people are then at risk within the 1%-annual-chance flood hazard area (5% of the total population for that census block).

Certain assumptions are inherent in any risk assessment. For the Wake County Multi-Jurisdictional HMP, three primary assumptions were discussed by the HMPC from the beginning of the risk assessment process: (1) that the best readily available data would be used, (2) that the hazard data selected for use is reasonably accurate for mitigation planning purposes, and (3) that the risk assessment will be regional in nature with local, municipal-level data provided where appropriate and practical.

Key methodologies and assumptions for specific hazard analyses are described in their respective profiles.

PRIORITY RISK INDEX

The conclusions drawn from the hazard profiling and vulnerability assessment process can be used to prioritize all potential hazards to the Wake County planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk was assigned a value (1 to 4) and a weighting factor as summarized in Table 4.5.

The results of the PRI scoring are provided in each hazard profile and Section 4.6 Conclusions on Hazard Risk.

Table 4.5 – Priority Risk Index

RISK ASSESSMENT	LEVEL	DEGREE OF RISK CRITERIA	INDEX	WEIGHT
PROBABILITY What is the likelihood of a hazard event occurring in a given year?	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY	4	
IMPACT In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 DAY	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES > 30 DAYS.	4	
SPATIAL EXTENT How large of an area could be impacted by a hazard event? Are impacts localized or regional?	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	4	
WARNING TIME Is there usually some lead time associated with the hazard event? Have warning measures been implemented?	**MORE THAN 24 HRS**	SELF DEFINED	1	10%
	12 TO 24 HRS	SELF DEFINED	2	
	6 TO 12 HRS	SELF DEFINED	3	
	LESS THAN 6 HRS	SELF DEFINED	4	
DURATION How long does the hazard event usually last?	**LESS THAN 6 HRS**	SELF DEFINED	1	10%
	LESS THAN 24 HRS	SELF DEFINED	2	
	LESS THAN 1 WEEK	SELF DEFINED	3	
	MORE THAN 1 WEEK	SELF DEFINED	4	

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the highest possible PRI value is 4.0).

PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

The purpose of the PRI is to categorize and prioritize all potential hazards for the Wake County planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of the high and moderate hazard risks for mitigation planning purposes.

4.4 ASSET INVENTORY

NCEM's IRISK database provided the asset inventory used for this vulnerability assessment. Population counts in IRISK are derived from 2020 census data and include a breakdown of two subpopulations assumed to be at greater risk to natural hazards than the general population: elderly (ages 65 and older) and children (under the age of 5). These population counts are detailed by jurisdiction in Table 4.6. It should be noted that population counts in IRISK include each community's extra-territorial jurisidiction as delineated in a spatial database of political areas maintained by NCEM. As a result, the population estimates in IRISK are higher than the Census population estimates for some communties because Census population estimates are based on municipal boundaries.

Table 4.6 – Population Counts with Vulnerable Population Breakdown

Jurisdiction	2020 Census Population	Elderly (Age 65 and Over)	Children (Age 5 and Under)
Raleigh	476,892	53,945	26,904
Apex	57,525	5,963	3,912
Cary	164,869	19,866	9,432
Fuquay-Varina	32,177	4,432	2,204
Garner	35,232	5,015	2,863
Holly Springs	30,885	2,685	2,254
Knightdale	29,077	3,207	1,917
Morrisville	21,999	1,533	1,627
Rolesville	12,236	1,401	919
Wake Forest	*47,601	4,777	2,891
Wendell	8,423	1,361	418
Zebulon	5,751	948	437
Wake County (Unincorporated Area)	230,494	29,196	14,301
TOTAL	**1,143,763**	**134,329**	**70,079**

Source: NCEM Risk Management Tool; 2000, 2010, 2020 Decennial Census
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

The HMPC noted that Wake County has experienced significant growth since the 2020 Census. Table 4.7 details the estimated total population by jurisdiction from the 2010 and 2020 Census, as reported in NCEM's Risk Management Tool, and the 2022 American Community Survey and includes a breakdown of percent change for the jurisdictional populations from 2010 to 2020. While the 2022 counts are not reflected in IRISK, they provide additional context for interpreting the IRISK vulnerability estimates.

Table 4.7 – Population Counts by Jurisdiction, 2010 - 2020

Jurisdiction	2010 Census Population	2020 Census Population	% Change 2010-2020	2022 ACS Population
Raleigh	420,104	476,892	14%	465,517
Apex	41,724	57,525	38%	65,541
Cary	137,544	164,869	20%	174,880
Fuquay-Varina	25,023	32,177	29%	35,428
Garner	30,981	35,232	14%	31,684

Jurisdiction	2010 Census Population	2020 Census Population	% Change 2010-2020	2022 ACS Population
Holly Springs	25,790	30,885	20%	42,023
Knightdale	18,501	29,077	57%	19,127
Morrisville	18,655	21,999	18%	29,756
Rolesville	5,199	12,236	135%	9,696
Wake Forest	31,175	*47,601	53%	48,047
Wendell	7,889	8,423	7%	10,575
Zebulon	6,102	5,751	-6%	7,421
Wake County (Unincorporated Area)	135,124	230,494	71%	192,408
TOTAL	**903,811**	**1,143,763**	**27%**	**1,132,103**

Source: NCEM Risk Management Tool; 2000, 2010, 2020 Decennial Census
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau.

Building counts were also provided by the IRISK database. These values were generated using locally-provided building footprint and parcel data. The methodology for generating the building asset inventory is described in greater detail in Section 4.3. Note that these building counts were originally provided in 2010 and it appears that only limited updates subsequently occurred whereas Wake County has since experienced a substantial amount of growth and new development. Therefore, the exposure reflected in the following tables is an underestimate of actual present-day exposure. Section 3 Planning Area Profile describes the growth that has occurred since 2010 and provides a means of estimating the degree to which exposure and vulnerability may have increased.

Table 4.8 – Building Counts and Values by Jurisdiction

Jurisdiction	Building Count	Building Value
Raleigh	128,062	$36,926,106,959
Apex	14,915	$3,460,323,705
Cary	45,306	$14,607,342,852
Fuquay-Varina	11,070	$2,268,420,955
Garner	11,975	$2,243,212,305
Holly Springs	10,528	$2,876,499,200
Knightdale	7,144	$1,240,283,673
Morrisville	5,181	$2,166,113,564
Rolesville	2,103	$388,407,100
Wake Forest	10,547	$2,829,746,009
Wendell	3,728	$483,437,990
Zebulon	3,231	$616,065,905
Wake County (Unincorporated Area)	59,919	$13,561,537,397
TOTAL PLAN	**313,709**	**$83,667,497,614**

Source: NCEM IRISK Database

For some hazards in this risk assessment, FEMA's Hazus software was used to provide loss estimates and better understand vulnerability. These analyses were run using the built-in asset inventory in Hazus, which estimates there are 371 thousand buildings in the county, with a total building replacement value of $215.283 billion.

Table 4.9 provides an estimate of the number of pre-FIRM buildings in each jurisdiction. This analysis was prepared using NCEM's IRISK database and comparing the year built for each structure to the corresponding community's initial Flood Insurance Rate Map (FIRM) date. The pre-FIRM building

counts include all building constructed prior to the year of the initial FIRM.

Table 4.9 – Pre-FIRM Buildings by Jurisdiction

Jurisdiction	Pre-FIRM Building Count	Date of Initial FIRM
Wake County	11,483	11/15/1978
Raleigh	44,658	8/15/1978
Apex	3,769	3/3/1992
Cary	7,616	7/17/1978
Fuquay-Varina	2,181	11/1/1978
Garner	5,561	7/3/1978
Holly Springs	1,532	3/3/1992
Knightdale	1,698	8/1/1978
Morrisville	287	11/1/1978
Rolesville	817	3/3/1992
Wake Forest	1,469	7/3/1978
Wendell	1,597	6/1/1978
Zebulon	1,552	7/3/1978

Source: NCEM IRISK Database; GIS analysis performed by WSP
Note: These estimates do not account for any historical changes in jurisdictional boundaries. Buildings were classified based on the Initial FIRM date for the current jurisdictional boundaries.

The IRISK database also identifies Critical Infrastructure and Key Resources (CIKR) buildings and High Potential Loss Properties. These properties are a subset of the total building inventory and are therefore likely an underestimate of the exposure of current CIKR and High Potential Loss Properties. These properties are detailed in Table 4.10 and Table 4.11, respectively.

Table 4.10 – Critical Infrastructure and Key Resources by Type and Jurisdiction

Jurisdiction	Food and Agriculture	Banking and Finance	Chemical & Hazardous	Commercial	Communications	Critical Manufacturing	EM	Government Facilities	Healthcare	Defense Industrial Base	National Monuments and Icons	Nuclear Reactors, Materials and Waste	Postal and Shipping	Transportation Systems	Energy	Emergency Services	Water	Total
Raleigh	166	213	1	3,645	8	1,677	0	1,641	457	2	0	2	0	690	13	40	12	**8,567**
Apex	75	14	0	313	0	238	0	97	27	1	0	0	0	59	0	2	0	**826**
Cary	91	55	0	1,259	5	270	0	334	98	1	0	1	0	203	4	12	27	**2,360**
Fuquay-Varina	138	17	0	282	0	152	0	69	28	1	0	0	0	37	0	3	5	**732**
Garner	67	19	0	297	0	309	0	110	23	0	0	0	0	27	1	3	4	**860**
Holly Springs	66	6	0	133	0	51	0	43	3	0	0	0	0	9	0	5	3	**319**
Knightdale	68	10	0	120	0	64	0	46	8	0	0	0	0	12	1	5	0	**334**
Morrisville	2	5	0	162	1	142	0	31	2	1	0	0	0	40	0	2	0	**388**
Rolesville	43	1	0	37	0	11	0	20	2	0	0	0	0	4	0	2	0	**120**
Wake Forest	8	12	0	315	0	199	0	93	23	0	0	0	0	36	0	4	3	**693**
Wendell	72	4	0	132	0	75	0	37	6	0	0	0	0	22	0	2	0	**350**

Jurisdiction	Food and Agriculture	Banking and Finance	Chemical & Hazardous	Commercial	Communications	Critical Manufacturing	EM	Government Facilities	Healthcare	Defense Industrial Base	National Monuments and Icons	Nuclear Reactors, Materials and Waste	Postal and Shipping	Transportation Systems	Energy	Emergency Services	Water	Total
Zebulon	64	8	0	172	0	85	0	52	18	0	0	0	0	19	0	2	2	**422**
Unincorporated Wake County	1,909	0	0	584	0	666	0	198	27	0	0	0	0	186	28	14	43	**3,655**
Total	**2,769**	**364**	**1**	**7,451**	**14**	**3,939**	**0**	**2,771**	**722**	**6**	**0**	**3**	**0**	**1,344**	**47**	**96**	**99**	**19,626**

Source: NCEM Risk Management Tool

Table 4.11 – High Potential Loss Properties by Use and Jurisdiction

Jurisdiction	Residential	Commercial	Industrial	Government	Agricultural	Religious	Utilities	Total
Raleigh	1,284	1,356	339	504	1	170	13	**3,667**
Apex	86	78	51	19	0	16	0	**250**
Cary	437	519	65	87	0	48	26	**1,182**
Fuquay-Varina	19	53	16	15	1	17	5	**126**
Garner	69	84	59	23	0	17	2	**254**
Holly Springs	15	37	20	14	0	5	2	**93**
Knightdale	40	37	4	19	0	8	1	**109**
Morrisville	148	100	59	10	0	7	0	**324**
Rolesville	4	8	1	4	0	1	0	**18**
Wake Forest	44	70	21	21	0	15	3	**174**
Wendell	2	13	3	6	0	10	0	**34**
Zebulon	3	23	15	17	0	5	2	**65**
Unincorporated Wake County	432	86	28	44	1	36	66	**693**
Total	**2,583**	**2,464**	**681**	**783**	**3**	**355**	**120**	**6,948**

Source: NCEM Risk Management Tool

Wake County and the HMPC supplemented the IRISK asset inventory with a current list of critical facilities, or community lifelines, which are defined by FEMA as the buildings and infrastructure that enable the continuous operation of critical business and government functions and are essential to human health and safety or economic security. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Critical facilities are a priority for mitigation planning and were examined against known hazard areas, where possible, in this risk assessment. Critical facilities in Wake County are summarized by FEMA lifeline category in Table 4.12 and Table 4.13 and are shown by lifeline category in Figure 4.1 through Figure 4.8.

Table 4.12 – Critical Facilities by FEMA Lifeline

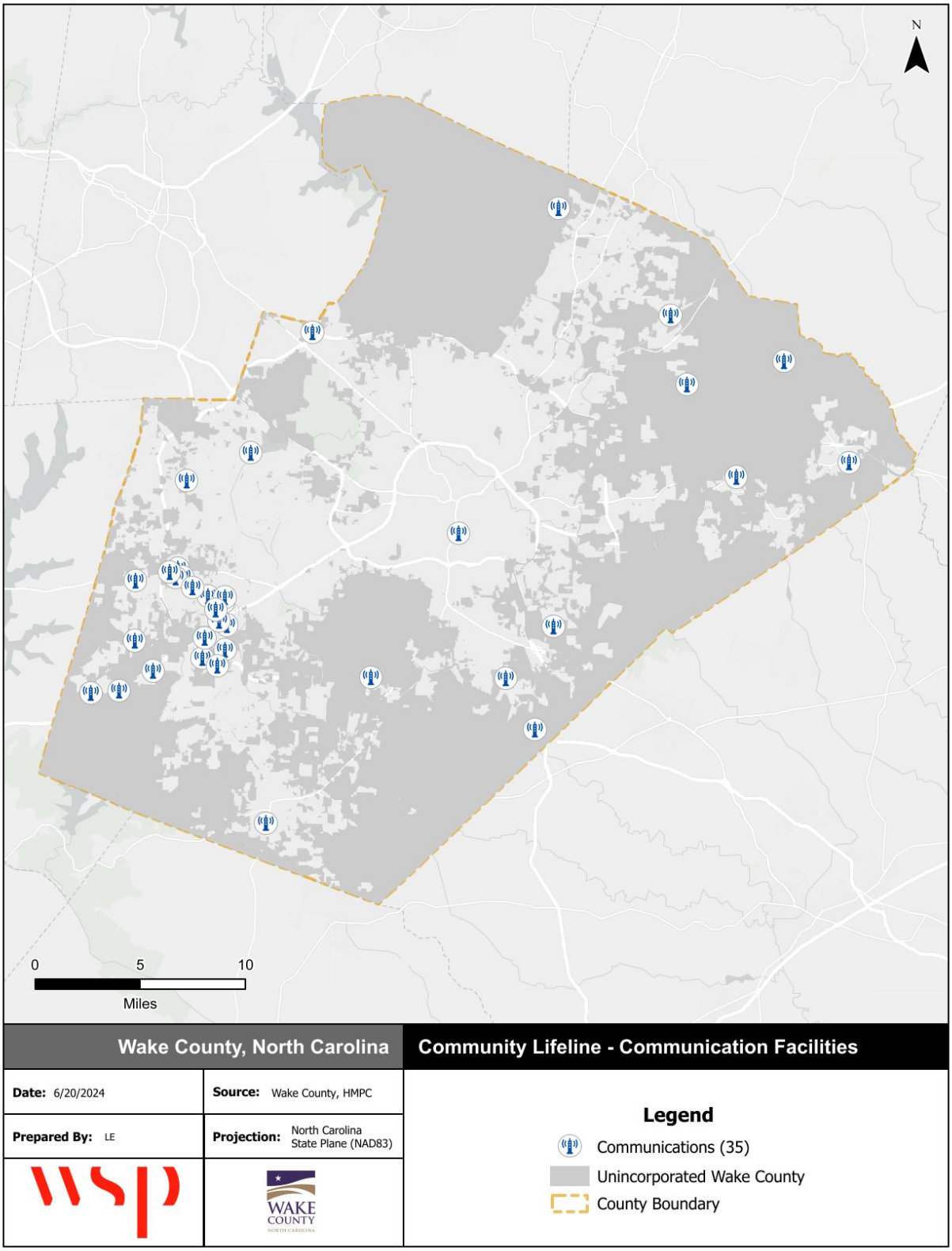
FEMA Lifeline	Facility Count	Sum of Structure Value
Communications	35	$81,435,016
Energy	496	$2,754,483,217
Food, Hydration, Shelter	360	$6,916,893,450
Hazardous Materials	1,623	$15,372,683,757
Health and Medical	514	$4,932,467,633
Safety and Security	303	$4,398,380,169
Transportation	21	$1,635,062,026
Water Systems	517	$2,603,929,940
Total	**3,869**	**$38,695,335,208**

Table 4.13 – Critical Facilities Summary by Jurisdiction and FEMA Lifeline

Jurisdiction	FEMA Lifeline Category								Total
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Water Systems	
Apex	17	38	11	84	49	55	5	14	**273**
Cary	1	47	17	206	62	30	1	52	**416**
Fuquay-Varina	1	26	7	37	16	11	0	45	**143**
Garner	3	31	8	98	24	10	2	18	**194**
Holly Springs	2	13	4	24	7	10	0	14	**74**
Knightdale	0	11	8	52	17	12	0	14	**114**
Morrisville	1	11	5	66	9	7	0	5	**104**
Raleigh	2	205	73	720	268	99	6	151	**1,524**
Rolesville	1	3	2	15	11	5	0	15	**52**
Wake County	6	59	208	213	12	32	7	156	**693**
Wake Forest	0	8	3	32	7	12	0	9	**71**
Wendell	0	31	8	41	26	14	0	18	**138**
Zebulon	1	13	6	35	6	6	0	6	**72**
Total	**35**	**496**	**360**	**1,623**	**514**	**303**	**21**	**517**	**3,351**

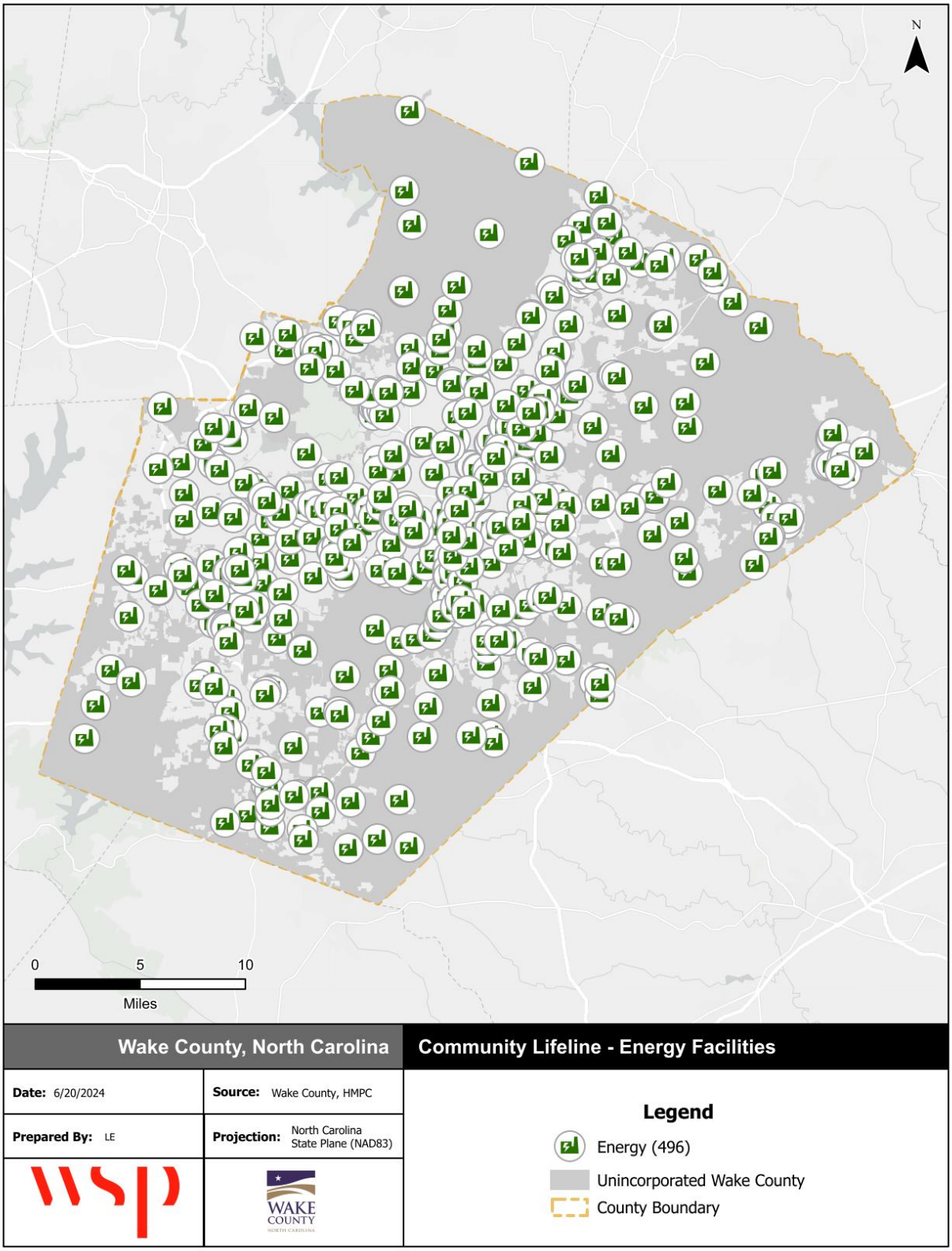
Source: Wake County HMPC, GIS analysis

Figure 4.1 – Wake County Critical Facilities, Communications Lifeline



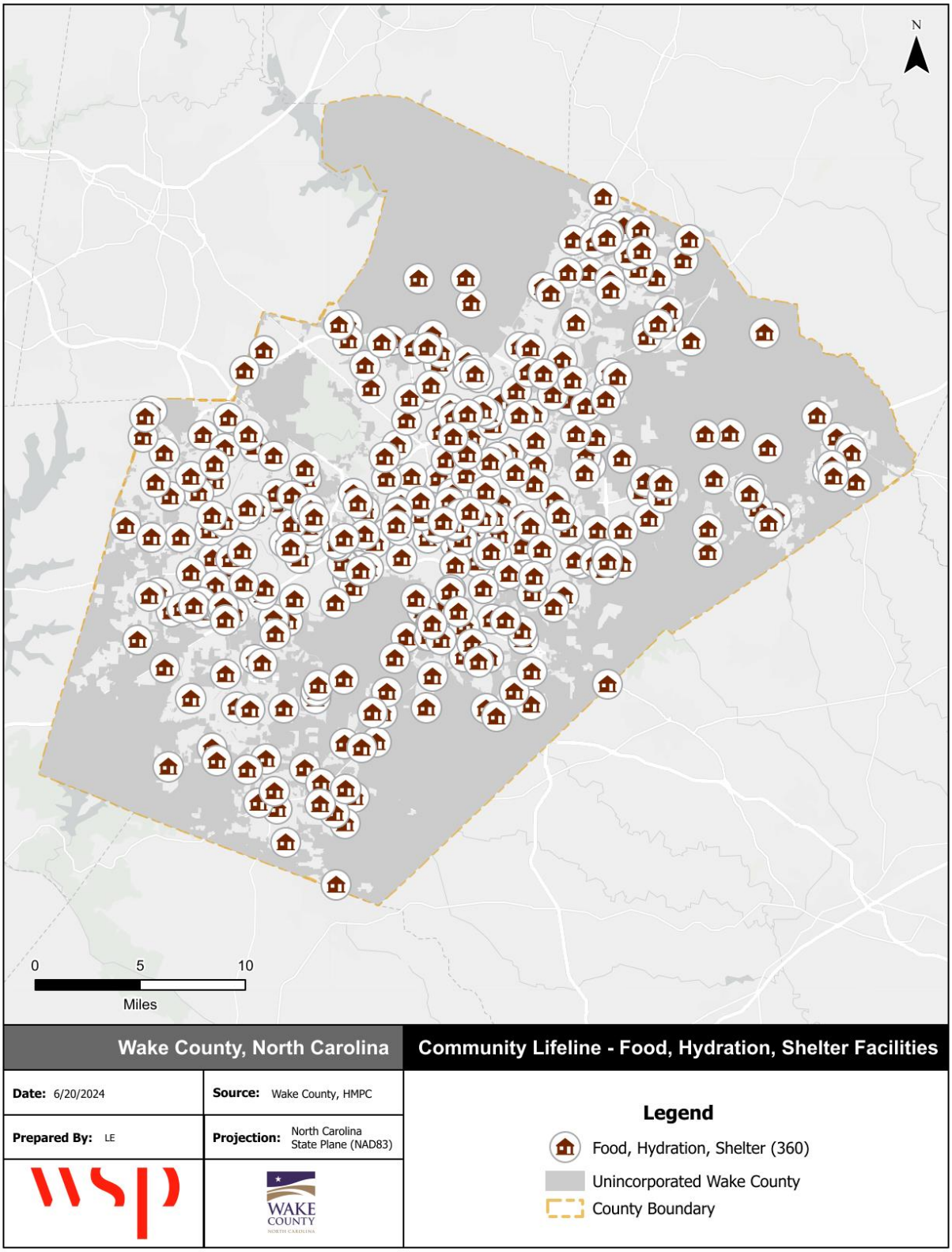
Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.2 – Wake County Critical Facilities, Energy Lifeline



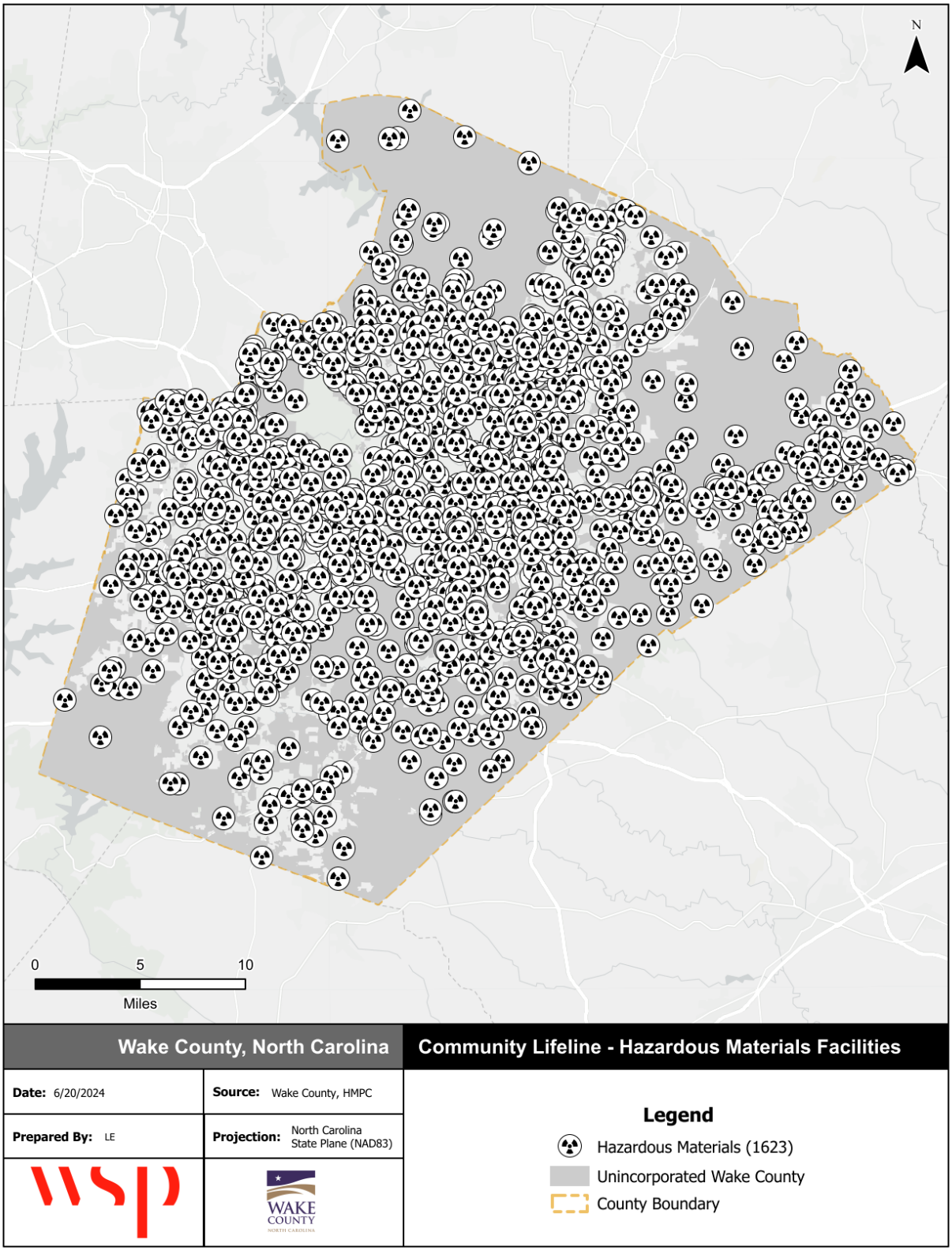
Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.3 – Wake County Critical Facilities, Food, Hydration, and Shelter Lifeline



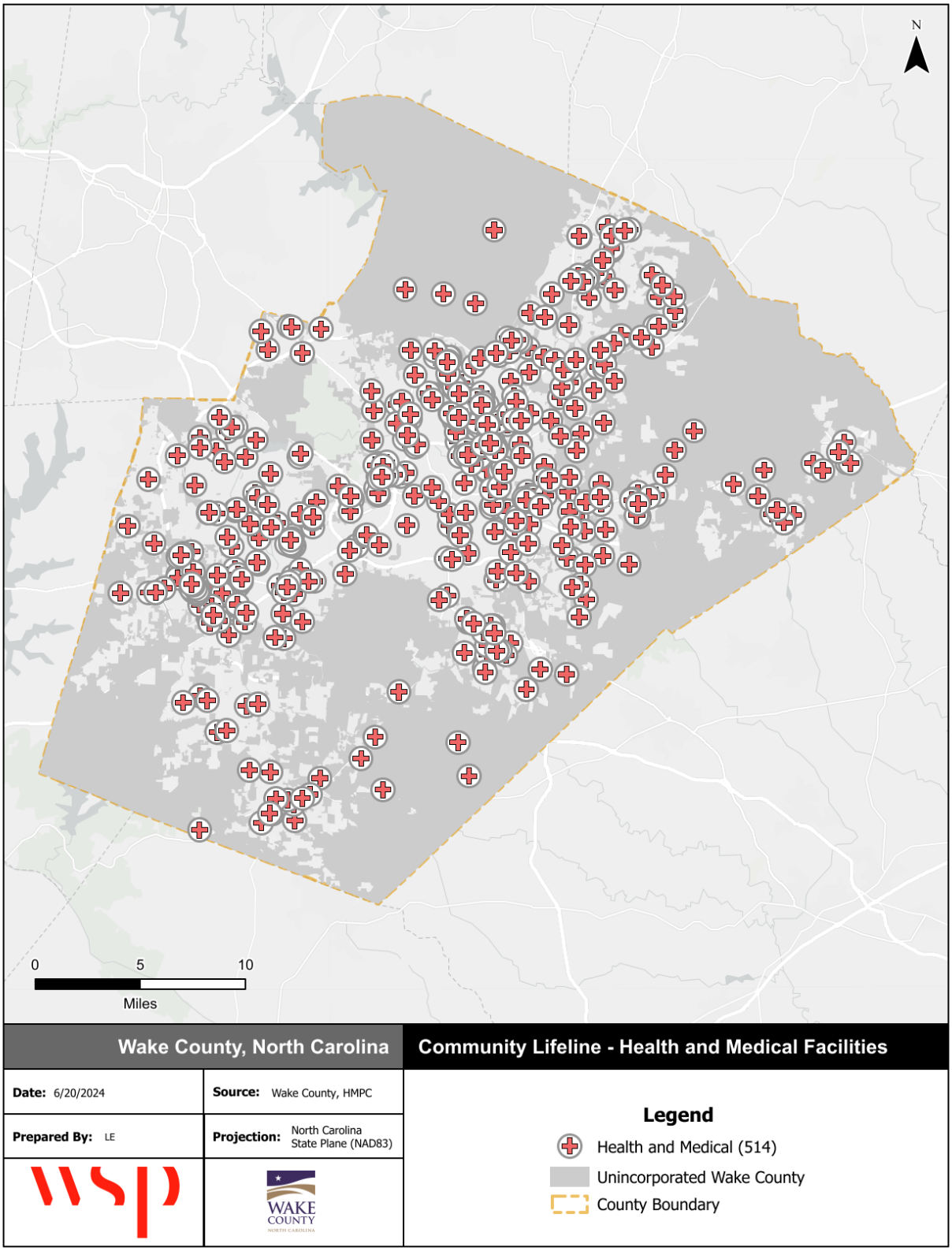
Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.4 – Wake County Critical Facilities, Hazardous Materials Lifeline



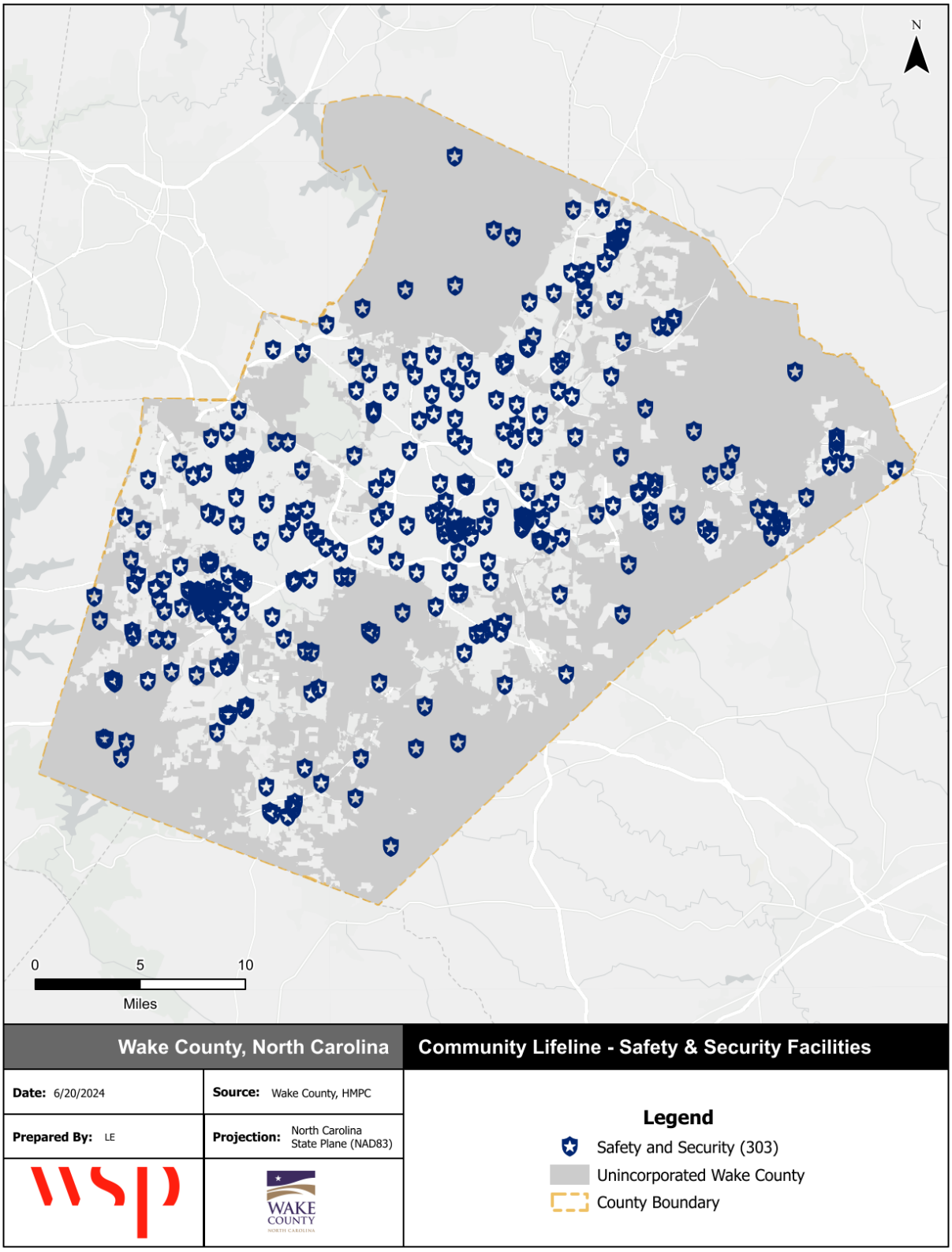
Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.5 – Wake County Critical Facilities, Health and Medical Lifeline



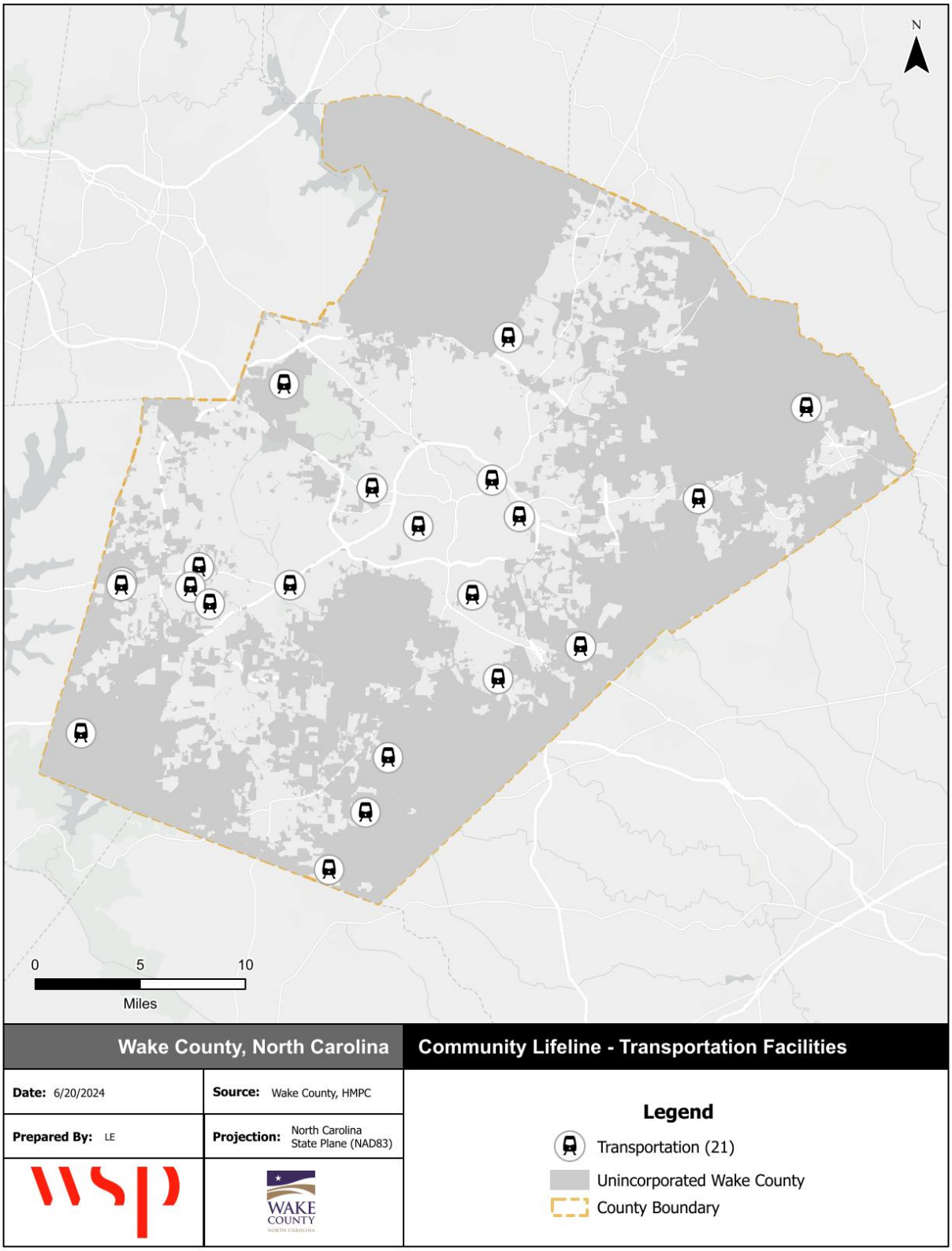
Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.6 – Wake County Critical Facilities, Safety and Security Lifeline



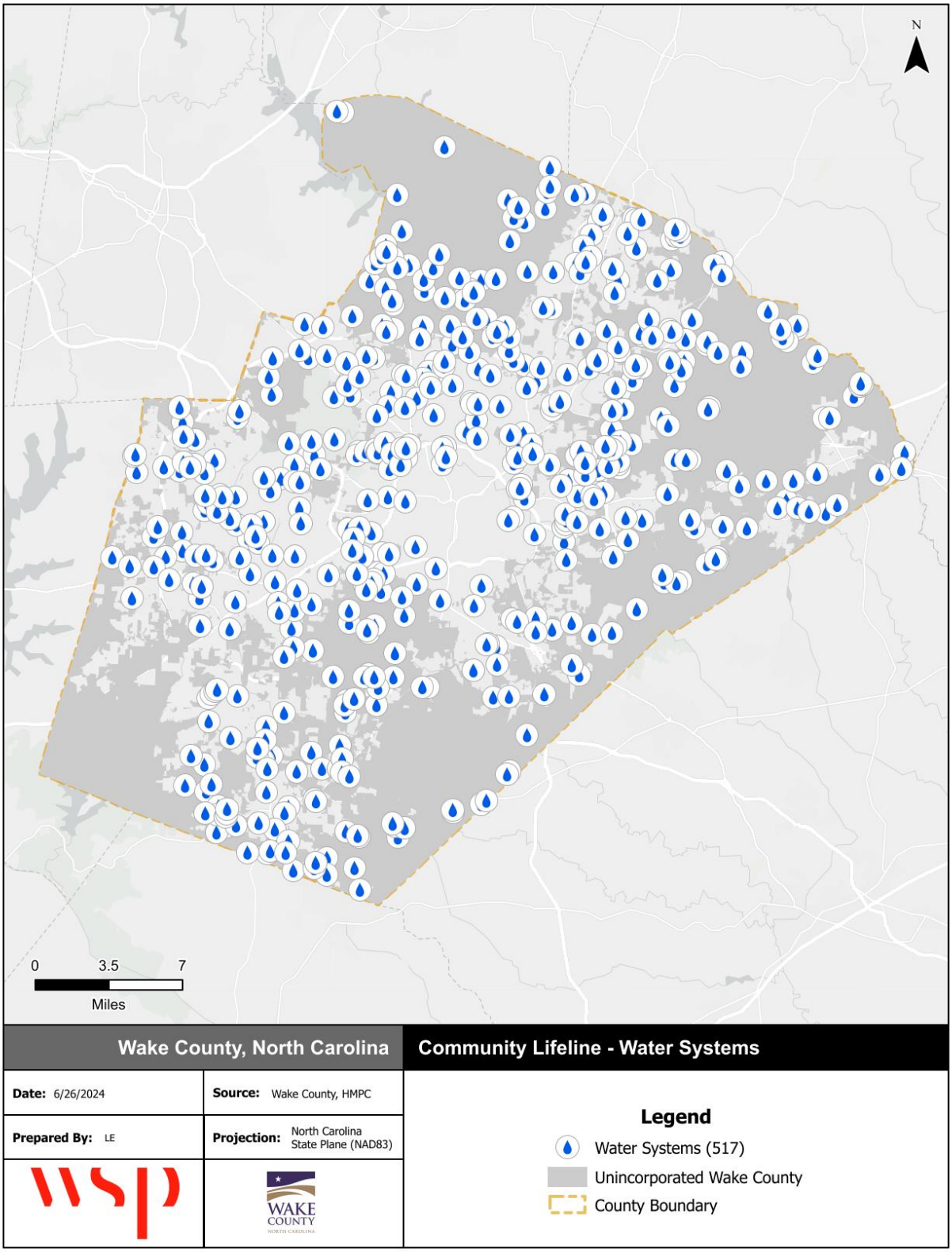
Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.7 – Wake County Critical Facilities, Transportation Lifeline



Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

Figure 4.8 – Wake County Critical Facilities, Water Systems Lifeline



Source: NCEM IRISK Database, GIS Analysis, Wake County HMPC

4.5 HAZARD PROFILES, ANALYSIS, AND VULNERABILITY

4.5.1 DAM FAILURE

HAZARD BACKGROUND

A dam is a barrier constructed across a watercourse that stores, controls, or diverts water. Dams are usually constructed of earth, rock, concrete, or mine tailings. The water impounded behind a dam is referred to as the reservoir and is measured in acre-feet. One acre-foot is the volume of water that covers one acre of land to a depth of one foot. Dams can benefit farmland, provide recreation areas, generate electrical power, and help control erosion and flooding issues. A dam failure is the collapse or breach of a dam that causes downstream flooding. Dam failures may be caused by natural events, manmade events, or a combination. Due to the lack of advance warning, failures resulting from natural events, such as earthquakes or landslides, may be particularly severe. Prolonged rainfall and subsequent flooding is the most common cause of dam failure.

Dam failures usually occur when the spillway capacity is inadequate and water overtops the dam or when internal erosion in dam foundation occurs (also known as piping). If internal erosion or overtopping causes a full structural breach, a high-velocity, debris-laden wall of water is released and rushes downstream, damaging or destroying anything in its path. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can also result from any one or a combination of the following:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross-section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway; or
- High winds, which can cause significant wave action and result in substantial erosion.

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. Dam failures are generally catastrophic if the structure is breached or significantly damaged. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major casualties and loss of life could result, as well as water quality and health issues. Potentially catastrophic effects to roads, bridges, and homes are also of major concern. Associated water quality and health concerns could also be issues. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

Dam failure can occur with little warning. Intense storms may produce a flood in a few hours or even

minutes for upstream locations. Flash floods occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow.

Dam failures are of particular concern because the failure of a large dam has the potential to cause more death and destruction than the failure of any other manmade structure. This is because of the destructive power of the flood wave that would be released by the sudden collapse of a large dam. Dams are innately hazardous structures. Failure or poor operation can result in the release of the reservoir contents—this can include water, mine wastes, or agricultural refuse–causing negative impacts upstream or downstream or at locations far from the dam. Negative impacts of primary concern are loss of human life, property damage, lifeline disruption, and environmental damage.

Warning Time: 4 – Less than 6 hours

Duration: 3 – Less than 1 week

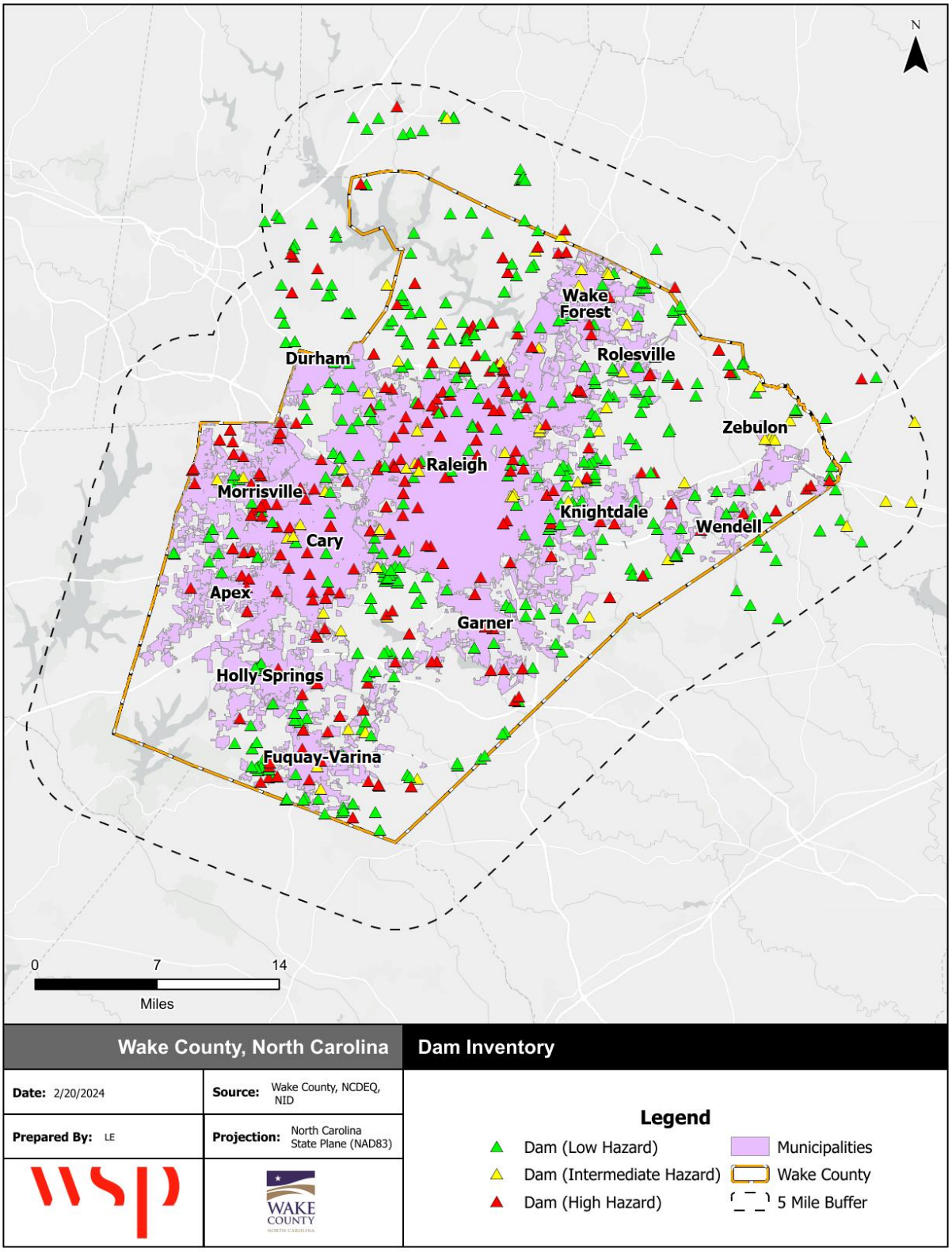
LOCATION

The North Carolina Dam Inventory, maintained by North Carolina Department of Environmental Quality, provides a detailed inventory of all dams in the state. Wake County worked with the state dam safety agency to compile information on all dams in an upstream of the planning area and to identify high hazard dams in poor condition which may be in need of mitigation.

As of February 2024, there are 577 dams in Wake County, of which 312 are rated low hazard, 59 are rated intermediate hazard, and 206 are rated high hazard. Additionally, there are 8 dams that are rated high hazard that are located within five miles of the Wake County jurisdictional boundary. Figure 4.9 shows the location of all dams in Wake County.

Table 4.14 lists all dams with high hazard potential in the county and Table 4.15 lists all dams with high hazard potential that are located within the five-mile buffer of Wake County. Dams are listed by jurisdiction according to the nearest downstream location listed in the North Carolina Dam Inventory.

Figure 4.9 – Dam Locations in Wake County and 5 Mile Buffer



Source: North Carolina Dam Inventory, February 2024

Table 4.14 – High Hazard Dams in Wake County

Dam Name	NID ID	Condition as of Last Inspection	Max Capacity (Ac-Ft)	Nearest River
Wake County				
Betts Pond Dam	NC05036	Fair	40	Marks Creek
Camp Adventure Lake Dam	NC00857	Fair	100	Crabtree Creek
Hasentree Golf Community Dam	NC05685	Satisfactory	139	Smith Creek
Coachman Trail Lake Dam Lower	NC01461	Satisfactory	93	Marsh Creek
Falls Of The Neuse Dam	NC01713		1128100	Lead Mine Creek
Stonebridge Lake Dam	NC01664	Fair	45	Honeycutt Creek
Marshall Pond #2 Dam	NC04576	Poor	59	Crabtree Creek
Brooks Pond Dam	NC00987	Fair	25	Crabtree Creek
Moss Lake Dam	NC00998	Fair	90	Crabtree Creek
Hackney-Gardner Pond Dam	NC01308	Fair	112	Haresnipe Creek
Johnson Pond Dam	NC00163	Fair	95	SW Beaverdam Creek
Gresham Lake Dam	NC00795	Fair	1755	Walnut Creek
Holding Lake Dam	NC00873	Satisfactory	145	Swift Creek
Camp Durant Lake Dam #2	NC01457	Satisfactory	150	Swift Creek
Wake Forest Water Supply Dam	NC00995	Fair	945	Little River
Partin Lake Dam	NC00853	Fair	95	
Rowland Lake Dam	NC00928	Fair	110	Little Creek
Lake Benson Dam	NC00861	Satisfactory	7200	
Lake Wheeler Dam	NC00864	Satisfactory	10800	
Panther Lake Dam	NC00876	Poor	253	
Eagle Ridge Golf Course Dam	NC05626	Fair	0	
Wrenn Road WWTP (aka Garner WW) Lagoon #1 Dam	NC04917	Fair	394	
Wrenn Road WWTP (aka Garner WW) Lagoon #2 Dam	NC04918	Fair	306	
Parker Lake Dam	NC00849	Satisfactory	75	
Preston Crossings Dam	NC00877	Satisfactory	19	
Seagroves Pond Dam	NC01311	Fair	24	
Ballentine Farms Pond Dam	NC04441	Poor	115	
Panther Creek Dam	NC05177	Satisfactory	202	
Cedar Hills Lake Dam	NC04482	Fair	20	
Haddon Hall Dam	NC05102	Fair	42	
Pulley Pond Dam	NC07546			
Wendell Commerce Center North Pond Dam	NC07597			
Wendell Commerce Center South Dam	NC07601			
Chamblee Road Dam	NC07608			
Marks Creek Dam	NC07617			
Mailman Road Dam 1	NC07620			
Mailman Road Dam 2	NC07621			
Mailman Road Dam 3	NC07622			
Lake Plaza Dam	NC05133	Satisfactory	18	
Underwood Pond Dam	NC05218	Fair	27	
Breckenridge Recreation Center Dam	NC05622	Satisfactory	38	
Ransdell-Wake Chapel Dam	NC06435	Poor	9	
Guilford Mills Dam	NC06442	Fair	24	
Ashton Raleigh Residential Dam #1	NC06537	Fair	999	
Ashton Raleigh Residential Dam #2	NC06538	Fair	999	
Ravenwood HOA Dam	NC06577	Fair	71	

Dam Name	NID ID	Condition as of Last Inspection	Max Capacity (Ac-Ft)	Nearest River
6301 Grasshopper Road Dam	NC06580	Fair	39	
Zebulon Outdoor Storage Dam	NC06606	Fair	0	
Cadence Meadows Dam	NC06621	Fair		
Flemming Fields Dam	NC06696			
Christie Dam	NC06806			
Preston Crossings Dam #2	NC06935			
Wheeler Dam	NC06936	Fair		
Holly Lane Dam	NC06992			
Del Webb Avenue Dam	NC07016			
Lambert Pond Dam #2	NC07041			
Charleston Village Pond Dam	NC07086	Poor	0	
Allen Park Dam Lower	NC07213			
Allen Park Dam Upper	NC07214			
Prevention Group Lake Dam	NC07266			
Hatch Lake Dam Lower	NC07275			
Wendell Falls Parkway Dam	NC07282			
Farthing Pond Dam	NC07318			
Powell Pond Dam	NC07319			
Stonehenge Townhomes Pond Dam	NC07387			
Brinkley Pond Dam	NC07428			
Mango Creek Dam	NC07491			
Lake Amberly Dam	NC05644	Satisfactory	0	
Carolina Pines Dam	NC05753	Fair	53	
Marshall Pond #1 Dam	NC04575	Fair	29	
Eastgate Park Dam	NC04490	Satisfactory	27	
Haddon Hall Upper Dam	NC05779	Fair	0	
Stonemont Pond Dam	NC05860	Fair	0	
Seymour Farms Pond Dam	NC05870	Fair	7	
Barton Creek Road Dam	NC06044	Fair	9999999999	
Bedford at Falls River Dam #1	NC06066	Satisfactory	4	
Woolner Dam	NC06089	Fair	11	
Carolina Country Club Water Harvesting Pond Dam	NC06108	Fair		
Duke Energy Garner NTA Yard Expansion SWMF #4 Dam	NC06147	Satisfactory		
Highland Creek SWF #1 Dam	NC06148	Satisfactory		
Highland Creek SWF #2 Dam	NC06149	Satisfactory		
Highland Creek SWF #10 Dam	NC06150	Satisfactory		
Silverton Dam	NC06171	Satisfactory		
Johnson Pond Dam	NC00845	Fair	5	
Leadmine Lake Dam	NC05142	Fair	92	
Northshore Lake Dam	NC01231	Fair	63	
Olde Raleigh Dam #3	NC05176	Fair	24	
Olde Raleigh Dam #1	NC05174	Fair	20	
North Ridge Country Club Hole #13 Dam	NC06197	Poor	0	
Olde Raleigh Dam #2	NC05175	Fair	25	
Courtyards at Kildaire SCM Dam A	NC06214	Satisfactory	440	
Gallop Dam	NC04619	Fair	42	
Howell Dam	NC04621	Fair	36	
Courtyards at Kildaire SCM Dam B	NC06215	Satisfactory		
Sutton Dam	NC05210	Fair		

Dam Name	NID ID	Condition as of Last Inspection	Max Capacity (Ac-Ft)	Nearest River
Trilogy Dam	NC06216	Fair		
Hobby Dam	NC05111	Not Rated	16	
Myrick Lake Dam	NC01656	Fair	5	
Landmark Apartments (Tribridge) Dam	NC04632	Fair	18	
Allen Trust Dam	NC06324	Fair		
Branaman Pond Dam	NC04634	Satisfactory		
Kildaire Farms Dam	NC04949	Poor	420	
RTP Lake W-1 Dam	NC05193	Satisfactory	327	
Jones Pond Dam	NC04946	Fair	19	
Ammons Lake Dam Upper	NC04527	Fair	50	
Ammons Lake Dam Lower	NC04528	Satisfactory	352	
Longview Lake Dam Lower	NC01627	Fair	143	
North Ridge Lake Dam Upper	NC01711	Satisfactory	168	
North Ridge Lake Dam Lower	NC01712	Fair	161	
Williams-Johnson Pond Dam	NC04537	Satisfactory	44	
State Fair H & L Dam	NC04539	Satisfactory	78	
Darden Dam	NC04554	Fair	45	
Apex				
MacGregor Downs Lake Dam	NC00848	Fair	486	Kitt Creek
Riggsbee Dam	NC04442	Satisfactory	24	Camp Branch
RTP South Dam	NC04444	Satisfactory	708	Turkey Creek
Powell Tract Dam	NC05707	Satisfactory	18	Swift Creek
Burnside Drive Dam	NC05802	Fair	12	Lynn's Branch
Lochmere Lake Dam #2	NC05146	Satisfactory	196	Upper Barton Creek
Grey Lake Dam	NC01706	Poor	30	Water Fork
Loch Highlands Dam	NC05145	Satisfactory	59	Cedar Creek
Cary				
Jack Rigsbee Dam	NC04438	Satisfactory	20	Neuse River
Apex Lake Dam	NC00933	Satisfactory	163	Barton Creek
Barbee Dam	NC04445	Fair	12	Sandford Creek
Blackhawk Dam	NC01451	Satisfactory	26	Black Creek
Breckenridge Tract 9 & 10 Dam	NC05623	Satisfactory	83	Lake Benson
Huggins Glen Dam	NC05658	Satisfactory	80	Swift Creek
Searstone Dam	NC05695	Fair	9	UT to Little River
Tryon Road Dam	NC05894	Satisfactory		UT to Reedy Branch
Coronado Lake Dam	NC04616	Satisfactory	26	Middle Creek
Lake Lochmere Dam	NC04961	Fair	728	UT to Middle Creek
Crabtree Creek WS Dam #2	NC01450	Fair	409	Marks Creek
Fuquay-Varina				
Bass Lake Dam	NC00934	Satisfactory	910	Upper Barton Creek
Bentwinds Upper Dam	NC01456	Fair	152	Perry Creek
Crooked Creek Dam	NC04446	Fair	40	Stirrup Iron Creek
Garner				
Peacock Dam	NC04614	Poor	132	Neuse River
Weston #1 Dam	NC05235	Poor	11	Simmons Branch
Weston #2 Dam	NC05236	Poor	10	Perry Creek
Massengill Dam	NC04626	Poor	82	Beaverdam Creek
Holly Springs				
Sunset Lake Dam	NC00880	Fair	750	
Windcrest Dam	NC05683	Satisfactory	42	Crabtree Creek
Knightdale				
Robertson Lake Dam	NC00802	Fair	133	Reedy Creek

Dam Name	NID ID	Condition as of Last Inspection	Max Capacity (Ac-Ft)	Nearest River
Robertson Pond Dam	NC04481	Fair	20	Haresnipe Creek
Morrisville				
Hatch Lake Dam Upper	NC00843		50	Kenneth Creek
Fred G Bond Dam	NC00926	Satisfactory	666	Turkey Creek
Crabtree Creek WS Dam #18	NC01453	Satisfactory	661	Terrible Creek
Raleigh				
St. Andrews Plantation Dam	NC04579	Fair	23	
North Blvd Comm Center Dam	NC04533	Fair	20	
Fuller Lake Dam	NC01719	Satisfactory	70	
Hedingham Dam #1	NC00794	Fair	303	Big Branch
Crossgate Lake Dam #1	NC00850	Fair	207	
Crossgate Lake Dam #2	NC04437	Fair	40	UT to Crabtree Creek
Shaw Lake Dam	NC00851	Fair	55	
Dunnaway Lake Dam	NC00858	Fair	290	
Lake Johnson Dam	NC00862	Fair	3090	Beaverdam Creek
Lake Raleigh Dam	NC00863	Satisfactory	1921	
Lake Crabtree Dam	NC04952	Satisfactory	8950	
Baker Lake Dam	NC00885	Fair	60	Lead Mine Creek
Turfgrass Lake Dam #3	NC00994	Fair	85	Marsh Creek
NCSU Centennial Campus Farm Pond Dam	NC01283	Fair	20	Crabtree Creek
Pendleton Lake Dam	NC04450	Fair	10	Crabtree Creek
Crabtree Creek WS Dam #20-A	NC04456	Satisfactory	2500	Crabtree Creek
Perimeter Park West Dam	NC05180	Fair	10	Crabtree Creek
Em Johnson Alum Sludge Lagoon Dam	NC04460	Satisfactory	108	Neuse River
Alyson Pond Dam	NC04462	Fair	40	Poplar Creek
Heathrow Dam	NC04466	Fair	26	Water Creek
Crabtree Creek WS Dam #1	NC01449	Satisfactory	988	Kit Creek
Shelley Lake Dam	NC01452	Satisfactory	4269	Perry Creek
Lake Lynn Dam	NC01454	Satisfactory	2292	Crabtree Creek
Springdale Estates Lower Dam	NC01633	Fair	190	UT to Upper Barton Creek
E.M. Johnson Water Plant B Dam	NC05078	Fair	383	
E.M. Johnson Water Plant A Dam	NC05077	Satisfactory	110	
Art Museum Dam	NC05026	Fair	10	
Neuse River WW Treatment Plant Equalization Basin Dam	NC05686	Fair	114	
RTP W-5 Dam	NC05795	Satisfactory	700	
Rosewood Subdivision Dam	NC05877	Satisfactory	6	
Pine Knoll Dam	NC06093	Poor		
NCSU Unit No. 4 Dam	NC04615	Fair	26	
Mallard Pond Dam	NC05154	Fair	8	
Delta Lake Dam	NC04910	Fair	42	
Bullard and Patterson Dam	NC04504	Poor	3	
Laurel Hills Dam	NC04620	Fair	35	
Symphony Lake Dam	NC04624	Satisfactory	350	
White Oak Lake Dam	NC04516	Not Rated	20	
Camp Pond Dam	NC04519	Poor	13	
Manchester Dam	NC04964	Fair	88	
Wooten Pond Dam	NC04520	Fair	40	
Remington Park Dam	NC04979	Fair	84	
Carolina Country Club Dam	NC05053	Fair	32	

Dam Name	NID ID	Condition as of Last Inspection	Max Capacity (Ac-Ft)	Nearest River
Crossgate Dam #3	NC05068	Fair	12	
Hedingham Dam #2	NC04927	Satisfactory	50	
Longview Lake Dam Upper	NC04529	Fair	44	
Springdale Estates Upper Dam	NC01665	Fair	75	
Coachman Trail Lake Dam Upper	NC04531	Satisfactory	180	
Crabtree Creek WS Dam #11-A	NC01720	Satisfactory	3327	
Byrd Dam	NC04532	Not Rated	10	
Hart-George Pond Dam	NC04535	Satisfactory	18	
Crabtree Creek WS Dam #5-A	NC04536	Satisfactory	3010	
Goodnight Dam	NC04543		305	
Summer Lake Dam	NC04545	Fair	18	
Meredith College Dam	NC04546	Satisfactory	34	
Underwood Dam	NC04547	Satisfactory	30	
Bailey Dam	NC04563	Fair	76	
Wake Forest				
Mason Lake Dam	NC00865	Fair	52	
Lewis Dam	NC04439	Poor	80	
Wendell				
Timberlake Dam	NC05843	Fair	9999	
Zebulon				
Mitchell Lake Dam	NC00866	Fair	105	

Source: North Carolina Dam Inventory, February 2024

Table 4.15 – High Hazard Dams Located within 5 Miles of Wake County

Dam Name	NID ID	Condition as of Last Inspection	Max Capacity (Ac-Ft)	Nearest River
Grove Park Dam	NC02323	Satisfactory	302	Little Lick Creek
Ridgefield Subdivision SWDP Dam #14	NC05629	Satisfactory	6	Chunky Pipe Creek
Gentz Dam	NC07014			
Bailey Lake Dam	NC01032	Fair	80	Little Lick Creek
Lowery Dam	NC02571	Fair	20	Horse Creek
Lambert Dam	NC02589	Fair	21	Press Prong Creek
Lake Rogers Dam	NC01003	Satisfactory	900	Ledge Creek
Moore Lake Dam	NC01064	Fair	650	Little River

Source: North Carolina Dam Inventory, February 2024

EXTENT

Each state has definitions and methods to determine the hazard potential of a dam. In North Carolina, dams are regulated by the state if they are 25 feet or more in height and impound 50 acre-feet or more. Dams and impoundments smaller than that may fall under state regulation if it is determined that failure of the dam could result in loss of human life or significant damage to property. The height of a dam is from the highest point on the crest of the dam to the lowest point on the downstream toe, and the storage capacity is the volume impounded at the elevation of the highest point on the crest of the dam.

Dam Safety Program engineers determine the "hazard potential" of a dam, meaning the probable damage that would occur if the structure failed, in terms of loss of human life and economic loss or environmental damage. Dams are assigned one of three classes based on the nature of their hazard potential:

- Class A (Low Hazard) includes dams located where failure may damage uninhabited low value

non-residential buildings, agricultural land, or low volume roads.

- Class B (Intermediate Hazard) includes dams located where failure may damage highways or secondary railroads, cause interruption of use or service of public utilities, cause minor damage to isolated homes, or cause minor damage to commercial and industrial buildings. Damage to these structures will be considered minor only when they are located in backwater areas not subjected to the direct path of the breach flood wave; and they will experience no more than 1.5 feet of flood rise due to breaching above the lowest ground elevation adjacent to the outside foundation walls or no more than 1.5 feet of flood rise due to breaching above the lowest floor elevation of the structure.
- Class C (High Hazard) includes dams located where failure will likely cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, primary highways, or major railroads.

Table 4.16 – Dam Hazard Classifications

Hazard Classification	Description	Quantitative Guidelines
Low	Interruption of road service, low volume roads	Less than 25 vehicles per day
	Economic damage	Less than $30,000
Intermediate	Damage to highways, interruption of service	25 to less than 250 vehicles per day
	Economic damage	$30,000 to less than $200,000
	Loss of human life*	Probable loss of 1 or more human lives
High	Economic damage	More than $200,000
	*Probable loss of human life due to breached roadway or bridge on or below the dam	250 or more vehicles per day

Source: NCDEQ

The most recent failure of a high hazard dam occurred in 1996 with the failure of the Lake Raleigh dam following Hurricane Fran.

Based on classification criteria, a high hazard dam failure could cause death and/or injury as well as severe property damage and economic impacts within the affected area. Therefore, though the affected area would be negligible in size relative to the entire planning area, the potential impact of a high hazard dam failure is critical.

Impact: 3 – Critical

Spatial Extent: 1 – Negligible

HISTORICAL OCCURRENCES

The following table details historical occurrences of dam failure reported in Wake County. No additional failures are known to have occurred in the County since 1996.

Table 4.17 – Dam failures in Wake County from 1996 to 2023

Dam Name	Location	Class at Time of Failure	Year of Failure	Cause of Failure
Cedar Hills*	Wake County	Intermediate*	mid 1970s	Heavy rain
Coachman's Trail Lower	Wake County	High	late 1970s	Heavy rain
Beaman's Lake	Wake County	Intermediate	late 1980s	Heavy rain
Bass Lake*	Holly Springs	Low*	1996	Hurricane Fran

Dam Name	Location	Class at Time of Failure	Year of Failure	Cause of Failure
Lake Raleigh	Raleigh	High	1996	Hurricane Fran
Penny Hill Lake	Zebulon	Low	1996	Hurricane Fran
Silver Lake*	Raleigh	Intermediate*	1996	Hurricane Fran
Yates Mill Pond	Wake County	Intermediate	1996	Hurricane Fran

*These dams are now classified as high hazard due to downstream development and/or increased downstream traffic.
Source: 2019 Wake County Multi-Jurisdictional Hazard Mitigation Plan

PROBABILITY OF FUTURE OCCURRENCE

Given the significant presence of high hazard dams in Wake County, failure of a dam is possible. Dam failure has not occurred in the county since 1996, however historical events alone do not provide an adequate estimate of potential future occurrence. With heavy rain events becoming more frequent and intense, conditions conducive to dam failure may occur more frequently as well.

Probability: 2 – Possible

Table 4.18 lists dams throughout Wake County that have a condition assessment of "poor" as of the date of their last inspection. A condition assessment of poor indicates the need for maintenance, monitoring, and/or repairs to mitigate risk of failure. Only three of these dams have an emergency action plan in place.

Table 4.18 - High Hazard Dams in Wake County with Condition Assessment of "Poor"

Dam Name	NID ID	Inspection Date	Nearest Downstream City & Distance (mi.)	EAP in Place
Panther Lake Dam	NC00876	01/08/2026	Smithfield (35 mi)	No
Lewis Dam	NC04439	07/12/2022	Wake Forest (3 mi.)	Yes
Ballentine Farms Pond Dam	NC04441	12/01/2022		No
Ransdell-Wake Chapel Dam	NC06435	01/01/2025		No
Charleston Village Pond Dam	NC07086	05/01/2035		No
Marshall Pond #2 Dam	NC04576	02/02/2024	Forestville (0 mi.)	No
Pine Knoll Dam	NC06093	03/07/2025	Raleigh (0 mi.)	No
Peacock Dam	NC04614	01/01/2025	Garner (0 mi.)	No
Weston #1 Dam	NC05235	07/06/2023	Garner (0 mi.)	No
Weston #2 Dam	NC05236	07/06/2023	Garner (0 mi.)	No
North Ridge Country Club Hole #13 Dam	NC06197	02/01/2024		No
Bullard and Patterson Dam	NC04504	03/01/2025	Raleigh (0 mi.)	No
Massengill Dam	NC04626	02/01/2023	Garner (4 mi.)	No
Camp Pond Dam	NC04519	11/24/2022	Raleigh (0 mi.)	Yes
Grey Lake Dam	NC01706	03/01/2025	Apex (0 mi.)	No
Kildaire Farms Dam	NC04949	03/22/2025		Yes

Source: North Carolina Dam Inventory, February 2024

CLIMATE CHANGE

Studies have been conducted to investigate the impact of climate change scenarios on dam safety. The safety of dams for the future climate can be based on an evaluation of changes in design floods and the freeboard available to accommodate an increase in flood levels. The results from the studies indicate that the design floods with the corresponding outflow floods and flood water levels will increase in the future, and this increase will affect the safety of the dams in the future. Studies concluded that the total hydrological failure probability of a dam will increase in the future climate and that the extent and depth of flood waters will increase by the future dam break scenario.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Dam inundation areas were not available for the identified dams; therefore, a quantitative vulnerability assessment could not be completed. Vulnerability discussed below is based on anecdotal evidence and theoretical understanding of potential risks.

PEOPLE

A person's immediate vulnerability to a dam failure is directly associated with the person's distance downstream of the dam as well as proximity to the stream carrying the floodwater from the failure. For dams that have an Emergency Action Plan (EAP), the vulnerability of loss of life for persons in their homes or on their property may be mitigated by following the EAP evacuation procedures; however, the displaced persons may still incur sheltering costs. For persons located on the river (e.g. for recreation) the vulnerability of loss of life is significant.

People are also vulnerable to the loss of the uses of the lake upstream of a dam following failure. Several uses are minor, such as aesthetics or recreational use. However, some lakes serve as drinking water supplies and their loss could disrupt the drinking water supply and present a public health problem.

PROPERTY

Vulnerability of the built environment includes damage to the dam itself and any man-made feature located within the inundation area caused by the dam failure. Downstream of the dam, vulnerability includes potential damage to homes, personal property, commercial buildings and property, and government owned buildings and property; destruction of bridge or culvert crossings; weakening of bridge supports through scour; and damage or destruction of public or private infrastructure that cross the stream such as water and sewer lines, gas lines and power lines. Water dependent structures on the lake upstream of the dam, such as docks/piers, floating structures or water intake structures, may be damaged by the rapid reduction in water level during the failure.

ENVIRONMENT

Aquatic species within the lake will either be displaced or destroyed. The velocity of the flood wave will likely destroy riparian and instream vegetation and destroy wetland function. The flood wave will like cause erosion within and adjacent to the stream. Deposition of eroded deposits may choke instream habitat or disrupt riparian areas. Sediments within the lake bottom and any low oxygen water from within the lake will be dispersed, potentially causing fish kills or releasing heavy metals found in the lake sediment layers.

CONSEQUENCE ANALYSIS

Table 4.19 summarizes the potential negative consequences of dam failure.

Table 4.19 – Consequence Analysis – Dam Failure

Category	Consequences
Public	Localized impact expected to be severe for inundation area and moderate to light for other adversely affected areas.
Responders	Localized impact expected to limit damage to personnel in the inundation area at the time of the incident.

Category	Consequences
Continuity of Operations (including Continued Delivery of Services)	Damage to facilities/personnel in the area of the incident may require temporary relocation of some operations. Localized disruption of roads and/or utilities may postpone delivery of some services. Regulatory waivers may be needed locally. Fulfillment of some contracts may be difficult. Impact may reduce deliveries.
Property, Facilities and Infrastructure	Localized impact to facilities and infrastructure in the inundation area of the incident. Some severe damage possible.
Environment	Localized impact expected to be severe for inundation area and moderate to light for other adversely affected areas. Consequences include erosion, water quality degradation, wildlife displacement or destruction, and habitat destruction.
Economic Condition of the Jurisdiction	Local economy and finances adversely affected, possibly for an extended period of time, depending on damage and length of investigation.
Public Confidence in the Jurisdiction's Governance	Localized impact expected to primarily adversely affect only the dam owner and local entities.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes dam failure hazard risk by jurisdiction. Warning time and duration are inherent to the hazard and remain constant across jurisdictions. Spatial extent of any dam failure will be negligible relative to the planning area. Jurisdictions with high hazard dams within their boundaries were assigned a probability rating of possible and an impact score of critical. Jurisdictions with no high hazard dams were assigned a probability rating of unlikely and an impact rating of limited.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	2	3	1	4	3	2.4	M
Apex	2	3	1	4	3	2.4	M
Cary	2	3	1	4	3	2.4	M
Fuquay-Varina	2	3	1	4	3	2.4	M
Garner	2	3	1	4	3	2.4	M
Holly Springs	2	3	1	4	3	2.4	M
Knightdale	2	3	1	4	3	2.4	M
Morrisville	2	3	1	4	3	2.4	M
Raleigh	2	3	1	4	3	2.4	M
Rolesville	1	2	1	4	3	1.8	L
Wake Forest	2	3	1	4	3	2.4	M
Wendell	1	2	1	4	3	1.8	L
Zebulon	1	2	1	4	3	1.8	L

4.5.2 DROUGHT

HAZARD BACKGROUND

Drought is a deficiency in precipitation over an extended period. It is a normal, recurrent feature of climate that occurs in virtually all climate zones. The duration of a drought varies widely. There are cases when drought develops relatively quickly and lasts a very short period of time, exacerbated by extreme heat and/or wind, and there are other cases when drought spans multiple years, or even decades. Studying the paleoclimate record is often helpful in identifying when long-lasting droughts have occurred. Common types of drought are detailed below in Table 4.20.

Table 4.20 – Types of Drought

Type	Details
Meteorological Drought	Meteorological Drought is based on the degree of dryness (rainfall deficit) and the length of the dry period.
Agricultural Drought	Agricultural Drought is based on the impacts to agriculture by factors such as rainfall deficits, soil water deficits, reduced ground water, or reservoir levels needed for irrigation.
Hydrological Drought	Hydrological Drought is based on the impact of rainfall deficits on the water supply such as stream flow, reservoir and lake levels, and ground water table decline.
Socioeconomic Drought	Socioeconomic drought is based on the impact of drought conditions (meteorological, agricultural, or hydrological drought) on supply and demand of some economic goods. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related deficit in water supply.

The wide variety of disciplines affected by drought, its diverse geographical and temporal distribution, and the many scales drought operates on make it difficult to develop both a definition to describe drought and an index to measure it. Many quantitative measures of drought have been developed in the United States, depending on the discipline affected, the region being considered, and the particular application. Several indices developed by Wayne Palmer, as well as the Standardized Precipitation Index, are useful for describing the many scales of drought.

The U.S. Drought Monitor provides a summary of drought conditions across the United States and Puerto Rico. Often described as a blend of art and science, the Drought Monitor map is updated weekly by combining a variety of data-based drought indices and indicators and local expert input into a single composite drought indicator.

The **Palmer Drought Severity Index** (PDSI) devised in 1965, was the first drought indicator to assess moisture status comprehensively. It uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for unirrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief. It is more complex than the Standardized Precipitation Index (SPI) and the Drought Monitor.

The **Standardized Precipitation Index** (SPI) is a way of measuring drought that is different from the Palmer Drought Severity Index (PDSI). Like the PDSI, this index is negative for drought, and positive for wet conditions. But the SPI is a probability index that considers only precipitation, while Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff).

The State of North Carolina has a Drought Assessment and Response Plan as an Annex to its Emergency

Operations Plan. This plan provides the framework to coordinate statewide response to a drought incident.

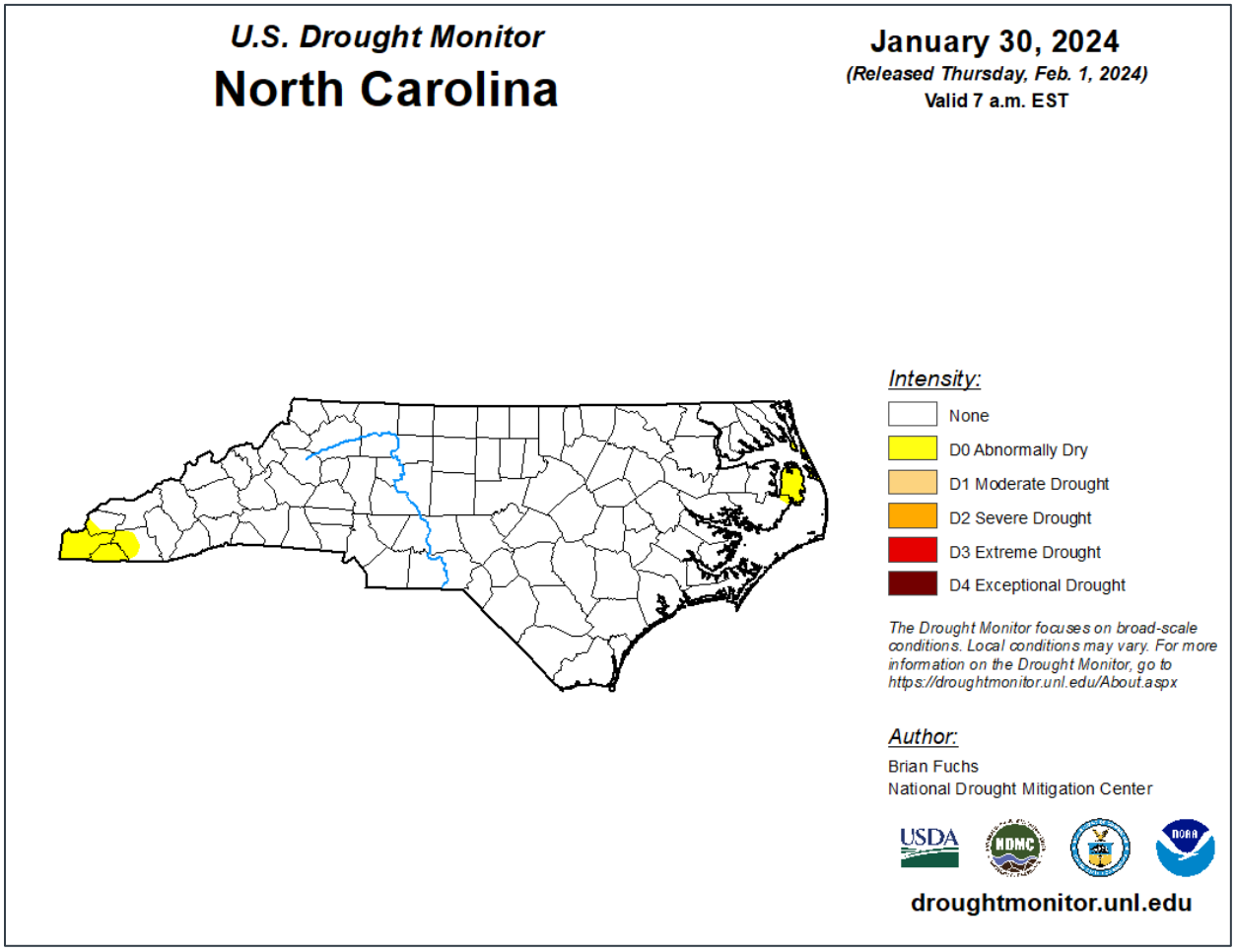
Warning Time: 1 – More than 24 hours

Duration: 4 – More than one week

LOCATION

Drought is a regional hazard that can cover an entire the entire planning area, and in some cases the entire state. The figure below notes the U.S. Drought Monitor's drought ratings for North Carolina as of January 30, 2024; as of that date, Wake County was experiencing no impacts of drought.

Figure 4.10 – US Drought Monitor for Week of January 30, 2024



Source: U.S. Drought Monitor

EXTENT

Drought extent can be defined in terms of intensity, using the U.S. Drought Monitor scale. The Drought Monitor Scale measures drought episodes with input from the Palmer Drought Severity Index, the Standardized Precipitation Index, the Keetch-Byram Drought Index, soil moisture indicators, and other inputs as well as information on how drought is affecting people. Figure 4.11 details the classifications used by the U.S. Drought Monitor. A category of D2 (severe) or higher on the U.S. Drought Monitor Scale can typically result in crop or pasture losses, water shortages, and the need to institute water restrictions.

Figure 4.11 – US Drought Monitor Classifications

			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Source: US Drought Monitor

The most severe drought to impact Wake County within the past 20 years occurred when the county spent 54 weeks in drought from May 2007 to May 2008. At the drought's peak from October 2, 2007 through March 4, 2008, the entirety of the county was considered in D4 (Exceptional) drought.

Impact: 1 – Minor

Spatial Extent: 4 – Large

HISTORICAL OCCURRENCES

Table 4.21 summarizes the drought events reported by the U.S. Drought Monitor for Wake County from 1998 through 2023 for events where the drought classification exceeded D0 (Abnormally Dry) in at least part of the county.

Table 4.21 – Recorded Instances of Drought in Wake County, 1998-2023

Start Date	End Date	Duration (Weeks)	Details
10/31/2000	11/11/2002	106	At the drought's peak from August 13 through August 19, 51.27% of Wake County was considered in a D4 drought (Exceptional)
9/6/2005	11/28/2005	12	At the drought's peak from November 1 through November 21, 28.99% of the County was considered in a D2 drought (Severe)
1/31/2006	6/19/2006	20	At the drought's peak from April 11 through May 1, 100% of the County was considered in a D2 drought (Severe)
8/22/2006	9/11/2006	3	At the drought's peak from August 29 through September 4, 64.94% of the County was considered in D1 drought (Moderate)
5/8/2007	5/19/2008	54	At the drought's peak from October 2, 2007 through March 4, 2008, 100% of the County was considered in D4 drought (Exceptional)

Start Date	End Date	Duration (Weeks)	Details
6/10/2008	9/8/2008	13	At the drought's peak from July 1 to July 7, 99% of the County was considered in D2 drought (Severe)
7/14/2009	11/16/2009	18	At the drought's peak from October 20 through October 26, 75% of the County was considered in D1 drought (Moderate)
7/6/2010	8/2/2010	4	At the drought's peak from July 27 through August 2, 34% of the County was considered in D1 drought (Moderate)
9/14/2010	10/4/2010	3	At the drought's peak from September 21 through September 27, 0.5% of the County was considered in D2 drought (Severe)
11/16/2010	8/29/2011	41	At the drought's peak from February 1 through April 4, 100% of the County was considered in D2 drought (Severe)
10/11/2011	6/4/2012	34	At the drought's peak, 100% of the County was considered in D1 drought (Moderate)
6/26/2012	7/30/2012	5	At the drought's peak from July 17 through July 23, 99% of the County was considered in D1 drought (Moderate)
11/13/2012	5/6/2013	25	At the drought's peak from December 4 through February 25, 100% of the County was considered in D1 drought (Moderate)
11/19/2013	12/30/2013	6	At the drought's peak from November 19 through December 30, 100% of the County was considered in D1 drought (Moderate)
6/16/2015	6/29/2015	2	At the drought's peak from June 16 through June 29, 100% of the County was considered in D1 drought (Moderate)
8/4/2015	10/5/2015	9	At the drought's peak from September 15 through September 28, 100% of the County was considered in D1 drought (Moderate)
3/28/2017	4/3/2017	1	At the drought's peak from March 28 through April 3, 13% of the County was considered in D1 drought (Moderate)
10/3/2017	5/21/2018	34	At the drought's peak from January 2 through January 29, 100% of the County was considered in D1 drought (Moderate)
9/17/2019	12/2/2019	11	At the drought's peak from October 8 to October 21, 100% of the County was considered in D1 drought (Moderate)
7/28/2020	8/3/2020	1	At the drought's peak from July 28 to August 3, 1% of the County was considered in D0 drought (Abnormally Dry)
4/27/2021	7/12/2021	11	At the drought's peak from June 1 to June 7, 100% of the County was considered in D1 drought (Moderate)
9/7/2021	1/17/2022	19	At the drought's peak from December 7 to January 3, 2% of the County was considered in D2 (Severe)
6/7/2022	10/3/2022	17	At the drought's peak from June 21 to July 11, 1.6% of the County was considered in D1 drought (Moderate)
8/1/2023	1/1/2024	22	At the drought's peak from November 14 to November 27, 35% of the County was considered in D1 drought (Moderate)

Source: US Drought Monitor

The National Drought Mitigation Center (NDMC), located at the University of Nebraska in Lincoln, provides a clearinghouse for information on the effects of drought, based on reports from media, observers, impact records, and other sources.

According to the National Drought Mitigation Center's Drought Impact Reporter, during the 10-year

period from January 2014 through January 2024, 91 drought impacts were noted for the State of North Carolina, of which 7 were reported to affect Wake County. Table 4.22 summarizes the number of impacts reported by category and the years impacts were reported for each category. Note that the Drought Impact Reporter assigns multiple categories to each impact.

Table 4.22 – Drought Impacts Reported for Wake County, January 2014 through January 2024

Category	Impacts	Years Reported
Agriculture	1	2019
Fire	4	2019, 2021
Plants & Wildlife	1	2019
Relief, Response & Restrictions	6	2017, 2019,2021
Society & Public Health	0	
Water Supply & Quality	2	2017, 2012

Source: Drought Impact Reporter Dashboard, NDMC Drought Impact Reporter (arcgis.com)

PROBABILITY OF FUTURE OCCURRENCE

Probability: 3 – Likely

Over the 25-year (1,303 week) period from 1998 through 2023, Wake County experienced 514 weeks of drought conditions ranging from abnormally dry to exceptional drought. This equates to a 39 percent chance of drought in any given week. Of this time, approximately 118 weeks were categorized as a severe (D2) drought or greater; which equates to an 9 percent chance of severe drought in any given week.

CLIMATE CHANGE

The Fifth National Climate Assessment reports that the risk of temperature extremes is increasing while the timing of precipitation is changing to drier conditions during spring and summer. Heavy precipitation events are becoming more frequent, meaning that there will likely be an increase in the average number of consecutive dry days. As temperature is projected to continue rising, evaporation rates are expected to increase, resulting in decreased surface soil moisture levels. Together, these factors suggest that drought will increase in intensity and duration in the Southeast.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Vulnerability to drought in Wake County is based on historical occurrences of drought in the planning area and generalized concerns regarding potential drought consequences. Agricultural vulnerability was estimated using data from the USDA Risk Management Agency Claims and a review of past claims related to drought.

PEOPLE

Drought can affect people's physical and mental health. For those economically dependent on a reliable water supply, drought may cause anxiety or depression about economic losses, reduced incomes, and other employment impacts. Conflicts may arise over water shortages. People may be forced to pay more for water, food, and utilities affected by increased water costs.

Drought may also cause health problems due to poorer water quality from lower water levels. If accompanied by extreme heat, drought can also result in higher incidents of heat stroke and even loss of human life.

PROPERTY

Drought is unlikely to cause damages to the built environment. However, in areas with shrinking and expansive soils, drought may lead to structural damages. Drought may cause severe property loss for the agricultural industry in terms of crop and livestock losses. The USDA's Risk Management Agency (RMA) maintains a database of all paid crop insurance claims. Between 2007-2023, the sum of claims paid for crop damage as a result of drought in Wake County was $9,553,908.37, or an average of $561,994.61 in losses every year. Losses were greatest in 2007 when 12,460 acres of soybeans, flue cured tobacco, and corn were affected, resulting in $1,684,909 in crop losses. Table 4.23 summarizes the crop losses due to drought in reported in the RMA system.

Table 4.23 – Crop Losses Resulting from Drought, 2007-2023

Year	Determined Acres	Indemnity Amount
2007	12,459.84	$1,684,909
2008	4,727.20	$506,630
2009	2,858.15	$282,486
2010	8,186.53	$1,202,328
2011	3,473.58	$656,081
2012	685.28	$91,120
2013	160.07	$8,811
2014	605.03	$123,391.1
2015	4,375.86	$1,152,001.62
2016	968.63	$682,636
2017	1767.51	$692,770.7
2018	1,050.36	$200,520.55
2019	4,577.28	$588,163.15
2020	730.874	$528,775
2022	2,177.083	$544,826.9
2023	3,240.932	$608,458.35
Total	**52,044.21**	**$9,553,908.37**

Source: USDA Risk Management Agency

ENVIRONMENT

Drought can affect local wildlife by shrinking food supplies and damaging habitats. Sometimes this damage is only temporary, and other times it is irreversible. Wildlife may face increased disease rates due to limited access to food and water. Increased stress on endangered species could cause extinction.

Drought conditions can also provide a substantial increase in wildfire risk. As plants and trees die from a lack of precipitation, increased insect infestations, and diseases—all of which are associated with drought—they become fuel for wildfire. Long periods of drought can result in more intense wildfires, which bring additional consequences for the economy, the environment, and society. Drought may also increase likelihood of wind and water erosion of soils.

CONSEQUENCE ANALYSIS

Table 4.24 summarizes the potential negative consequences of drought.

Table 4.24 – Consequence Analysis – Drought

Category	Consequences
Public	Can cause anxiety or depression about economic losses, conflicts over water shortages, reduced incomes, fewer recreational activities, higher incidents of heat stroke, and fatality.
Responders	Impacts to responders are unlikely. Exceptional drought conditions may impact the amount of water immediately available to respond to wildfires.
Continuity of Operations (including Continued Delivery of Services)	Drought would have minimal impacts on continuity of operations due to the relatively long warning time that would allow for plans to be made to maintain continuity of operations.
Property, Facilities and Infrastructure	Drought has the potential to affect water supply for residential, commercial, institutional, industrial, and government-owned areas. Drought can reduce water supply in wells and reservoirs. Utilities may be forced to increase rates.
Environment	Environmental impacts include strain on local plant and wildlife; increased probability of erosion and wildfire.
Economic Condition of the Jurisdiction	Farmers may face crop losses or increased livestock costs. Businesses that depend on farming may experience secondary impacts. Extreme drought has the potential to impact local businesses in landscaping, recreation and tourism, and public utilities.
Public Confidence in the Jurisdiction's Governance	When drought conditions persist with no relief, local or State governments must often institute water restrictions, which may impact public confidence.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes drought hazard risk by jurisdiction. Drought risk is uniform across the planning area. Warning time, duration, and spatial extent are inherent to the hazard and remain constant across jurisdictions. The majority of damages that result from drought are to crops and other agriculture-related activities as well as water-dependent recreation industries. The magnitude of the impacts is typically greater in unincorporated areas, however Wake County is highly developed. In developed areas, the magnitude of drought is less severe, with lawns and local gardens affected and potential impacts on local water supplies during severe, prolonged drought.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	3	1	4	1	4	2.5	M
Apex	3	1	4	1	4	2.5	M
Cary	3	1	4	1	4	2.5	M
Fuquay-Varina	3	1	4	1	4	2.5	M
Garner	3	1	4	1	4	2.5	M
Holly Springs	3	1	4	1	4	2.5	M
Knightdale	3	1	4	1	4	2.5	M
Morrisville	3	1	4	1	4	2.5	M
Raleigh	3	1	4	1	4	2.5	M
Rolesville	3	1	4	1	4	2.5	M
Wake Forest	3	1	4	1	4	2.5	M
Wendell	3	1	4	1	4	2.5	M
Zebulon	3	1	4	1	4	2.5	M

4.5.3 EARTHQUAKE

HAZARD BACKGROUND

An earthquake is a movement or shaking of the ground. Most earthquakes are caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along borders of the Earth's 10 tectonic plates. The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

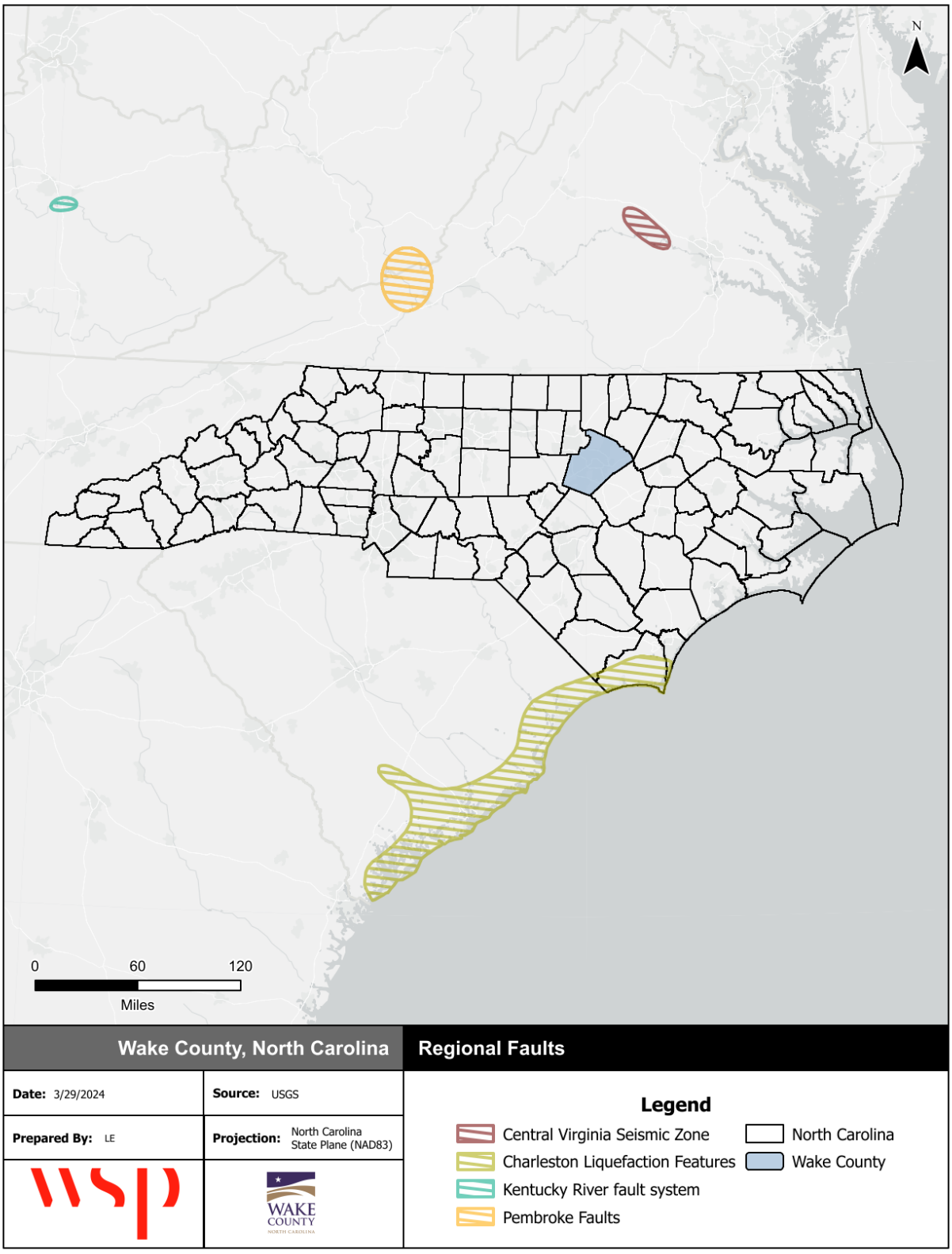
Warning Time: 4 – Less than 6 hours

Duration: 1 – Less than 6 hours

LOCATION

Figure 4.12 reflects the Quaternary faults that present an earthquake hazard for the Wake County planning area based on data from the USGS Earthquake Hazards Program.

Figure 4.12 – US Quaternary Faults



Source: USGS Earthquake Hazards Program

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The state is affected by both the Charleston Fault in South Carolina and New Madrid Fault in Tennessee. Both of these faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking.

EXTENT

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude. A detailed description of the Richter Scale is given in Table 4.25. Although the Richter scale is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public, the scale currently used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table 4.26 shows descriptions for levels of earthquake intensity on the MMI scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Table 4.25 – Richter Scale

Magnitude	Effects
Less than 3.5	Generally not felt, but recorded.
3.5 – 5.4	Often felt, but rarely causes damage.
5.4 – 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 – 6.9	Can be destructive in areas up to 100 kilometers across where people live.
7.0 – 7.9	Major earthquake. Can cause serious damage over larger areas.
8.0 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: FEMA

Table 4.26 – Modified Mercalli Intensity (MMI) Scale

MMI	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

MMI	Shaking	Description/Damage
VII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Source: USGS Earthquake Hazards Program

The most severe earthquake to impact the Wake County area was the Charleston earthquake of 1886. It is estimated to have been felt as a 7 or 8 on the MMI Scale. Since then, six earthquakes have been felt in Wake County, and all were at an MMI Scale of 4 or lower.

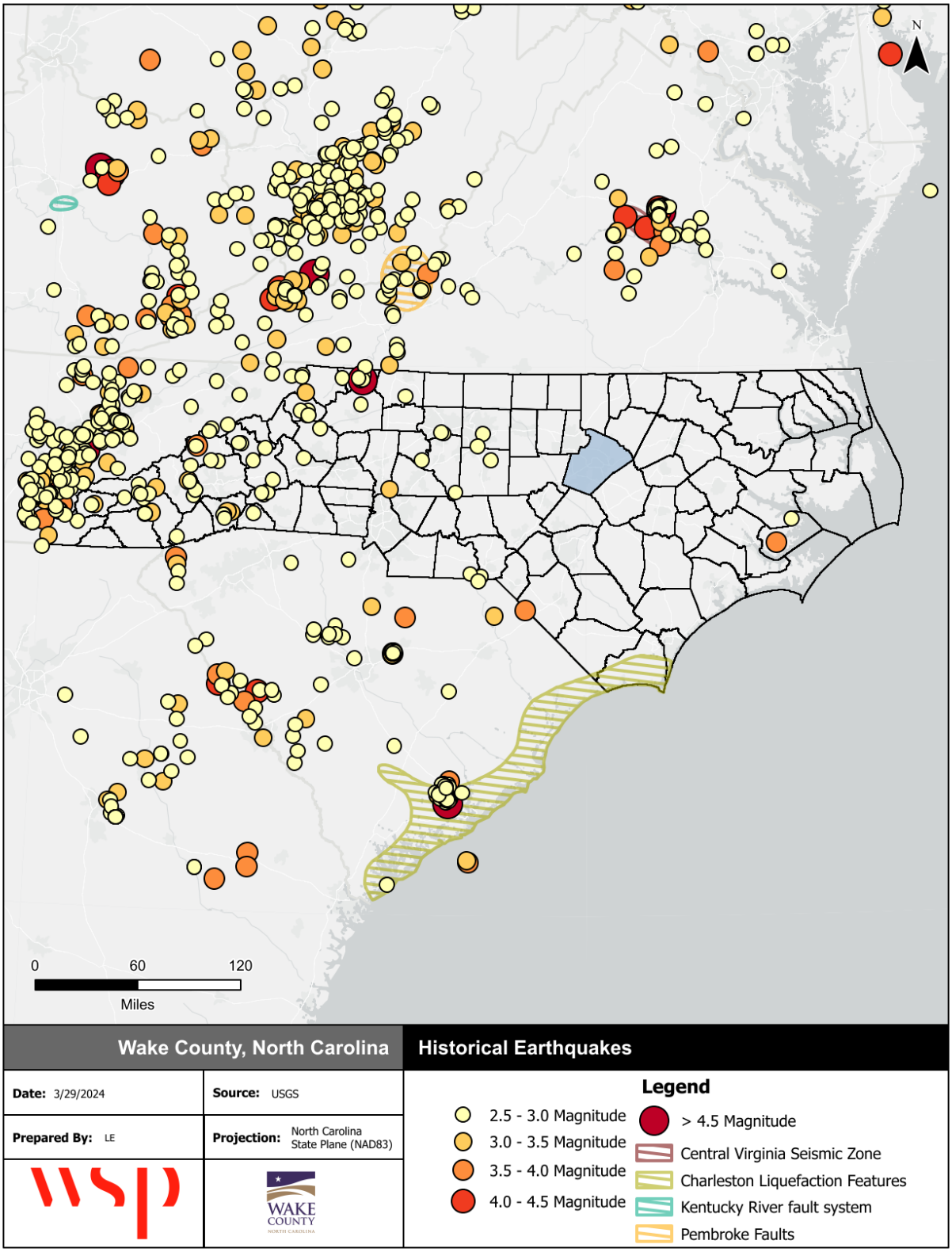
Impact: 1 – Minor

Spatial Extent: 4 – Large

HISTORICAL OCCURRENCES

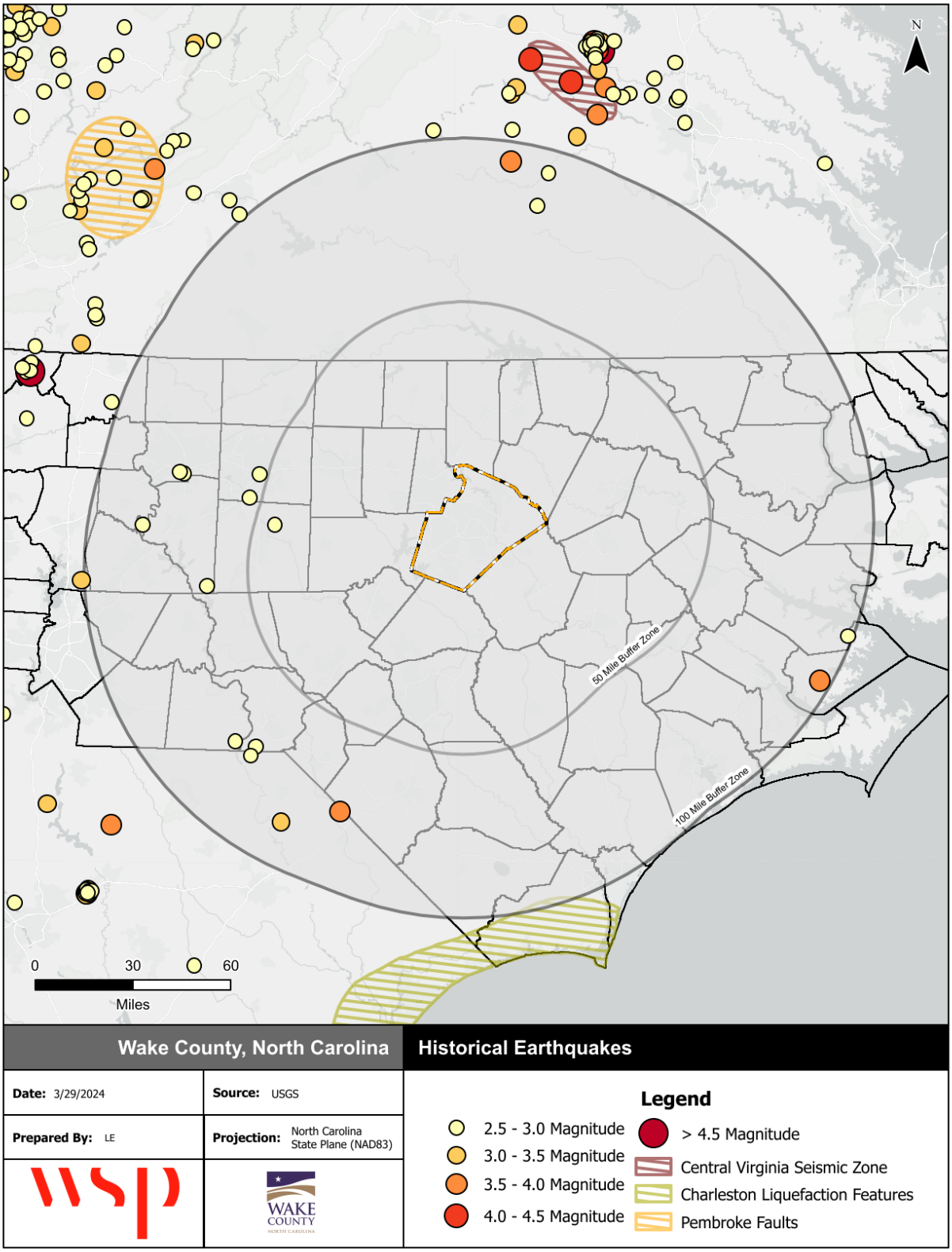
The USGS Earthquake Hazards Program maintains a database of all historical earthquakes of a magnitude 2.5 and greater. These events are illustrated in the following pages. Figure 4.13 shows historical earthquakes by magnitude in relation to North Carolina and the Quaternary Faults identified by USGS. This includes events from 1973 to 2023. Figure 4.14 provides a more detailed view of earthquakes that have occurred within 50 and 100 miles of Wake County.

Figure 4.13 – Historical Earthquakes by Magnitude, 1973-2023



Source: USGS Earthquakes Hazard Program

Figure 4.14 – Historical Earthquakes, Distance from Wake County, 1973-2023



Source: USGS Earthquakes Hazard Program

According to data from the USGS Earthquake Hazards Program, there has been a total of 13 recorded earthquakes with a magnitude of 2.5 or greater that have occurred within 100 miles of Wake County from 1973 to 2023. Approximately 69% of these earthquakes were measured with a magnitude between 2.5-3.0 on the Richter scale, while 31% were measured with a magnitude between 3.0-4.0. The highest recorded magnitude of these earthquakes was 3.8, which occurred twice, in 1994 and in 1998. The most recent earthquake to occur within 100 miles of Wake County was on November 15th, 2015, located in Denton, North Carolina, and had a magnitude of 2.6.

The above map documents all earthquakes that have occurred within North Carolina; however, given the long distances across which earthquake impacts can be felt, these events do not encompass all earthquakes that have affected North Carolina. The following data, detailed in Table 4.27, was compiled and presented in the 2019 Wake County Hazard Mitigation Plan and remains relevant to the planning area.

Table 4.27 – Historical Earthquakes Impacting North Carolina

Date	Location	Richter Scale (Magnitude)	MMI (Intensity)	MMI in North Carolina
12/16/1811 – 1	NE Arkansas	8.5	XI	VI
12/16/1811 – 2	NE Arkansas	8.0	X	VI
12/18/1811 – 3	NE Arkansas	8.0	X	VI
01/23/1812	New Madrid, MO	8.4	XI	VI
02/071812	New Madrid, MO	8.7	XII	VI
04/29/1852	Wytheville, VA	5.0	VI	VI
08/31/1861	Wilkesboro, NC	5.1	VII	VII
12/23/1875	Central Virginia	5.0	VII	VI
08/31/1886	Charleston, SC	7.3	X	VII
05/31/1897	Giles County, VA	5.8	VIII	VI
01/01/1913	Union County, SC	4.8	VII	VI
02/21/1916	Asheville, NC	5.5	VII	VII
07/08/1926	Mitchell County, NC	5.2	VII	VII
11/03/1928	Newport, TN	4.5	VI	VI
05/13/1957	McDowell County, NC	4.1	VI	VI
07/02/1957	Buncombe County, NC	3.7	VI	VI
11/24/1957	Jackson County, NC	4.0	VI	VI
10/27/1959 *	Chesterfield, SC	4.0	VI	VI
07/13/1971	Newry, SC	3.8	VI	VI
11/30/1973	Alcoa, TN	4.6	VI	VI
11/13/1976	Southwest Virginia	4.1	VI	VI
05/05/1981	Henderson County, NC	3.5	VI	VI

* Conflicting reports on this event, intensity in North Carolina could have been either V or VI
Source: 2019 Wake County Hazard Mitigation Plan (This information compiled by Dr. Kenneth B. Taylor and provided by Tiawana Ramsey of NCEM. Information was compiled from the National Earthquake Center, Earthquakes of the US by Carl von Hake (1983), and a compilation of newspaper reports in the Eastern Tennessee Seismic Zone compiled by Arch Johnston, CERI, Memphis State University (1983)).

PROBABILITY OF FUTURE OCCURRENCE

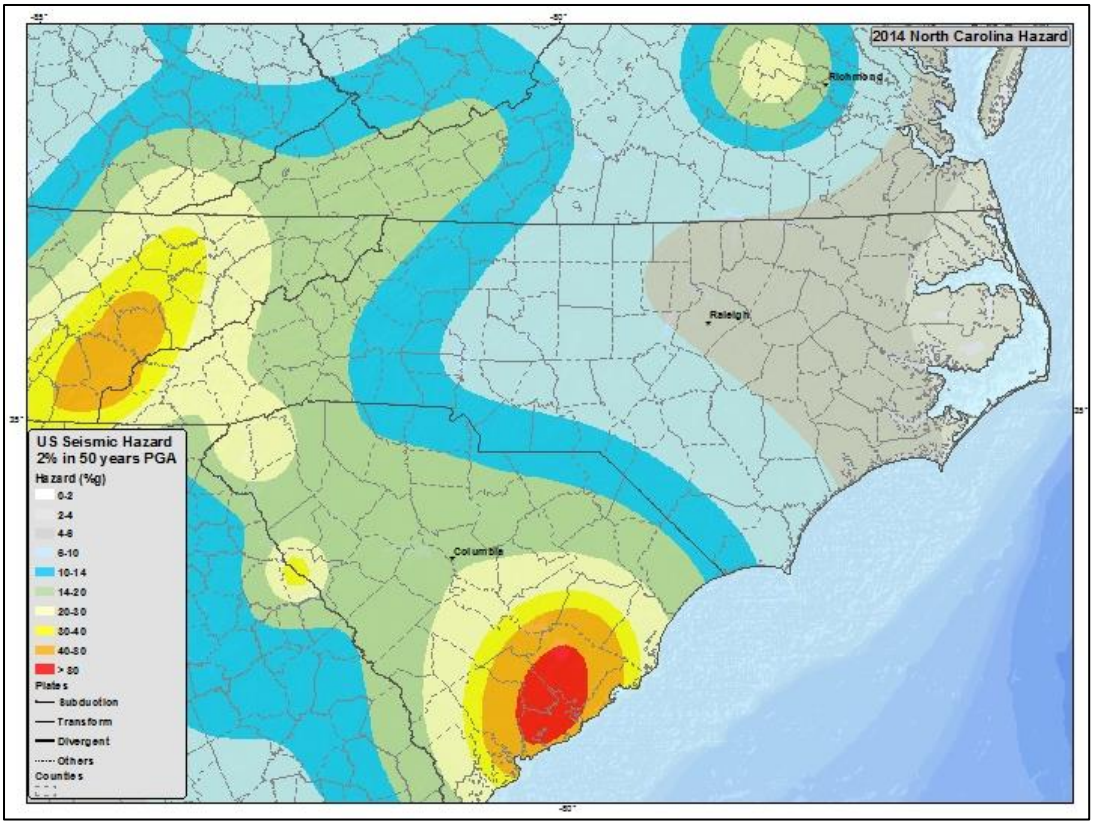
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is

depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions (of a particular frequency) that have a common given probability of being exceeded in 50 years.

Figure 4.15 reflects the seismic hazard for Wake County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the recurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value.

Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions. Wake County is located within the light blue and dark gray zones representing a low peak acceleration of 0.04 to 0.1% g.

Figure 4.15 – Seismic Hazard Information for North Carolina



Source: USGS Earthquake Hazards Program

Based on this data, it can be reasonably assumed that an earthquake event affecting Wake County is unlikely.

Probability: 1 – Unlikely

CLIMATE CHANGE

Scientists are beginning to believe there may be a connection between climate change and earthquakes. Changing ice caps and sea-level redistribute weight over fault lines, which could potentially have an

influence on earthquake occurrences. However, currently no studies quantify the relationship to a high level of detail, so recent earthquakes should not be linked with climate change. While not conclusive, early research suggest that more intense earthquakes and tsunamis may eventually be added to the adverse consequences that are caused by climate change.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Population and property at risk to flooding was estimated using data from the NCEM IRISK database, which was compiled in NCEM's Risk Management Tool.

PEOPLE

Earthquake events in Wake County are unlikely to produce more than mild ground shaking; therefore, injury or death is unlikely. Objects falling from shelves generally pose the greatest threat to safety.

Table 4.28 and Table 4.29 detail the population estimated to be at risk from a 250-year earthquake and a 500-year earthquake, respectively, according to the NCEM IRISK database.

Table 4.28 – Estimated Population Impacted by 250-Year Earthquake

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	48,639	10%	53,945	6,246	12%	26,904	3,115	12%
Apex	57,525	4,320	8%	5,963	617	10%	3,912	405	10%
Cary	164,869	12,025	7%	19,866	1,737	9%	9,432	825	9%
Fuquay-Varina	32,177	2,972	9%	4,432	526	12%	2,204	262	12%
Garner	35,232	4,534	13%	5,015	734	15%	2,863	419	15%
Holly Springs	30,885	2,402	8%	2,685	250	9%	2,254	210	9%
Knightdale	29,077	3,307	11%	3,207	573	18%	1,917	343	18%
Morrisville	21,999	4,676	21%	1,533	384	25%	1,627	408	25%
Rolesville	12,236	834	7%	1,401	225	16%	919	147	16%
Wake Forest	*47,601	3,726	10%	4,777	571	12%	2,891	346	12%
Wendell	8,423	835	10%	1,361	144	11%	418	44	11%
Zebulon	5,751	748	13%	948	116	12%	437	54	12%
Unincorporated Wake County	230,494	22,616	10%	29,196	4,887	17%	14,301	2,394	17%
TOTAL	**1,143,763**	**111,634**	**10%**	**134,329**	**17,010**	**13%**	**70,079**	**8,972**	**13%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

Table 4.29 – Estimated Population Impacted by 500-Year Earthquake

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	420,104	88%	53,945	53,945	100%	26,904	26,904	100%
Apex	57,525	41,724	73%	5,963	5,963	100%	3,912	3,912	100%
Cary	164,869	137,544	83%	19,866	19,866	100%	9,432	9,432	100%
Fuquay-Varina	32,177	25,023	78%	4,432	4,432	100%	2,204	2,204	100%
Garner	35,232	30,981	88%	5,015	5,015	100%	2,863	2,863	100%
Holly Springs	30,885	25,787	83%	2,685	2,685	100%	2,254	2,254	100%
Knightdale	29,077	18,501	64%	3,207	3,207	100%	1,917	1,917	100%
Morrisville	21,999	18,655	85%	1,533	1,533	100%	1,627	1,627	100%
Rolesville	12,236	5,199	42%	1,401	1,401	100%	919	919	100%
Wake Forest	*47,601	31,175	82%	4,777	4,777	100%	2,891	2,891	100%
Wendell	8,423	7,889	94%	1,361	1,361	100%	418	418	100%
Zebulon	5,751	6,102	106%	948	948	100%	437	437	100%
Unincorporated Wake County	230,494	135,124	59%	29,196	29,196	100%	14,301	14,301	100%
TOTAL	**1,143,763**	**903,808**	**79%**	**134,329**	**134,329**	**100%**	**70,079**	**70,079**	**100%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

PROPERTY

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also cause damages to infrastructure, resulting in secondary hazards. Damages to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well.

Wake County has not been impacted by an earthquake with more than a moderate intensity, so damage to the built environment is unlikely.

Table 4.30 through Table 4.31 detail the estimated buildings impacted from varying magnitudes of earthquake events.

Table 4.30 – Estimated Buildings Impacted by 250-Year Earthquake Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	7,807	6%	13,673	11%	$424,380	6,149	5%	$1,297,187	2,075	2%	$534,202	21,897	17%	$2,255,769
Apex	14,915	742	5%	1,453	10%	$34,034	661	4%	$104,118	134	1%	$25,172	2,248	15%	$163,323
Cary	45,306	1,255	3%	3,712	8%	$153,063	1,837	4%	$386,301	428	1%	$101,539	5,977	13%	$640,903
Fuquay-Varina	11,070	499	5%	1,217	11%	$13,111	584	5%	$95,179	120	1%	$25,330	1,921	17%	$133,619
Garner	11,975	718	6%	1,611	13%	$16,109	677	6%	$94,971	164	1%	$25,963	2,452	20%	$137,042
Holly Springs	10,528	286	3%	951	9%	$10,325	244	2%	$67,258	59	1%	$21,074	1,254	12%	$98,658
Knightdale	7,144	354	5%	1,217	17%	$12,152	255	4%	$26,315	59	1%	$13,951	1,531	21%	$52,417
Morrisville	5,181	72	1%	1,198	23%	$32,527	334	6%	$106,722	42	1%	$7,218	1,574	30%	$146,467
Rolesville	2,103	278	13%	318	15%	$751	88	4%	$5,204	29	1%	$2,999	435	21%	$8,954
Wake Forest	10,547	296	3%	1,170	11%	$13,756	527	5%	$56,347	134	1%	$14,127	1,831	17%	$84,230
Wendell	3,728	263	7%	356	10%	$1,344	263	7%	$17,247	58	2%	$6,949	677	18%	$25,540
Zebulon	3,231	286	9%	341	11%	$2,146	311	10%	$42,304	64	2%	$5,620	716	22%	$50,071
Unincorporated Wake County	59,918	2,817	5%	9,404	16%	$23,274	3,118	5%	$196,971	360	1%	$52,279	12,882	21%	$272,523
TOTAL	**313,708**	**15,673**	**5%**	**36,621**	**12%**	**$736,972**	**15,048**	**5%**	**$2,496,124**	**3,726**	**1%**	**$836,423**	**55,395**	**18%**	**$4,069,516**

Source: NCEM Risk Management Tool

Table 4.31 – Estimated Buildings Impacted by 500-Year Earthquake Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$9,406,336	6,336	5%	$12,608,955	2,270	2%	$5,413,973	128,042	100%	$27,429,264
Apex	14,915	3,715	25%	14,089	94%	$1,091,136	671	4%	$959,965	155	1%	$287,962	14,915	100%	$2,339,063
Cary	45,306	7,401	16%	42,944	95%	$3,946,800	1,872	4%	$4,179,591	462	1%	$1,027,396	45,278	100%	$9,153,787
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$607,455	596	5%	$878,976	131	1%	$259,069	11,065	100%	$1,745,500
Garner	11,975	4,982	42%	11,103	93%	$563,146	687	6%	$910,771	181	2%	$257,289	11,971	100%	$1,731,206
Holly Springs	10,528	994	9%	10,208	97%	$696,982	248	2%	$595,919	68	1%	$207,385	10,524	100%	$1,500,286
Knightdale	7,144	1,696	24%	6,811	95%	$308,199	265	4%	$235,747	67	1%	$138,754	7,143	100%	$682,700
Morrisville	5,181	274	5%	4,793	93%	$646,953	340	7%	$1,032,965	48	1%	$64,561	5,181	100%	$1,744,480
Rolesville	2,103	808	38%	1,983	94%	$71,720	91	4%	$39,738	29	1%	$24,399	2,103	100%	$135,857
Wake Forest	10,547	1,459	14%	9,852	93%	$542,005	541	5%	$495,629	151	1%	$169,170	10,544	100%	$1,206,803
Wendell	3,728	1,536	41%	3,378	91%	$83,614	277	7%	$151,000	73	2%	$78,095	3,728	100%	$312,709
Zebulon	3,231	1,519	47%	2,809	87%	$76,899	336	10%	$370,352	84	3%	$62,970	3,229	100%	$510,220
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$2,485,876	3,183	5%	$2,009,151	403	1%	$533,623	59,849	100%	$5,028,650
TOTAL PLAN	**313,708**	**82,750**	**26%**	**294,007**	**94%**	**$20,527,121**	**15,443**	**5%**	**$24,468,759**	**4,122**	**1%**	**$8,524,646**	**313,572**	**100%**	**$53,520,525**

Source: NCEM Risk Management Tool

The planning team also evaluated earthquake risk with FEMA's Hazus software using a probabilistic scenario for an earthquake with a 250-year return period. Per this analysis, a 250-year earthquake would cause an estimated $126.8 million in building related damages. The results of the Hazus loss estimate are summarized in Table 4.32.

Table 4.32 – Hazus Building-Related Loss Estimates, 250-year Probabilistic Earthquake Scenario

Area	Residential		Commercial	Industrial	Others	Total
	Single Family	Other				
Structural	$23,974,600	$1,757,900	$9,400,300	$1,827,700	$3,642,400	$40,602,900
Non-Structural	$45,968,500	$6,511,600	$12,361,200	$1,962,500	$6,285,400	$73,089,200
Content	$5,593,900	$1,039,600	$2,975,300	$900,000	$1,581,900	$12,090,700
Inventory	$0	$0	$729,900	$180,000	$131,700	$1,041,600
Total	**$75,537,000**	**$9,309,100**	**$25,466,700**	**$4,870,200**	**$11,641,400**	**$126,824,400**

Source: Hazus version 6.1

ENVIRONMENT

An earthquake is unlikely to cause substantial impacts to the natural environment in Wake County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type of damage is unlikely based on historical occurrences.

CONSEQUENCE ANALYSIS

Table 4.33 summarizes the potential negative consequences of earthquake.

Table 4.33 – Consequence Analysis - Earthquake

Category	Consequences
Public	Impact expected to be severe for people who are unprotected or unable to take shelter; moderate to light impacts are expected for those who are protected.
Responders	Responders may be required to enter unstable structures or compromised infrastructure. Adverse impacts are expected to be severe for unprotected personnel and moderate to light for protected personnel.
Continuity of Operations (including Continued Delivery of Services)	Damage to facilities/personnel in the area of the incident may require relocation of operations and lines of succession execution. Disruption of lines of communication and destruction of facilities may extensively postpone delivery of services.
Property, Facilities and Infrastructure	Damage to facilities and infrastructure in the area of the incident may be extensive for facilities, people, infrastructure, and HazMat.
Environment	May cause extensive damage, creating denial or delays in the use of some areas. Remediation may be needed.
Economic Condition of the Jurisdiction	Local economy and finances expected to be adversely affected, possibly for an extended period of time.
Public Confidence in the Jurisdiction's Governance	Ability to respond and recover may be questioned and challenged if planning, response, and recovery are not timely and effective.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes earthquake hazard risk by jurisdiction. Earthquake risk is uniform across the planning area.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	1	1	4	4	1	1.9	L
Apex	1	1	4	4	1	1.9	L
Cary	1	1	4	4	1	1.9	L
Fuquay-Varina	1	1	4	4	1	1.9	L
Garner	1	1	4	4	1	1.9	L
Holly Springs	1	1	4	4	1	1.9	L
Knightdale	1	1	4	4	1	1.9	L
Morrisville	1	1	4	4	1	1.9	L
Raleigh	1	1	4	4	1	1.9	L
Rolesville	1	1	4	4	1	1.9	L
Wake Forest	1	1	4	4	1	1.9	L
Wendell	1	1	4	4	1	1.9	L
Zebulon	1	1	4	4	1	1.9	L

4.5.4 EXTREME HEAT

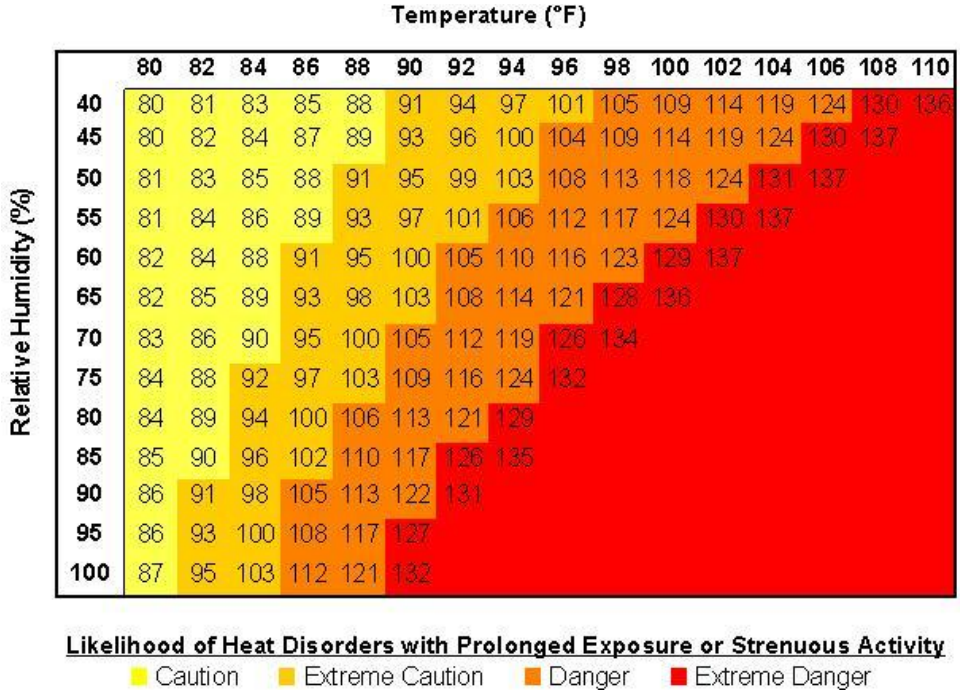
HAZARD BACKGROUND

Per information provided by FEMA, in most of the United States extreme heat is defined as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. In extreme heat, evaporation is slowed and the body must work extra hard to maintain a normal temperature, which can lead to death by overwork of the body. Extreme heat often results in the highest annual number of deaths among all weather-related disasters. Per Ready.gov:

- Extreme heat can occur quickly and without warning
- Older adults, children, and sick or overweight individuals are at greater risk from extreme heat
- Humidity increases the feeling of heat as measured by heat index

Ambient air temperature is one component of heat conditions, with relative humidity being the other. The relationship of these factors creates what is known as the apparent temperature. The Heat Index Chart in Figure 4.16 uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Figure 4.16 – Heat Index Chart



Source: National Weather Service (NWS) http://www.nws.noaa.gov/os/heat/heat_index.shtml
Note: Exposure to direct sun can increase Heat Index values by as much as 15˚F. The shaded zone above 105˚F corresponds to a heat index that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

During these conditions, the human body has difficulties cooling through the normal method of the evaporation of perspiration. Health risks rise when a person is over exposed to heat.

The most dangerous place to be during an extreme heat incident is in a permanent home, with little or no air conditioning. Those at greatest risk for heat-related illness include people 65 years of age and older, young children, people with chronic health problems such as heart disease, people who are obese, people who are socially isolated, and people who are on certain medications, such as tranquilizers,

antidepressants, sleeping pills, or drugs for Parkinson's disease. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather or are not acclimated to hot weather. Table 4.34 lists typical symptoms and health impacts of exposure to extreme heat.

Table 4.34 – Typical Health Impacts of Extreme Heat

Classification	Heat Index (HI)	Effect on the body
Caution	80-90˚ F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90-103˚ F	Heat Stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103-124˚ F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125˚ F or higher	Heat stroke highly likely

Source: National Weather Service

The National Weather Service has a system in place to initiate alert procedures (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°F) and the night time minimum Heat Index is 80°F or above for two or more consecutive days. A heat advisory is issued when temperatures reach 105 degrees and a warning is issued at 115 degrees.

Impacts of extreme heat are not only focused on human health, as prolonged heat exposure can have devastating impacts on infrastructure as well. Prolonged high heat exposure increases the risk of pavement deterioration, as well as railroad warping or buckling. High heat also puts a strain on energy systems and consumption, as air conditioners are run at a higher rate and for longer; extreme heat can also reduce transmission capacity over electric systems.

Warning Time: 1 – More than 24 hours warning time

Duration: 4 – More than one week

LOCATION

The entire planning area is susceptible to high temperatures and incidents of extreme heat.

EXTENT

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 2 hours or more and/or excessive heat for 3 consecutive days.
- **Excessive Heat Watch** – Conditions are favorable for an excessive heat event to meet or exceed local Excessive Heat Warning criteria; valid for the entire heat episode and not just the daytime hours.

  Note: Excessive heat occurs from a combination of hot temperatures and high humidity.

- **Excessive Heat Warning** – Heat Index values 110°F or higher for 2 hours or more

Based on data from the "Raleigh State Univ" weather station from January 1892 through January 2024, the highest temperature recorded in Wake County was 107°F and occurred in July 2011.

Impact: 3 – Critical

Spatial Extent: 4 – Large

HISTORICAL OCCURRENCES

According to the National Oceanic and Atmospheric Administration (NOAA), 2020 was North Carolina's hottest year on record with an average of 61.7 degrees Fahrenheit; that record stretches back 128 years to 1895.

The following two heat-related incidents were reported by NCEI for Wake County; these incidents caused one injury and no fatalities, property damage, or crop damage:

July 22, 1998 – Excessive heat plagued central North Carolina during July 22 through July 23. Maximum temperatures reached the 98 to 103 degree range combined with dew points in the 78 to 80 degree range with little wind to give heat index values of around 110 degrees for several hours each afternoon. To make matters worse, the minimum temperatures did not fall below 80 at several locations and those that did achieved that feat for only an hour or two. Strong thunderstorms ended the 2 day excessive heat ordeal on the evening of the 23 when rain cooled the environment enough to send temperatures into the lower 70s at most locations.

August 22, 2007 – An athlete from Enloe High School running track collapsed from heat exhaustion and was sent to the hospital in critical condition. The student remained in the hospital in critical condition for several days.

PROBABILITY OF FUTURE OCCURRENCE

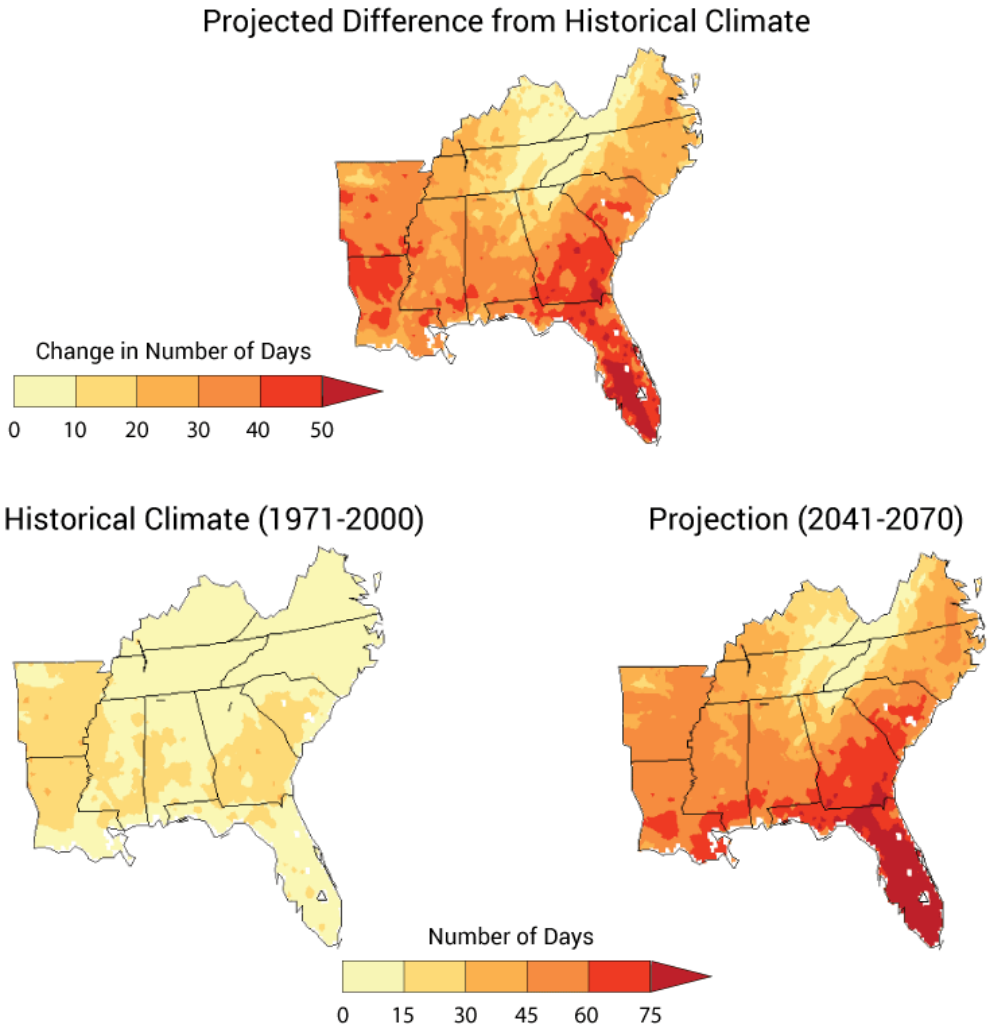
Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the Raleigh State University weather station as an approximation for Wake County. During the 25-year period from 1998 through 2023, Wake County experienced 49 days with a high temperature greater than or equal to 100°F, or an average of 1.9 days per year. In 2012, there were 10 days with recorded temperatures above this threshold.

Probability: 4 – Highly Likely

CLIMATE CHANGE

Research shows that average temperatures will continue to rise in the Southeast United States and globally, directly affecting the Wake County region in North Carolina. Per the Fifth National Climate Assessment, "The number of extreme warm days (above 95°F) is expected to continue increasing with every increment of global warming." Additional heat stresses can be attributed to the urban heat island effect which can increase the temperature of those living in urban environments compared to rural areas. The number of days over 95°F is expected to increase by between 20 and 30 days annually, as shown in Figure 4.17. The Triangle Regional Resilience Partnership Resilience Assessment notes that the number of days with extreme temperatures has been increasing in the Triangle; climbing from an average of 18 days over 92°F per year from 1948 to 2012 to a peak of 48 days over 92°F in 2010.

Figure 4.17 – Projected Change in Number of Days Over 95˚F



Source: NOAA NCDC from 2014 National Climate Assessment

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

No data is available to assess the vulnerability of people or property in the planning area to extreme heat.

PEOPLE

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated or who work in outdoor settings are also more vulnerable to extreme heat.

PROPERTY

Extreme heat is unlikely to cause significant damages to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat.

Train rails may also distort or buckle under the stress of head induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

Extreme heat can also cause significant agricultural losses. Between 2007-2023, the sum of claims paid for crop damage due to heat in Wake County was $3,429,607.85, or an average of $201,741.64 in losses every year. Losses were greatest in 2016 when 512 acres of flue cured tobacco, soybeans, and corn were affected, resulting in $494,026.75 in crop losses. Table 4.35 summarizes the crop losses due to drought in reported in the RMA system.

Table 4.35 – Crop Losses Resulting from Heat, 2007-2023

Year	Determined Acres	Indemnity Amount
2008	16.40	$380.00
2010	1480.92	$338,250.00
2011	296.21	$104,999.00
2012	456.98	$114,504.00
2015	239.62	$280,358.30
2016	512.32	$494,026.75
2017	386.77	$179,418.00
2018	101.215	$48,761.2
2019	72.4675	$17,014.25
2020	19.95	$38,091.9
2022	523.1735	$242,355
2023	1361.971	$238,931.4
Total	**8,470.45**	**$3,429,607.85**

Source: USDA Risk Management Agency

ENVIRONMENT

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

CONSEQUENCE ANALYSIS

Table 4.36 summarizes the potential negative consequences of extreme heat.

Table 4.36 – Consequence Analysis – Extreme Heat

Category	Consequences
Public	Extreme heat may cause illness and/or death.
Responders	Consequences may be greater for responders if their work requires exertion and/or wearing heavy protective gear.
Continuity of Operations (including Continued Delivery of Services)	Continuity of operations is not expected to be impacted by extreme heat because warning time for these events is long.
Property, Facilities and Infrastructure	Minor impacts may occur, including possible damages to road surfaces and power lines.
Environment	Environmental impacts include strain on local plant and wildlife, including potential for illness or death.

Category	Consequences
Economic Condition of the Jurisdiction	Farmers may face crop losses or increased livestock costs.
Public Confidence in the Jurisdiction's Governance	Extreme heat is unlikely to impact public confidence.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes extreme heat hazard risk by jurisdiction. Extreme heat risk does not vary significantly by jurisdiction.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	4	3	4	1	3	3.3	H
Apex	4	3	4	1	3	3.3	H
Cary	4	3	4	1	3	3.3	H
Fuquay-Varina	4	3	4	1	3	3.3	H
Garner	4	3	4	1	3	3.3	H
Holly Springs	4	3	4	1	3	3.3	H
Knightdale	4	3	4	1	3	3.3	H
Morrisville	4	3	4	1	3	3.3	H
Raleigh	4	3	4	1	3	3.3	H
Rolesville	4	3	4	1	3	3.3	H
Wake Forest	4	3	4	1	3	3.3	H
Wendell	4	3	4	1	3	3.3	H
Zebulon	4	3	4	1	3	3.3	H

4.5.5 FLOOD

HAZARD BACKGROUND

Flooding is defined by the rising and overflowing of water onto normally dry land. As defined by FEMA, a flood is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties. Flooding can result from an overflow of inland waters or an unusual accumulation or runoff of surface waters from any source.

Flooding is the most frequent and costly of all natural hazards in the United States. According to the National Weather Service, a total of 1,392 flood fatalities occurred in the United States from 2010 to 2023. Of those fatalities, 62 or 4% occurred in the State of North Carolina. FEMA indicates that from May 1953 to February 2024 there have been a total of 4,842 declared disasters and 884 of those declared disasters result from floods alone. This does not consider the floods that may occur during tropical or severe thunderstorms that have been declared disasters.

SOURCES AND TYPES OF FLOODING

Flooding within Wake County can be attributed to two main sources as noted below.

Riverine Flooding: The primary riverine flooding sources in Wake County are the Black River, Contentnea River, Haw River, Cape Fear River, and Neuse River, according to the 2022 Preliminary Flood Insurance Study for Wake County. These rivers and their tributaries are susceptible to overflowing their banks during and following excessive precipitation events. Though less common, riverine flood events (such as the "100-year flood") will cause significantly more damage and economic disruption for the area than incidences of localized stormwater flooding.

The Effective FIRM and revised Flood Insurance Study (FIS) report for Wake County are dated July 19, 2022. The FIS summarizes the principal flood problems in the county as follows:

"Flooding problems in the unincorporated areas of Wake County have been mostly attributed to the inefficient removal of runoff from highly developed areas. The extent to which development in this area has affected flooding problems can be seen by comparing a flood in May 1957 with one in February 1973. The 1957 flood resulted from approximately 5.7 inches of rain and was considered to have an average frequency of once in 7 years. The 1973 flood reached higher levels in the floodplain but resulted from only 3.5 inches of rain, or a storm predicted to occur once in every 2 to 5 years. This increase in flood potential, caused partially by the intense development which has taken place in the area, has resulted in reduced crop yields and lowered land values and caused more frequent property damage."

Flash Flooding: A flash flood occurs when water levels rise at an extremely fast rate as a result of intense rainfall over a brief period, possibly from slow-moving intense thunderstorms and sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil, or impermeable surfaces. Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by the National Flood Insurance Program (NFIP) and can also happen in areas not associated with floodplains. Flash flood hazards caused by surface water runoff are most common in urbanized areas, where greater population density generally equates to more impervious surface (e.g., pavement and buildings) which increases the amount of surface water generated.

Flash flooding is a dangerous form of flooding which can reach full peak in only a few minutes. Rapid onset allows little or no time for protective measures. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding

can result in higher loss of life, both human and animal, than slower developing river and stream flooding.

In certain areas, aging storm sewer systems are not designed to carry the capacity currently needed to handle the increased storm runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.

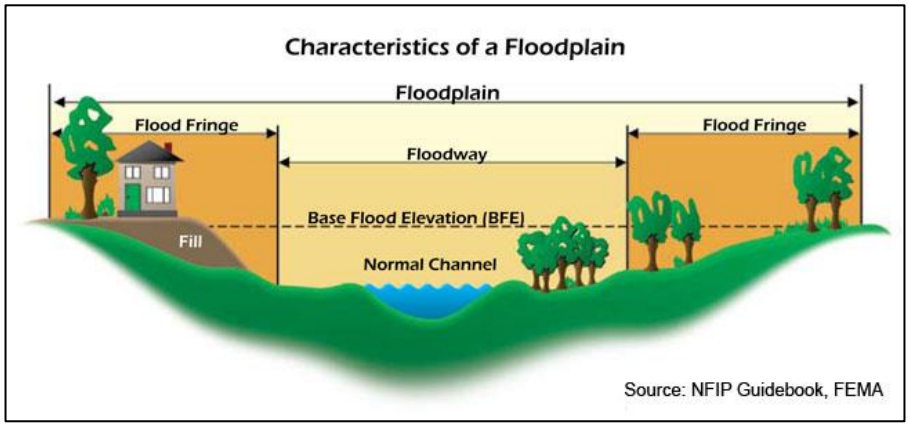
Localized flooding may be caused by the following issues:

- **Inadequate Capacity –** An undersized/under capacity pipe system can cause water to back-up behind a structure which can lead to areas of ponded water and/or overtopping of banks.
- **Clogged Inlets** – Debris covering the asphalt apron and the top of grate at catch basin inlets may contribute to an inadequate flow of stormwater into the system. Debris within the basin itself may also reduce the efficiency of the system by reducing the carrying capacity.
- **Blocked Drainage Outfalls** – Debris blockage or structural damage at drainage outfalls may prevent the system from discharging runoff, which may lead to a back-up of stormwater within the system.
- **Improper Grade** – Poorly graded asphalt around catch basin inlets may prevent stormwater from entering the catch basin as designed. Areas of settled asphalt may create low spots within the roadway that allow for areas of ponded water.

FLOODING AND FLOODPLAINS

In the case of riverine flooding, the area adjacent to a channel is the floodplain, as shown in Figure 4.18. A floodplain is flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. Floodplains are made when floodwaters exceed the capacity of the main channel or escape the channel by eroding its banks. When this occurs, sediments (including rocks and debris) are deposited that gradually build up over time to create the floor of the floodplain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream.

Figure 4.18 – Characteristics of a Floodplain



In its common usage, the floodplain most often refers to that area that is inundated by the "100-year flood," which is the flood that has a 1% chance in any given year of being equaled or exceeded. The 500-year flood is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage

channels. These changes are most often created by human activity.

The 100-year flood, which is the minimum standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. Participation in the NFIP requires adoption and enforcement of a local floodplain management ordinance which is intended to prevent unsafe development in the floodplain, thereby reducing future flood damages. Participation in the NFIP allows for the federal government to make flood insurance available within the community as a financial protection against flood losses. Since floods have an annual probability of occurrence, have a known magnitude, depth and velocity for each event, and in most cases, have a map indicating where they will likely occur, they are in many ways often the most predictable and manageable hazard.

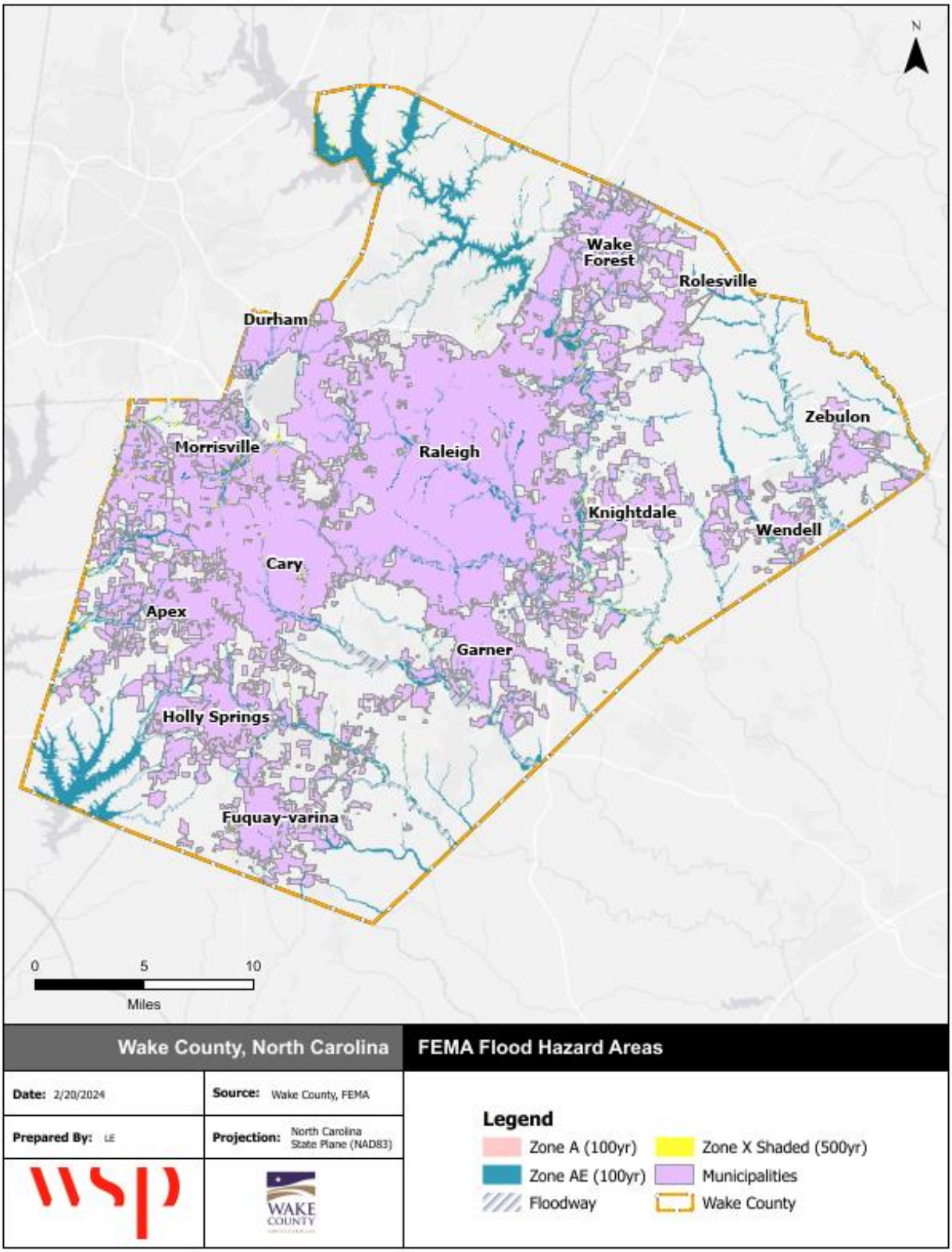
Warning Time: 3 – 6 to 12 hours

Duration: 3 – Less than 1 week

LOCATION

Figure 4.19 reflects the effective mapped flood insurance zones for Wake County.

Figure 4.19 – FEMA Flood Hazard Areas in Wake County



Source: FEMA 2009 Effective DFIRM

EXTENT

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood height and velocity.

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). It is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 100-year flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Flood prone areas were identified within Wake County using the Effective FIRMs, dated May 2, 2006. Table 4.37 summarizes the flood insurance zones identified by the Digital FIRM (DFIRM).

Table 4.37 – Mapped Flood Insurance Zones within Wake County

Zone	Description
AE	AE Zones, also within the 100-year flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 100-year flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. The Coastal AE Zone is differentiated from the AE Zone by the Limit of Moderate Wave Action (LiMWA) and includes areas susceptible to wave action between 1.5 to 3 feet.
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
0.2% Annual Chance (shaded Zone X)	Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.)
Zone X (unshaded)	Minimal risk areas outside the 1-percent and .2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C.

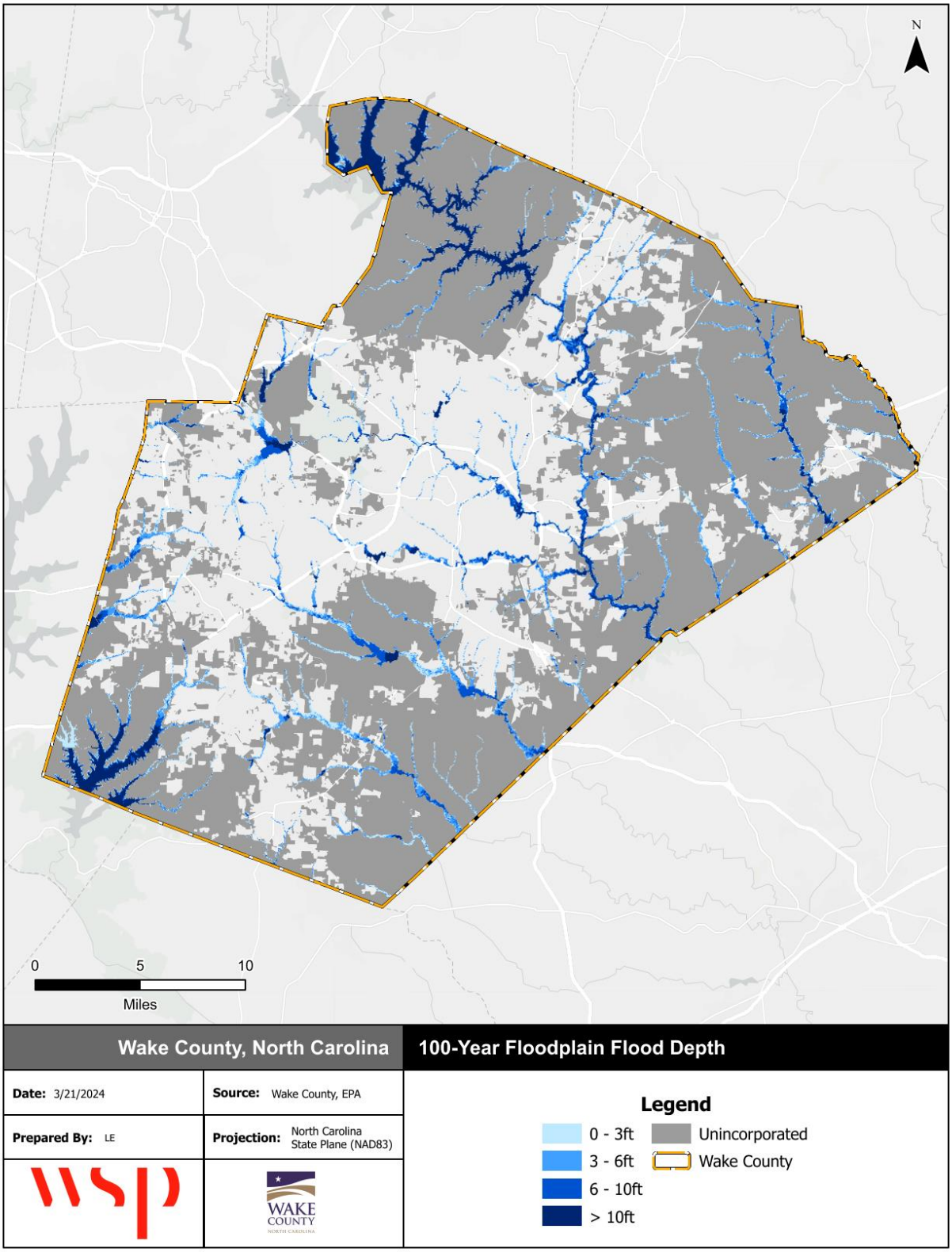
Approximately 9% of the County falls within the SFHA. Table 4.38 below summarizes acreage of the County's total area by flood zone on the effective DFIRM. Figure 4.20 shows the depth of flooding predicted from a 1% annual chance flood.

Table 4.38 – Flood Zone Acreage in Wake County

Flood Zone	Acreage	Percent of Total (%)
Zone A	1.8	0.0
Zone AE	49,083.3	8.9
Zone X (500-year)	1,679.2	0.3
Zone X Unshaded	498,850.5	90.8
Total	**549,614.8**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure 4.20 – Flood Depth, 100-Year Floodplain



Source: FEMA Effective DFIRM

The NFIP utilizes the 100-year flood as a basis for floodplain management. The Flood Insurance Study (FIS) defines the probability of flooding as flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 100-year period (recurrence intervals). Or considered another way, properties within a 100-year flood zone have a one percent probability of being equaled or exceeded during any given year. Mortgage lenders require that owners of properties with federally-backed mortgages located within SFHAs purchase and maintain flood insurance policies on their properties. Consequently, newer and recently purchased properties in the community are typically insured against flooding.

Impact: 3 – Critical

Spatial Extent: 2 – Small

HISTORICAL OCCURRENCES

Table 4.39 details the historical occurrences of flooding identified from 1996 through 2023 by NCEI Storm Events database. It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other, unrecorded or unreported events may have occurred within the planning area during this timeframe.

Table 4.39 – NCEI Records of Flooding, 1996-2023

Location	Date	Type	Deaths	Injuries	Reported Property Damage	Reported Crop Damage
RALEIGH	9/6/1996	Flash Flood	0	0	$0	$0
RALEIGH	9/10/1996	Flash Flood	0	0	$0	$0
RALEIGH	9/10/1996	Flash Flood	0	0	$0	$0
RALEIGH	9/11/1996	Flash Flood	0	0	$0	$0
RALEIGH	10/8/1996	Flash Flood	0	0	$0	$0
RALEIGH	4/28/1997	Flash Flood	0	0	$0	$0
COUNTY WIDE	7/24/1997	Flash Flood	0	0	$0	$0
RALEIGH	1/16/1998	Flash Flood	0	0	$50,000	$0
RALEIGH	1/23/1998	Flood	0	0	$0	$0
RALEIGH	3/9/1998	Flash Flood	0	0	$0	$0
RALEIGH	3/19/1998	Flash Flood	0	0	$0	$0
RALEIGH	8/8/1998	Flood	0	0	$20,000	$0
RALEIGH	8/16/1998	Flood	0	0	$40,000	$0
WAKE FOREST	8/26/1999	Flash Flood	0	0	$0	$0
COUNTY WIDE	9/5/1999	Flash Flood	0	0	$0	$0
COUNTY WIDE	9/15/1999	Flash Flood	0	0	$0	$0
COUNTY WIDE	9/27/1999	Flash Flood	0	0	$0	$0
COUNTY WIDE	9/28/1999	Flash Flood	0	0	$0	$0
RALEIGH	7/29/2000	Flash Flood	0	0	$0	$0
RALEIGH	8/1/2000	Flash Flood	0	0	$0	$0
RALEIGH	8/4/2000	Flash Flood	0	0	$0	$0
FUQUAY SPGS	8/4/2000	Flash Flood	0	0	$0	$0
RALEIGH	9/3/2000	Flash Flood	0	0	$0	$0
RALEIGH	9/4/2000	Flash Flood	0	0	$0	$0
RALEIGH	9/25/2000	Flash Flood	0	0	$0	$0
COUNTYWIDE	6/16/2001	Flash Flood	0	0	$0	$0
SOUTH PORTION	7/4/2001	Flash Flood	0	0	$0	$0
SOUTH PORTION	7/9/2001	Flash Flood	0	0	$0	$0
HOLLY SPGS	8/11/2001	Flash Flood	0	0	$0	$0
WAKE FOREST	9/10/2001	Flash Flood	0	0	$0	$0

Location	Date	Type	Deaths	Injuries	Reported Property Damage	Reported Crop Damage
RALEIGH	3/31/2002	Flash Flood	0	0	$0	$0
RALEIGH	6/28/2002	Flash Flood	0	0	$0	$0
RALEIGH	8/26/2002	Flash Flood	0	0	$0	$0
RALEIGH	10/11/2002	Flash Flood	0	0	$0	$0
	3/20/2003	Flood	0	0	$0	$0
	4/10/2003	Flood	0	0	$0	$0
RALEIGH	6/7/2003	Flash Flood	0	0	$0	$0
FUQUAY SPGS	7/17/2003	Flash Flood	0	0	$0	$0
RALEIGH	7/29/2003	Flash Flood	0	0	$0	$0
EAST PORTION	8/1/2003	Flash Flood	0	0	$0	$0
CENTRAL PORTION	8/8/2003	Flash Flood	0	0	$0	$0
CENTRAL PORTION	8/8/2003	Flash Flood	0	0	$0	$0
FUQUAY SPGS	6/4/2004	Flash Flood	0	0	$0	$0
MORRISVILLE	7/29/2004	Flash Flood	0	0	$0	$0
COUNTYWIDE	8/12/2004	Flash Flood	0	0	$0	$0
RALEIGH	8/13/2004	Flash Flood	0	0	$0	$0
RALEIGH	8/30/2004	Flash Flood	0	0	$0	$0
RALEIGH	6/7/2005	Flash Flood	0	0	$0	$0
RALEIGH	6/7/2005	Flash Flood	0	0	$0	$0
GARNER	6/11/2006	Flash Flood	0	0	$0	$0
COUNTYWIDE	6/14/2006	Flash Flood	0	0	$0	$0
MORRISVILLE	6/23/2006	Flash Flood	0	0	$0	$0
MORRISVILLE	6/23/2006	Flash Flood	0	0	$0	$0
MORRISVILLE	6/23/2006	Flash Flood	0	0	$0	$0
RALEIGH	6/23/2006	Flash Flood	0	0	$0	$0
CARY	6/23/2006	Flash Flood	0	0	$0	$0
MORRISVILLE	8/30/2006	Flash Flood	0	0	$0	$0
CARY	7/17/2007	Flash Flood	0	0	$0	$0
BRENTWOOD	4/27/2008	Flash Flood	0	0	$0	$0
MILLBROOK	4/27/2008	Flash Flood	0	0	$0	$0
CARIO	8/28/2008	Flash Flood	0	0	$0	$0
MORRISVILLE	8/30/2008	Flash Flood	0	0	$0	$0
ECHO HGTS	8/30/2008	Flash Flood	0	0	$0	$0
MILLBROOK	9/6/2008	Flash Flood	0	0	$100,000	$0
MORRISVILLE	5/5/2009	Flash Flood	0	0	$0	$0
MILLBROOK	5/5/2009	Flash Flood	0	0	$0	$0
BRENTWOOD	5/5/2009	Flash Flood	0	0	$0	$0
ASBURY	5/5/2009	Flood	0	0	$0	$0
RALEIGH	6/16/2009	Flash Flood	0	0	$0	$0
WESTOVER	6/16/2009	Flash Flood	0	0	$0	$0
WILLOW	9/22/2009	Flash Flood	0	0	$0	$0
WAKE FOREST	12/2/2009	Flash Flood	0	0	$0	$0
COLLEGE VIEW	12/2/2009	Flash Flood	0	0	$0	$0
WESTOVER	12/2/2009	Flash Flood	0	0	$0	$0
CAMP POLK	12/2/2009	Flash Flood	0	0	$0	$0
RALEIGH	1/25/2010	Flash Flood	0	0	$0	$0
CARALEIGH	1/25/2010	Flash Flood	0	0	$0	$0
ASBURY	6/1/2010	Flash Flood	0	0	$0	$0
APEX	7/27/2010	Flash Flood	0	0	$0	$0
APEX	7/27/2010	Flash Flood	0	0	$0	$0
LEESVILLE	8/5/2010	Flash Flood	0	0	$0	$0

Location	Date	Type	Deaths	Injuries	Reported Property Damage	Reported Crop Damage
CARALEIGH	8/24/2010	Flash Flood	0	0	$0	$0
WILLIAMS XRDS	9/30/2010	Flash Flood	0	0	$0	$0
RALEIGH	9/30/2010	Flash Flood	0	0	$0	$0
RALEIGH	9/30/2010	Flash Flood	0	0	$0	$0
HOLLY SPGS	5/27/2011	Flash Flood	0	0	$0	$0
CARY	7/24/2011	Flash Flood	0	0	$0	$0
CARY	8/6/2011	Flash Flood	0	0	$0	$0
RALEIGH	8/6/2011	Flash Flood	0	0	$0	$0
STARMOUNT	8/6/2011	Flash Flood	0	0	$0	$0
COLLEGE VIEW	9/21/2011	Flash Flood	0	0	$5,000	$0
MILLBROOK	7/30/2012	Flash Flood	0	0	$0	$0
MILLBROOK	9/6/2012	Flash Flood	0	0	$0	$0
COLLEGE VIEW	9/8/2012	Flash Flood	0	0	$0	$0
MILLBROOK	9/8/2012	Flash Flood	0	0	$0	$0
MILLBROOK	9/18/2012	Flash Flood	0	0	$0	$0
LEESVILLE	6/7/2013	Flash Flood	0	0	$0	$0
HOLLY SPGS	6/7/2013	Flash Flood	0	0	$0	$0
CAMP POLK	6/7/2013	Flash Flood	0	0	$0	$0
WAKE FOREST	6/7/2013	Flash Flood	0	0	$0	$0
BROOKHAVEN	6/7/2013	Flash Flood	0	0	$0	$0
WAKE XRDS	7/8/2013	Flash Flood	0	0	$0	$0
CAMP POLK	9/1/2013	Flash Flood	0	0	$10,000	$0
WILDERS GROVE	5/15/2014	Flash Flood	0	0	$0	$0
MILLBROOK	5/15/2014	Flash Flood	0	0	$0	$0
APEX	5/15/2014	Flash Flood	0	0	$0	$0
LEESVILLE	5/15/2014	Flash Flood	0	0	$0	$0
WESTOVER	7/10/2014	Flash Flood	0	0	$10,000	$0
CARPENTER	7/15/2014	Flash Flood	0	0	$2,500	$0
MORRISVILLE	7/21/2014	Flash Flood	0	0	$0	$0
MORRISVILLE	7/21/2014	Flash Flood	0	0	$0	$0
RALEIGH	8/12/2014	Flash Flood	0	0	$2,500,000	$0
MORRISVILLE	8/12/2014	Flash Flood	0	0	$10,000	$0
ECHO HGTS	8/12/2014	Flash Flood	0	0	$0	$0
MACEDONIA	8/12/2014	Flash Flood	0	0	$0	$0
HOLLY SPGS	4/9/2015	Flash Flood	0	0	$20,000	$0
NEWHILL	4/9/2015	Flash Flood	0	0	$5,000	$0
MORRISVILLE	6/18/2015	Flash Flood	0	0	$5,000	$0
ZEBULON	6/18/2015	Flash Flood	0	0	$20,000	$0
WESTOVER	6/18/2015	Flash Flood	0	0	$0	$0
COLLEGE VIEW	6/18/2015	Flash Flood	0	0	$0	$0
WILDERS GROVE	12/30/2015	Flash Flood	0	0	$0	$0
MORRISVILLE	7/16/2016	Flash Flood	0	0	$250,000	$0
RALEIGH	7/17/2016	Flood	0	0	$0	$0
PURNELL	10/8/2016	Flash Flood	0	0	$65,500,000	$0
BROOKHAVEN	4/25/2017	Flash Flood	0	0	$150,000	$0
(RDU)RALEIGH-DURHAM	4/25/2017	Flash Flood	0	0	$10,000	$0
BANKS	4/25/2017	Flash Flood	0	0	$2,000	$0
APEX	4/25/2017	Flash Flood	0	0	$2,000	$0

Location	Date	Type	Deaths	Injuries	Reported Property Damage	Reported Crop Damage
(RDU)RALEIGH-DURHAM	6/16/2017	Flash Flood	0	0	$0	$0
WAKE FOREST	9/1/2017	Flash Flood	0	0	$0	$0
LEESVILLE	5/21/2018	Flash Flood	0	0	$600,000	$0
MORRISVILLE	7/5/2018	Flash Flood	0	0	$0	$0
WILDERS GROVE	7/6/2018	Flash Flood	0	0	$10,000	$0
RALEIGH	7/6/2018	Flash Flood	0	0	$0	$0
MILLBROOK	7/6/2018	Flash Flood	0	0	$0	$0
SUTPHIN	7/7/2018	Flash Flood	0	0	$0	$0
ECHO HGTS	7/7/2018	Flash Flood	0	0	$10,000	$0
COLLEGE VIEW	8/19/2018	Flash Flood	0	0	$0	$0
RALEIGH	8/19/2018	Flash Flood	0	0	$0	$0
MILLBROOK	8/19/2018	Flash Flood	0	0	$0	$0
RALEIGH	8/20/2018	Flash Flood	0	0	$80,000	$0
FAWLERS XRDS	8/20/2018	Flash Flood	0	0	$0	$0
RALEIGH	8/20/2018	Flash Flood	0	0	$0	$0
ECHO HGTS	8/20/2018	Flash Flood	0	0	$0	$0
HOLLAND	9/14/2018	Flash Flood	0	0	$0	$0
KENNEBEC	9/17/2018	Flood	0	0	$5,000,000	$20,000,000
ZEBULON	10/11/2018	Flash Flood	0	0	$50,000	$0
PURNELL	11/13/2018	Flash Flood	0	0	$0	$0
MILLBROOK	4/15/2019	Flash Flood	0	0	$0	$0
BARHAM	6/8/2019	Flash Flood	0	0	$0	$0
BARHAM	6/8/2019	Flash Flood	0	0	$20,000	$0
CARPENTER	8/2/2019	Flash Flood	0	0	$10,000	$0
LEESVILLE	8/5/2019	Flash Flood	0	0	$0	$0
CARY	8/5/2019	Flash Flood	0	0	$0	$0
RALEIGH	2/6/2020	Flash Flood	0	0	$0	$0
MILLBROOK	2/6/2020	Flash Flood	0	0	$0	$0
BURT	2/6/2020	Flash Flood	0	0	$0	$0
WILDERS GROVE	8/4/2020	Flash Flood	0	0	$0	$0
MILLBROOK	8/14/2020	Flash Flood	0	0	$0	$0
MILLBROOK	8/14/2020	Flash Flood	0	0	$15,000	$0
WENDELL ARPT	8/14/2020	Flash Flood	0	0	$0	$0
BROOKHAVEN	8/14/2020	Flash Flood	0	0	$0	$0
ROYAL MILLS	8/15/2020	Flash Flood	0	0	$0	$0
PET XRDS	8/15/2020	Flash Flood	0	0	$0	$0
RALEIGH	8/31/2020	Flash Flood	0	0	$50,000	$0
BROOKHAVEN	8/31/2020	Flash Flood	0	0	$0	$0
MILLBROOK	9/1/2020	Flash Flood	0	0	$0	$0
BROOKHAVEN	9/1/2020	Flash Flood	0	0	$50,000	$0
GARNER	11/12/2020	Flash Flood	0	0	$0	$0
NEW HILL	11/12/2020	Flash Flood	0	0	$0	$0
BARHAM	11/12/2020	Flash Flood	0	0	$0	$0
WILLOW	11/12/2020	Flash Flood	0	0	$0	$0
MILLBROOK	11/12/2020	Flash Flood	0	0	$0	$0
WILBON	11/12/2020	Flash Flood	0	0	$0	$0
WILLOW	11/12/2020	Flash Flood	0	0	$0	$0
ROLESVILLE	11/12/2020	Flash Flood	1	0	$0	$0

Location	Date	Type	Deaths	Injuries	Reported Property Damage	Reported Crop Damage
NEW HILL	11/12/2020	Flash Flood	0	0	$15,000	$0
ROYAL MILLS	7/8/2021	Flash Flood	0	0	$0	$0
MILLBROOK	9/9/2021	Flash Flood	0	0	$0	$0
BROOKHAVEN	9/9/2021	Flash Flood	0	0	$0	$0
WESTOVER	10/9/2021	Flash Flood	0	0	$200,000	$0
LEESVILLE	10/9/2021	Flash Flood	0	0	$50,000	$0
MACEDONIA	10/9/2021	Flash Flood	0	0	$0	$0
CAMP POLK	10/9/2021	Flash Flood	0	0	$0	$0
NEW HILL	10/9/2021	Flash Flood	0	0	$0	$0
WAKE FOREST	1/3/2022	Flash Flood	0	0	$0	$0
CARALEIGH	1/3/2022	Flash Flood	0	0	$0	$0
COLLEGE VIEW	1/3/2022	Flash Flood	0	0	$0	$0
WILDERS GROVE	1/3/2022	Flash Flood	0	0	$0	$0
ASBURY	1/3/2022	Flash Flood	0	0	$0	$0
RALEIGH	3/17/2022	Flash Flood	0	0	$0	$0
RALEIGH	5/7/2022	Flash Flood	0	0	$0	$0
ASBURY	5/23/2022	Flash Flood	0	0	$0	$0
ASBURY	5/23/2022	Flash Flood	0	0	$0	$0
BURT	5/27/2022	Flash Flood	0	0	$0	$0
RALEIGH	7/7/2022	Flash Flood	0	0	$415,000	$0
FALLS	7/9/2022	Flash Flood	0	0	$0	$0
KNIGHTDALE	7/9/2022	Flash Flood	0	0	$100,000	$0
BROOKHAVEN	7/9/2022	Flash Flood	0	0	$0	$0
KNIGHTDALE WNDLL ARP	7/9/2022	Flash Flood	0	0	$50,000	$0
LEESVILLE	7/15/2022	Flash Flood	0	0	$15,000	$0
LEESVILLE	7/15/2022	Flash Flood	0	0	$0	$0
(RDU)RALEIGH-DURHAM	7/15/2022	Flash Flood	0	0	$15,000	$0
BROOKHAVEN	7/15/2022	Flash Flood	0	0	$0	$0
LEESVILLE	7/15/2022	Flash Flood	0	0	$15,000	$0
BROOKHAVEN	7/15/2022	Flash Flood	0	0	$15,000	$0
CAMP POLK	7/15/2022	Flash Flood	0	0	$25,000	$0
BROOKHAVEN	8/11/2022	Flash Flood	0	0	$0	$0
RALEIGH	8/11/2022	Flash Flood	0	0	$0	$0
WILDERS GROVE	9/30/2022	Flash Flood	0	0	$0	$0
MORRISVILLE	9/30/2022	Flash Flood	0	0	$0	$0
CARIO	4/7/2023	Flash Flood	0	0	$0	$0
FUQUAY SPGS	4/7/2023	Flash Flood	0	0	$0	$0
HOLLAND	4/7/2023	Flash Flood	0	0	$0	$0
MILLBROOK	7/8/2023	Flash Flood	0	0	$0	$0
COLLEGE VIEW	7/8/2023	Flash Flood	0	0	$0	$0
METHOD	7/9/2023	Flash Flood	0	0	$0	$0
RALEIGH	7/9/2023	Flash Flood	0	0	$0	$0
WESTOVER	7/9/2023	Flash Flood	0	0	$0	$0
COLLEGE VIEW	7/9/2023	Flash Flood	0	0	$0	$0
PURNELL	7/14/2023	Flash Flood	0	0	$0	$0
MACEDONIA	9/9/2023	Flash Flood	0	0	$0	$0
CARY	9/9/2023	Flash Flood	0	0	$0	$0
ASBURY	9/9/2023	Flash Flood	0	0	$0	$0
WESTOVER	9/9/2023	Flash Flood	0	0	$0	$0

Location	Date	Type	Deaths	Injuries	Reported Property Damage	Reported Crop Damage
MORRISVILLE	9/9/2023	Flash Flood	0	0	$0	$0
STARMOUNT	9/23/2023	Flash Flood	0	0	$30,000	$0
MILLBROOK	9/23/2023	Flash Flood	0	0	$0	$0
WILDERS GROVE	9/23/2023	Flash Flood	0	0	$0	$0
LEESVILLE	9/23/2023	Flash Flood	0	0	$0	$0
Total		**231**	**1**	**0**	**$75,551,500**	**$20,000,000**

Source: NCEI

According to NCEI, 231 recorded flood events affected the planning area from 1996 to 2023 causing an estimated $75,551,500 in property damage, $20,000,000 in crop damage, and 1 death.

Table 4.40 provides a summary of this historical information by participating jurisdiction. It is important to note that many of the events attributed to the county are countywide or cover large portions of the county. The individual counts by jurisdiction are for those events that are only attributed to that one jurisdiction.

Table 4.40 – Summary of Historical Flood Occurrences by Participating Jurisdiction, 1996-2023

Jurisdiction	Event Count	Deaths	Injuries	Property Damage	Crop Damage
Raleigh	50	0	0	$3,180,000	$0
Apex	4	0	0	$2,000	$0
Cary	6	0	0	$267,500	$0
Fuquay-Varina	4	0	0	$0	$0
Holly Springs	4	0	0	$20,000	$0
Morrisville	15	0	0	$265,000	$0
Wake Forest	6	0	0	$0	$0
Zebulon	2	0	0	$70,000	$0
Unincorporated Wake County	140	1	0	$72,014,500	$20,000,000
Total	**231**	**1**	**0**	**$75,551,500**	**$20,000,000**

Source: NCEI

The following historical flood elevations are pulled from NCEI and illustrate the potential for flooding throughout the county:

January 23, 1998 - Urban flooding occurred in the city of Raleigh as a general soaking rain became heavy during the late morning and lasted into the early afternoon. Rainfall amounts of 1 inch per hour brought storm totals in the 3 to 4 inch range in the area. Several small streams came out of their banks and numerous streets in low lying/flood prone areas became flooded with 6 to 12 inches of water. Jones Sausage and Rock Quarry Roads in east Raleigh were closed for brief periods of time. Several cars became submerged in the water on Capital Boulevard near Crabtree Boulevard and at Capital and New Hope Church Roads.

July 4, 2001 – Middle Creek and Swift Creek overflowed their banks, causing extensive flooding in Holly Springs, Fuquay-Varina, and Garner. A mobile home park near Ten-Ten Road and Highway 401 was evacuated. Many roads and a few bridges were washed out, causing some people to abandon their cars.

April 27, 2008 – Over three inches of rain fell between 6:45 p.m. and 11:00 p.m. with nearly 2.5 inches falling in the first hour alone. The heavy rainfall caused Marsh Creek to overflow, flooding south bound

lanes of Capital Boulevard near the intersection of Brentwood Road. The softball field and walking trail in Brentwood Park also experienced flooding, with 4 to 5 feet of flowing water through the park.

September 6, 2008 – During the early morning house Tropical Storm Hanna made landfall near Myrtle beach, SC and tracked north into central North Carolina along Interstate 95. Four to seven inches of rain which fell over the eastern piedmont resulted in flash flooding over large areas including the Triangle. Up to seven inches of rain caused flash flooding in many locations across Raleigh particularly along Crabtree Creek and other flood prone areas. A motorist was rescued from a vehicle after driving into a flooded underpass at Hillsborough Drive and Chapel Hill Drive in west Raleigh. Sullivan Drive between Dan Allen and Varsity Drive was closed due to flooding along with Avent Ferry Road at Trailwood Drive. Number creeks across the region flooded low lying areas as well as some vehicles.

May 5, 2009 - Two tornadic supercells developed along a stalled warm front that extended across southern piedmont and coastal plain of North Carolina. The cells produced 4 tornadoes in Johnston, Nash and Wilson counties.

July 17, 2016 - A warm moist atmosphere combined with a disturbance moving across central North Carolina during peak heating, modest instability and seasonably strong deep layer shear allowed for the development of numerous showers and storms during the late afternoon into the evening. Many of these storms became strong to severe and produced widespread wind damage. In addition, several areas of very heavy rain fell across the Northern Coastal Plain and the Triangle Region of central North Carolina. This resulted in many reports of flooding and water rescues.

September 17, 2018 - A ridge of high pressure over eastern North America stalled Florence's forward motion a few miles off the southeast North Carolina coast on September 13th. Hurricane Florence made landfall near Wrightsville Beach early on Saturday September 15, and weakened further as it moved slowly inland. Despite making landfall as a weakened Category 1 hurricane, Florence still produced 40 to 70 mph wind gusts, enough wind speed to uproot trees and cause widespread power outages throughout the Carolinas. As the storm moved inland, from September 15 to 17, heavy rain of 10 to 25 inches caused widespread inland flooding, inundating cities such as Fayetteville, Smithfield, Goldsboro, Durham, and Chapel Hill, and causing major river flooding on main-stem rivers such as the Neuse, Cape Fear, and Little River. Most major roads and highways in the area experienced some flooding, with large stretches of I-40 and I-95 remaining impassable for days after the storm had passed. The storm also spawned tornadoes in several places along its path.

August 11, 2022 - A cluster of showers and thunderstorms developed along a slow moving cold front across the central Piedmont of central North Carolina. A few of the storms became strong to severe and produced damaging wind gusts and flash flooding across Wake County.

PROBABILITY OF FUTURE OCCURRENCE

By definition of the 100-year flood event, SFHAs are defined as those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. Properties located in these areas have a 26 percent chance of flooding over the life of a 30-year mortgage.

The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

While exposure to flood hazards vary across jurisdictions, all jurisdictions have at least some area of land in FEMA flood hazard areas, therefore the likelihood of flooding is considered possible (between 10% and 50% annual probability) for all jurisdictions.

Additional flood risk comes from localized stormwater flooding and flash floods. Historical records indicate that an average of 11.68% flood or flash flood events occur each year in the planning area.

Probability: 3 – Likely

CLIMATE CHANGE

Per the Fifth National Climate Assessment, frequency and intensity of heavy precipitation events is expected to increase across the country. Additionally, increased levels of rainfall, temperatures, sea level rise, and land cover change can exacerbate flood risks and are expected to occur throughout the southeast. Therefore, with more rainfall falling in more intense incidents, the region may experience more frequent flash flooding. Increased flooding may also result from more intense tropical cyclone; researchers have noted the occurrence of more intense storms bringing greater rainfall totals, a trend that is expected to continue as ocean and air temperatures rise.

VULNERABILITY ASSESSMENT

The following section provides an assessment of vulnerability to flooding by jurisdiction and flood return period.

METHODOLOGIES AND ASSUMPTIONS

Population and property at risk to flooding was estimated using data from the NCEM IRISK database, which was compiled in NCEM's Risk Management Tool.

As a subset of the building vulnerability analysis, exposure of pre-FIRM structures was also estimated. Table 4.41 below provides the NFIP entry date for each participating jurisdiction, which was used to determine which buildings were constructed pre-FIRM. Pre-FIRM structures were built prior to the adoption of flood protection building standards and are therefore assumed to be at greater risk to the flood hazard.

Table 4.41 – NFIP Entry Dates

Jurisdiction	NFIP Entry Date
City of Raleigh	08/15/78
Town of Apex	03/03/92
Town of Cary	07/17/78
Town of Fuquay-Varina	11/01/78
Town of Garner	07/03/78
Town of Holly Springs	03/03/92
Town of Knightdale	08/01/78
Town of Morrisville	11/01/78
Town of Rolesville	03/03/92
Town of Wake Forest	07/03/78
Town of Wendell	06/01/78
Town of Zebulon	07/03/78
Unincorporated Wake County	11/15/78

Source: Federal Emergency Management Agency Community Status Book Report: Communities Participating in the National Flood Program, August 2013

If the NFIP entry date for a given community is between January and June, buildings constructed the same year as the entry date are considered to be post-FIRM (e.g., if the NFIP entry date is 02/01/1991, buildings constructed in 1990 and before are pre-FIRM. Buildings constructed from 1991 to the present are post-FIRM.). If the NFIP entry date is between July and December, then the following year applies for the year built cut-off (e.g., if the NFIP entry date is 12/18/2007, buildings constructed in the year 2007 and before are pre-FIRM, 2008 and newer are post-FIRM).

Effective FEMA DFIRM data was used for the flood hazard areas. Flood zones used in the analysis consist of Zone AE (1-percent-annual-chance flood), Zone AE Floodway, and the 0.2-percent-annual-chance flood hazard area.

PEOPLE

Certain health hazards are common to flood events. While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams.

Debris also poses a risk both during and after a flood. During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus. People must be aware of these dangers prior to a flood so that they understand the risks and take necessary precautions before, during, and after a flood.

Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E. coli and other disease-causing agents.

The second type of health problem arises after most of the water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet areas of a building that have not been properly cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the City water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one‘s home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face particularly high risk when driving through flooded streets. According to NCEI records, there was 1 death in Wake County caused by flood events.

Table 4.42 through Table 4.46 detail the population at risk from the 10-year through the 500-year flood event, according to data from the NCEM IRISK database. There is no population at risk in the floodway according to IRISK data. Note that development and population growth have occurred since the original analysis for the IRISK dataset was performed, therefore actual population at risk is likely higher.

Table 4.42 – Population Impacted by the 10 Year Flood Event

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	242	0.1%	53,945	31	0.1%	26,904	16	0.1%
Apex	57,525	27	0.0%	5,963	4	0.1%	3,912	2	0.1%
Cary	164,869	291	0.2%	19,866	42	0.2%	9,432	20	0.2%
Fuquay-Varina	32,177	7	0.0%	4,432	1	0.0%	2,204	1	0.0%
Garner	35,232	86	0.2%	5,015	14	0.3%	2,863	8	0.3%
Holly Springs	30,885	0	0.0%	2,685	0	0.0%	2,254	0	0.0%
Knightdale	29,077	0	0.0%	3,207	0	0.0%	1,917	0	0.0%
Morrisville	21,999	23	0.1%	1,533	2	0.1%	1,627	2	0.1%
Rolesville	12,236	0	0.0%	1,401	0	0.0%	919	0	0.0%
Wake Forest	*47,601	6	0.0%	4,777	1	0.0%	2,891	1	0.0%
Wendell	8,423	9	0.1%	1,361	2	0.1%	418	0	0.0%
Zebulon	5,751	0	0.0%	948	0	0.0%	437	0	0.0%
Unincorporated Wake County	230,494	60	0.0%	29,196	13	0.0%	14,301	6	0.0%
TOTAL	**1,143,763**	**751**	**0.1%**	**134,329**	**110**	**0.1%**	**70,079**	**56**	**0.1%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

Table 4.43 – Population Impacted by the 25 Year Flood Event

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	512	0.1%	53,945	66	0.1%	26,904	33	0.1%
Apex	57,525	33	0.1%	5,963	5	0.1%	3,912	3	0.1%
Cary	164,869	441	0.3%	19,866	64	0.3%	9,432	30	0.3%
Fuquay-Varina	32,177	19	0.1%	4,432	3	0.1%	2,204	2	0.1%
Garner	35,232	128	0.4%	5,015	21	0.4%	2,863	12	0.4%
Holly Springs	30,885	3	0.0%	2,685	0	0.0%	2,254	0	0.0%
Knightdale	29,077	0	0.0%	3,207	0	0.0%	1,917	0	0.0%
Morrisville	21,999	47	0.2%	1,533	4	0.3%	1,627	4	0.2%
Rolesville	12,236	0	0.0%	1,401	0	0.0%	919	0	0.0%
Wake Forest	*47,601	6	0.0%	4,777	1	0.0%	2,891	1	0.0%
Wendell	8,423	14	0.2%	1,361	2	0.1%	418	1	0.2%
Zebulon	5,751	9	0.2%	948	1	0.1%	437	1	0.2%
Unincorporated Wake County	230,494	94	0.0%	29,196	20	0.1%	14,301	10	0.1%
TOTAL	**1,143,763**	**1,306**	**0.1%**	**134,329**	**187**	**0.1%**	**70,079**	**97**	**0.1%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

Table 4.44 – Population Impacted by the 50 Year Flood Event

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	842	0.2%	53,945	108	0.2%	26,904	54	0.2%
Apex	57,525	36	0.1%	5,963	5	0.1%	3,912	3	0.1%
Cary	164,869	547	0.3%	19,866	79	0.4%	9,432	38	0.4%
Fuquay-Varina	32,177	24	0.1%	4,432	4	0.1%	2,204	2	0.1%
Garner	35,232	136	0.4%	5,015	22	0.4%	2,863	13	0.5%
Holly Springs	30,885	3	0.0%	2,685	0	0.0%	2,254	0	0.0%
Knightdale	29,077	0	0.0%	3,207	0	0.0%	1,917	0	0.0%
Morrisville	21,999	85	0.4%	1,533	7	0.5%	1,627	7	0.4%
Rolesville	12,236	0	0.0%	1,401	0	0.0%	919	0	0.0%
Wake Forest	*47,601	6	0.0%	4,777	1	0.0%	2,891	1	0.0%
Wendell	8,423	16	0.2%	1,361	3	0.2%	418	1	0.2%
Zebulon	5,751	9	0.2%	948	1	0.1%	437	1	0.2%
Unincorporated Wake County	230,494	106	0.0%	29,196	23	0.1%	14,301	11	0.1%
TOTAL	**1,143,763**	**1,810**	**0.2%**	**134,329**	**253**	**0.2%**	**70,079**	**131**	**0.2%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

Table 4.45 – Population Impacted by the 100 Year Flood Event

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	1,242	0.3%	53,945	159	0.3%	26,904	80	0.3%
Apex	57,525	41	0.1%	5,963	6	0.1%	3,912	4	0.1%
Cary	164,869	672	0.4%	19,866	97	0.5%	9,432	46	0.5%
Fuquay-Varina	32,177	29	0.1%	4,432	5	0.1%	2,204	3	0.1%
Garner	35,232	153	0.4%	5,015	25	0.5%	2,863	14	0.5%
Holly Springs	30,885	8	0.02%	2,685	1	0.04%	2,254	1	0.04%
Knightdale	29,077	3	0.01%	3,207	0	0%	1,917	0	0%
Morrisville	21,999	109	0.5%	1,533	9	0.6%	1,627	9	0.6%
Rolesville	12,236	0	0%	1,401	0	0%	919	0	0%
Wake Forest	*47,601	6	0.02%	4,777	1	0.02%	2,891	1	0.03%
Wendell	8,423	26	0.3%	1,361	4	0.3%	418	1	0.2%
Zebulon	5,751	28	0.5%	948	4	0.4%	437	2	0.5%
Unincorporated Wake County	230,494	134	0.06%	29,196	29	0.1%	14,301	14	0.1%
TOTAL	**1,143,763**	**2,451**	**0.2%**	**134,329**	**340**	**0.3%**	**70,079**	**175**	**0.2%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

Table 4.46 – Population Impacted by the 500 Year Flood Event

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	2,688	0.6%	53,945	345	0.6%	26,904	172	0.6%
Apex	57,525	83	0.1%	5,963	12	0.2%	3,912	8	0.2%
Cary	164,869	959	0.6%	19,866	139	0.7%	9,432	66	0.7%
Fuquay-Varina	32,177	43	0.1%	4,432	8	0.2%	2,204	4	0.2%
Garner	35,232	167	0.5%	5,015	27	0.5%	2,863	15	0.5%
Holly Springs	30,885	10	0.0%	2,685	1	0.0%	2,254	1	0.0%
Knightdale	29,077	8	0.0%	3,207	1	0.0%	1,917	1	0.1%
Morrisville	21,999	198	0.9%	1,533	16	1.0%	1,627	17	1.0%
Rolesville	12,236	0	0.0%	1,401	0	0.0%	919	0	0.0%
Wake Forest	*47,601	51	0.1%	4,777	8	0.2%	2,891	5	0.2%
Wendell	8,423	35	0.4%	1,361	6	0.4%	418	2	0.5%
Zebulon	5,751	87	1.5%	948	13	1.4%	437	6	1.4%
Unincorporated Wake County	230,494	187	0.1%	29,196	40	0.1%	14,301	20	0.1%
TOTAL	**1,143,763**	**4,516**	**0.4%**	**134,329**	**616**	**0.5%**	**70,079**	**317**	**0.5%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

PROPERTY

Residential, commercial, and public buildings, as well as critical infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

Table 4.47 through Table 4.51 detail the property at risk from the 10-year through the 500-year flood event, according to data from the NCEM IRISK database. As with population vulnerability data, there are no estimated impacts in the floodway, and actual property at risk is likely higher due to the amount of development that has occurred since the original analysis for the IRISK dataset was performed.

The damage estimates for the 1% annual chance flood event total $30,624,034, which equates to a loss ratio of less than 1 percent. The loss ratio is the damage estimate divided by the total potential exposure (i.e., total value of all buildings in the planning area), displayed as a percentage of value at risk. FEMA considers loss ratios greater than 10% to be significant and an indicator a community may have more difficulties recovering from an event.

Table 4.52 provides building counts and estimated damages for Critical Infrastructure and Key Resources (CIKR) buildings across all jurisdictions, by sector and flood event. Vulnerability of CIKR as well as High Potential Loss Properties, where applicable, can be found by jurisdiction in each community's annex to this plan.

Table 4.47 – Buildings Impacted by the 10-Year Flood Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	71	0.1%	69	0.1%	$586,707	26	0.0%	$295,767	0	0.0%	$0	95	0.1%	$882,474
Apex	14,915	1	0.0%	9	0.1%	$16,293	0	0.0%	$0	0	0.0%	$0	9	0.1%	$16,293
Cary	45,306	59	0.1%	91	0.2%	$119,246	2	0.0%	$12,515	0	0.0%	$0	93	0.2%	$131,761
Fuquay-Varina	11,070	1	0.0%	3	0.0%	$2,764	0	0.0%	$0	0	0.0%	$0	3	0.0%	$2,764
Garner	11,975	24	0.2%	31	0.3%	$110,453	0	0.0%	$0	0	0.0%	$0	31	0.3%	$110,453
Holly Springs	10,528	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Knightdale	7,144	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Morrisville	5,181	4	0.1%	6	0.1%	$248,745	1	0.0%	$3,772	0	0.0%	$0	7	0.1%	$252,517
Rolesville	2,103	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Wake Forest	10,547	1	0.0%	2	0.0%	$4,259	1	0.0%	$627	0	0.0%	$0	3	0.0%	$4,886
Wendell	3,728	1	0.0%	4	0.1%	$2,941	0	0.0%	$0	0	0.0%	$0	4	0.1%	$2,941
Zebulon	3,231	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Unincorporated Wake County	59,918	6	0.0%	25	0.0%	$41,690	7	0.0%	$58,048	2	0.0%	$49,162	34	0.1%	$148,900
TOTAL	**313,708**	**168**	**0.1%**	**240**	**0.1%**	**$1,133,098**	**37**	**0.0%**	**$370,729**	**2**	**0.0%**	**$49,162**	**279**	**0.1%**	**$1,552,989**

Source: NCEM Risk Management Tool

Table 4.48 – Buildings Impacted by the 25-Year Flood Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	132	0.1%	146	0.1%	$2,461,650	47	0.0%	$1,586,189	0	0.0%	$0	193	0.2%	$4,047,839
Apex	14,915	2	0.0%	11	0.1%	$18,748	0	0.0%	$0	0	0.0%	$0	11	0.1%	$18,748
Cary	45,306	78	0.2%	138	0.3%	$426,254	5	0.0%	$187,348	0	0.0%	$0	143	0.3%	$613,601
Fuquay-Varina	11,070	3	0.0%	8	0.1%	$17,405	0	0.0%	$0	0	0.0%	$0	8	0.1%	$17,405
Garner	11,975	34	0.3%	46	0.4%	$203,540	1	0.0%	$53	0	0.0%	$0	47	0.4%	$203,593
Holly Springs	10,528	1	0.0%	1	0.0%	$1,066	0	0.0%	$0	0	0.0%	$0	1	0.0%	$1,066
Knightdale	7,144	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Morrisville	5,181	5	0.1%	12	0.2%	$272,163	1	0.0%	$3,772	0	0.0%	$0	13	0.3%	$275,935
Rolesville	2,103	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Wake Forest	10,547	1	0.0%	2	0.0%	$4,482	1	0.0%	$2,435	0	0.0%	$0	3	0.0%	$6,917
Wendell	3,728	2	0.1%	6	0.2%	$6,917	0	0.0%	$0	0	0.0%	$0	6	0.2%	$6,917
Zebulon	3,231	1	0.0%	4	0.1%	$2,586	0	0.0%	$0	0	0.0%	$0	4	0.1%	$2,586
Unincorporated Wake County	59,918	15	0.0%	39	0.1%	$89,075	10	0.0%	$182,340	2	0.0%	$88,524	51	0.1%	$359,938
TOTAL	**313,708**	**274**	**0.1%**	**413**	**0.1%**	**$3,503,886**	**65**	**0.0%**	**$1,962,137**	**2**	**0.0%**	**$88,524**	**480**	**0.2%**	**$5,554,545**

Source: NCEM Risk Management Tool

Table 4.49 – Buildings Impacted by the 50-Year Flood Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	219	0.2%	240	0.2%	$4,679,060	70	0.1%	$2,614,337	1	0.0%	$29,545	311	0.2%	$7,322,942
Apex	14,915	3	0.0%	12	0.1%	$28,383	0	0.0%	$0	0	0.0%	$0	12	0.1%	$28,383
Cary	45,306	80	0.2%	170	0.4%	$616,356	8	0.0%	$556,597	1	0.0%	$36,398	179	0.4%	$1,209,350
Fuquay-Varina	11,070	3	0.0%	10	0.1%	$25,248	0	0.0%	$0	0	0.0%	$0	10	0.1%	$25,248
Garner	11,975	34	0.3%	49	0.4%	$252,821	1	0.0%	$319	0	0.0%	$0	50	0.4%	$253,140
Holly Springs	10,528	1	0.0%	1	0.0%	$1,066	0	0.0%	$0	0	0.0%	$0	1	0.0%	$1,066
Knightdale	7,144	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Morrisville	5,181	7	0.1%	22	0.4%	$339,786	2	0.0%	$3,892	0	0.0%	$0	24	0.5%	$343,678
Rolesville	2,103	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Wake Forest	10,547	1	0.0%	2	0.0%	$4,902	1	0.0%	$8,338	0	0.0%	$0	3	0.0%	$13,240
Wendell	3,728	3	0.1%	7	0.2%	$15,004	0	0.0%	$0	0	0.0%	$0	7	0.2%	$15,004
Zebulon	3,231	1	0.0%	4	0.1%	$2,586	0	0.0%	$0	0	0.0%	$0	4	0.1%	$2,586
Unincorporated Wake County	59,918	21	0.0%	44	0.1%	$112,941	15	0.0%	$289,397	3	0.0%	$101,736	62	0.1%	$504,074
TOTAL	**313,708**	**373**	**0.1%**	**561**	**0.2%**	**$6,078,153**	**97**	**0.0%**	**$3,472,880**	**5**	**0.0%**	**$167,679**	**663**	**0.2%**	**$9,718,711**

Source: NCEM Risk Management Tool

Table 4.50 – Buildings Impacted by the 100-Year Flood Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	271	0.2%	354	0.3%	$7,680,061	86	0.1%	$19,063,956	2	0.002%	$42,989	442	0.3%	$26,787,006
Apex	14,915	3	0.02%	14	0.1%	$62,369	0	0%	$0	0	0%	$0	14	0.1%	$62,369
Cary	45,306	86	0.2%	209	0.5%	$1,044,720	11	0.02%	$920,911	1	0.002%	$124,757	221	0.5%	$2,090,388
Fuquay-Varina	11,070	3	0.03%	12	0.1%	$33,437	0	0%	$0	0	0%	$0	12	0.1%	$33,437
Garner	11,975	36	0.3%	55	0.5%	$304,540	1	0.01%	$319	0	0%	$0	56	0.5%	$304,858
Holly Springs	10,528	1	0.01%	3	0.03%	$9,209	0	0%	$0	0	0%	$0	3	0.03%	$9,209
Knightdale	7,144	0	0%	1	0.01%	$1,399	0	0%	$0	0	0%	$0	1	0.01%	$1,399
Morrisville	5,181	9	0.2%	28	0.02%	$438,567	3	0.06%	$4,015	1	0.02%	$51,751	32	0.6%	$494,332
Rolesville	2,103	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Wake Forest	10,547	1	0.1%	2	0.02%	$5,202	1	0.01%	$25,973	0	0%	$0	3	0.03%	$31,176
Wendell	3,728	5	0.1%	11	0.3%	$26,257	1	0.03%	$3,316	0	0%	$0	12	0.3%	$29,573
Zebulon	3,231	1	0.03%	13	0.4%	$22,539	0	0%	$0	0	0%	$0	13	0.4%	$22,539
Unincorporated Wake County	59,918	27	0.04%	56	0.1%	$201,641	18	0.03%	$415,866	3	0.01%	$140,242	77	0.13%	$757,748
TOTAL	**313,708**	**443**	**0.1%**	**758**	**0.2%**	**$9,829,941**	**121**	**0%**	**$20,434,356**	**7**	**0%**	**$359,739**	**886**	**0.3%**	**$30,624,034**

Source: NCEM Risk Management Tool

Table 4.51 – Buildings Impacted by the 500-Year Flood Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	429	0.3%	766	0.6%	$37,982,434	147	0.1%	$104,262,441	4	0.0%	$117,502	917	0.7%	$142,362,376
Apex	14,915	3	0.0%	28	0.2%	$144,668	0	0.0%	$0	0	0.0%	$0	28	0.2%	$144,668
Cary	45,306	94	0.2%	299	0.7%	$2,649,581	19	0.0%	$3,722,522	2	0.0%	$181,624	320	0.7%	$6,553,727
Fuquay-Varina	11,070	8	0.1%	18	0.2%	$65,495	0	0.0%	$0	1	0.0%	$71,738	19	0.2%	$137,233
Garner	11,975	39	0.3%	60	0.5%	$387,748	1	0.0%	$1,116	0	0.0%	$0	61	0.5%	$388,864
Holly Springs	10,528	1	0.0%	4	0.0%	$13,049	1	0.0%	$3,249	0	0.0%	$0	5	0.0%	$16,298
Knightdale	7,144	0	0.0%	3	0.0%	$32,943	0	0.0%	$0	0	0.0%	$0	3	0.0%	$32,943
Morrisville	5,181	14	0.3%	51	1.0%	$3,614,562	16	0.3%	$478,779	1	0.0%	$95,077	68	1.3%	$4,188,418
Rolesville	2,103	0	0.0%	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0	0	0.0%	$0
Wake Forest	10,547	1	0.0%	16	0.2%	$868,762	1	0.0%	$32,983	0	0.0%	$0	17	0.2%	$901,745
Wendell	3,728	8	0.2%	15	0.4%	$178,102	1	0.0%	$11,178	0	0.0%	$0	16	0.4%	$189,280
Zebulon	3,231	4	0.1%	40	1.2%	$256,547	0	0.0%	$0	0	0.0%	$0	40	1.2%	$256,547
Unincorporated Wake County	59,918	38	0.1%	78	0.1%	$485,033	23	0.0%	$987,582	4	0.0%	$279,038	105	0.2%	$1,751,653
TOTAL	**313,708**	**639**	**0.2%**	**1,378**	**0.4%**	**$46,678,924**	**209**	**0.1%**	**$109,499,850**	**12**	**0.0%**	**$744,979**	**1,599**	**0.5%**	**$156,923,752**

Source: NCEM Risk Management Tool

Table 4.52 – Critical Infrastructure and Key Resources Buildings at Risk to Flood Events by Sector

Sector	Event	Number of Buildings At Risk	Estimated Damages
Banking and Finance	10 Year	1	$30,522
	25 Year	1	$48,579
	50 Year	1	$51,662
	100 Year	2	$724,548
	500 Year	4	$1,131,379
Commercial Facilities	10 Year	35	$$338,700
	25 Year	60	$1,865,809
	50 Year	88	$3,112,349
	100 Year	105	$19,012,746
	500 Year	181	$104,414,301
Critical Manufacturing	25 Year	3	$22,595
	50 Year	7	$285,471
	100 Year	9	$452,833
	500 Year	15	$1,806,744
Government Facilities	100 Year	5	$192,635
	500 Year	9	$446,959
Healthcare and Public Health	500 Year	2	$95,195
Transportation Systems	100 Year	4	$254,518
	500 Year	7	$2,168,332
All Categories	**10 Year**	39	**$419,893**
	25 Year	67	**$2,050,660**
	50 Year	101	**$3,604,159**
	100 Year	127	**$20,669,338**
	500 Year	220	**$110,063,686**

Source: NCEM Risk Management Tool

To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team also evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event across the county would cause an estimated $511.6 million in building related damages. The results of the Hazus loss estimate are summarized in Table 4.53.

Table 4.53 – Hazus Building-Related Loss Estimates, 1%-Annual-Chance Flood Event, Countywide

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	94	$7,626,000	$834,000	$2,393,000	$3,227,000	42%
Commercial	516	$471,253,000	$40,293,000	$118,191,000	$158,484,000	34%
Educational	58	$248,659,000	$6,287,000	$48,060,000	$54,347,000	22%
Government	36	$53,955,000	$898,000	$5,392,000	$6,290,000	12%
Industrial	284	$41,956,000	$10,320,000	$24,003,000	$34,323,000	82%
Religious	82	$16,847,000	$873,000	$6,179,000	$7,052,000	42%
Residential	1576	$321,787,000	$160,206,000	$87,657,000	$247,863,000	77%
Total	**2,646**	**$1,162,083,000**	**$219,711,000**	**$291,875,000**	**$511,586,000**	**44%**

Source: Hazus version 6.1

FLOOD INSURANCE DATA

ACTIVE POLICIES AND PAST CLAIMS

Flood insurance data on active policies and past claims in a valuable source of information on flood hazards. Flood insurance is available in communities that participate in the National Flood Insurance Program (NFIP) and is required as a condition for federal aid or for a mortgage or loan that is federally insured for a building located in a FEMA flood zone. The following tables summarize flood insurance data by property type and flood zone for all participating jurisdictions.

WAKE COUNTY

Table 4.54 – NFIP Policy and Claims Data by Occupancy Type, Wake County

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	275	$157,202	$85,587,000	67	$535,158.52
2-4 Family	0	$0	$0	1	$10,458.76
All Other Residential	0	$0	$0	0	$0.00
Non Residential	1	$1,413	$95,000	22	$357,122.41
Total	**276**	**$158,615**	**$85,682,000**	**90**	**$902,739.69**

Source: FEMA Community Information System as of 06/02/2024

Table 4.55 – NFIP Policy and Claims Data by Flood Zone, Wake County

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	20	$16,014	$4,794,000	49	$511,745.15
A Zones	1	$940	$350,000	2	$3,575.95
B, C & X Zone					
Standard	255	$141,661	$80,538,000	3	$103,973.20
Preferred	0	$0	$0	33	$270,847.33
Total	**276**	**$158,615**	**$85,682,000**	**87**	**$890,141.63**

Source: FEMA Community Information System as of 06/02/2024

APEX

Table 4.56 – NFIP Policy and Claims Data by Occupancy Type, Apex

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	79	$40,316	$23,175,000	3	$1,299.97
2-4 Family	3	$470	$476,000	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	1	$2,079	$666,000	0	$0.00
Total	**83**	**$42,865**	**$24,317,000**	**3**	**$1,299.97**

Source: FEMA Community Information System as of 06/02/2024

Table 4.57 – NFIP Policy and Claims Data by Flood Zone, Apex

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	121	$8,147	$3,283,000	0	$0.00
B, C & X Zone					
Standard	71	$34,718	$21,034,000	0	$0.00
Preferred	0	$0	$0	3	$1,299.97
Total	**83**	**$42,865**	**$24,317,000**	**3**	**$1,299.9**

Source: FEMA Community Information System as of 06/02/2024

CARY

Table 4.58 – NFIP Policy and Claims Data by Occupancy Type, Cary

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	437	$324,171	$138,514,000	184	$2,787,528.75
2-4 Family	6	$2,016	$1,600,000	0	$0.00
All Other Residential	18	$5,070	$4,008,000	0	$0.00
Non Residential	21	$45,605	$10,100,000	3	$20,114.89
Total	**482**	**$376,862**	**$154,222,000**	**187**	**$2,807,643.64**

Source: FEMA Community Information System as of 06/02/2024

Table 4.59 – NFIP Policy and Claims Data by Flood Zone, Cary

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	159	$160,293	$49,692,000	54	$943,603.58
A Zones	0	$0	$0	1	$0.00
B, C & X Zone					
Standard	323	$216,569	$104,530,000	24	$361,184.21
Preferred	0	$0	$0	108	$1,502,855.85
Total	**482**	**$376,862**	**$154,222,000**	**187**	**$2,807,643.64**

Source: FEMA Community Information System as of 06/02/2024

FUQUAY-VARINA

Table 4.60 – NFIP Policy and Claims Data by Occupancy Type, Fuquay-Varina

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	75	$39,828	$23,822,000	9	$126,565.10
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	1	$769	$810,000	1	$0.00
Total	**76**	**$40,597**	**$24,632,000**	**10**	**$126,565.10**

Source: FEMA Community Information System as of 06/02/2024

Table 4.61 – NFIP Policy and Claims Data by Flood Zone, Fuquay-Varina

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	9	$6,508	$2,139,000	2	$101,268.39
A Zones	0	$0	$0	1	$0.00
B, C & X Zone					
Standard	67	$34,089	$22,493,000	0	$0.00
Preferred	0	$0	$0	7	$25,296.71
Total	**76**	**$40,597**	**$24,632,000**	**10**	**$126,565.10**

Source: FEMA Community Information System as of 06/02/2024

GARNER

Table 4.62 – NFIP Policy and Claims Data by Occupancy Type, Garner

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	80	$47,254	$23,754,000	34	$187,135.96
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	1	$52	$45,000	0	$0.00
Non Residential	1	$818	$328,000	3	$22,684.95
Total	**82**	**$48,124**	**$24,127,000**	**37**	**$209,820.91**

Source: FEMA Community Information System as of 06/02/2024

Table 4.63 – NFIP Policy and Claims Data by Flood Zone, Garner

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	26	$18,930	$6,562,000	24	$127,800.11
A Zones	1	$610	$275,000	1	$2,531.54
B, C & X Zone					
Standard	55	$28,584	$17,290,000	5	$0.00
Preferred	0	$0	$0	7	$79,489.26
Total	**82**	**$48,124**	**$24,127,000**	**37**	**$209,820.91**

Source: FEMA Community Information System as of 06/02/2024

HOLLY SPRINGS

Table 4.64 – NFIP Policy and Claims Data by Occupancy Type, Holly Springs

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	65	$37,762	$20,772,000	10	$178,624.43
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	1	$2,490	$1,000,000	2	$8,969.79
Total	**66**	**$40,252**	**$21,772,000**	**12**	**$187,594.22**

Source: FEMA Community Information System as of 06/02/2024

Table 4.65 – NFIP Policy and Claims Data by Flood Zone, Holly Springs

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	8	$8,775	$3,438,000	9	$134,388.63
B, C & X Zone					
Standard	58	$31,477	$18,334,000	1	$6,237.93
Preferred	0	$0	$0	2	$46,967.66
Total	**66**	**$40,252**	**$21,772,000**	**12**	**$187,594.22**

Source: FEMA Community Information System as of 06/02/2024

KNIGHTDALE

Table 4.66 – NFIP Policy and Claims Data by Occupancy Type, Knightdale

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	29	$14,866	$8,365,000	3	$31,363.63
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	2	$925	$1,210,000	0	$0.00
Total	**31**	**$15,791**	**$9,575,000**	**3**	**$31,363.63**

Source: FEMA Community Information System as of 06/02/2024

Table 4.67 – NFIP Policy and Claims Data by Flood Zone, Knightdale

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	5	$2,824	$1,104,000	1	$14,002.27
B, C & X Zone					
Standard	26	$12,967	$8,471,000	0	$0.00
Preferred	0	$0	$0	2	$17,361.36
Total	**31**	**$15,791**	**$9,575,000**	**3**	**$31,363.63**

Source: FEMA Community Information System as of 06/02/2024

MORRISVILLE

Table 4.68 – NFIP Policy and Claims Data by Occupancy Type, Morrisville

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	32	$18,553	$9,439,000	6	$92,752.15
2-4 Family	1	$326	$85,000	0	$0.00
All Other Residential	13	$9,189	$5,749,000	0	$0.00
Non Residential	3	$2,954	$1,546,000	0	$0.00
Total	**49**	**$31,022**	**$16,819,000**	**6**	**$92,752.15**

Source: FEMA Community Information System as of 06/02/2024

Table 4.69 – NFIP Policy and Claims Data by Flood Zone, Morrisville

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	15	$10,485	$4,930,000	3	$52,860.61
B, C & X Zone					
Standard	34	$20,537	$11,889,000	0	$0.00
Preferred	0	$0	$0	3	$39,891.54
Total	**49**	**$31,022**	**$16,819,000**	**6**	**$92,752.15**

Source: FEMA Community Information System as of 06/02/2024

RALEIGH

Table 4.70 – NFIP Policy and Claims Data by Occupancy Type, Raleigh

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	866	$585,488	$259,775,000	639	$5,575,555.25
2-4 Family	57	$58,816	$10,421,000	97	$2,116,649.03
All Other Residential	192	$213,981	$52,162,000	126	$5,134,284.13
Non Residential	106	$275,873	$52,825,000	294	$12,921,552.46
Total	**1,221**	**$1,134,158**	**$375,183,000**	**1,156**	**$25,748,040.87**

Source: FEMA Community Information System as of 06/02/2024

Table 4.71 – NFIP Policy and Claims Data by Flood Zone, Raleigh

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	473	$675,014	$142,219,000	748	$18,052,710.51
A Zones	9	$2,703	$1,634,000	18	$886,058.42
B, C & X Zone					
Standard	739	$456,441	$231,330,000	150	$4,654,452.04
Preferred	0	$0	$0	204	$2,042,582.49
Total	**1,221**	**$1,134,158**	**$375,183,000**	**1,120**	**$25,635,803.46**

Source: FEMA Community Information System as of 06/02/2024

ROLESVILLE

Table 4.72 – NFIP Policy and Claims Data by Occupancy Type, Rolesville

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	12	$5,206	$3,748,000	0	$0.00
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	0	$0	$0	0	$0.00
Total	**12**	**$5,206**	**$3,748,000**	**0**	**$0.00**

Source: FEMA Community Information System as of 06/02/2024

Table 4.73 – NFIP Policy and Claims Data by Flood Zone, Rolesville

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	0	$0	$0	0	$0.00
A Zones	0	$0	$0	0	$0.00
B, C & X Zone					
Standard	12	$5,206	$3,748,000	0	$0.00
Preferred	0	$0	$0	0	$0.00
Total	**12**	**$5,206**	**$3,748,000**	**0**	**$0.00**

Source: FEMA Community Information System as of 06/02/2024

WAKE FOREST

Table 4.74 – NFIP Policy and Claims Data by Occupancy Type, Wake Forest

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	88	$50,346	$27,762,000	7	$13,130.86
2-4 Family	1	$262	$350,000	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	3	$879	$366,000	0	$0.00
Total	**92**	**$51,487**	**$28,478,000**	**7**	**$13,130.86**

Source: FEMA Community Information System as of 06/02/2024

Table 4.75 – NFIP Policy and Claims Data by Flood Zone, Wake Forest

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	17	$11,091	$5,128,000	1	$0.00
B, C & X Zone					
Standard	75	$40,396	$23,350,000	1	$0.00
Preferred	0	$0	$0	5	$13,130.86
Total	**92**	**$51,487**	**$28,478,000**	**7**	**$13,130.86**

Source: FEMA Community Information System as of 06/02/2024

WENDELL

Table 4.76 – NFIP Policy and Claims Data by Occupancy Type, Wendell

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	12	$7,073	$3,652,000	9	$144,907.36
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	0	$0	$0	0	$0.00
Total	**12**	**$7,073**	**$3,652,000**	**9**	**$144,907.36**

Source: FEMA Community Information System as of 06/02/2024

Table 4.77 – NFIP Policy and Claims Data by Flood Zone, Wendell

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	4	$2,623	$1,128,000	4	$55,546.12
B, C & X Zone					
Standard	8	$4,450	$2,524,000	1	$16,618.82
Preferred	0	$0	$0	4	$72,742.42
Total	**12**	**$7,073**	**$3,652,000**	**9**	**$144,907.36**

Source: FEMA Community Information System as of 06/02/2024

ZEBULON

Table 4.78 – NFIP Policy and Claims Data by Occupancy Type, Zebulon

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	13	$8,315	$3,270,000	10	$173,307.69
2-4 Family	0	$0	$0	0	$0.00
All Other Residential	0	$0	$0	0	$0.00
Non Residential	0	$0	$0	0	$0.00
Total	**13**	**$8,315**	**$3,270,000**	**10**	**$173,307.69**

Source: FEMA Community Information System as of 06/02/2024

Table 4.79 – NFIP Policy and Claims Data by Flood Zone, Zebulon

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	8	$5,431	$1,520,000	6	$48,093.86
B, C & X Zone					
Standard	5	$2,884	$1,750,000	3	$14,133.86
Preferred	0	$0	$0	3	$124,837.59
Total	**13**	**$8,315**	**$3,270,000**	**12**	**$187,065.31**

Source: FEMA Community Information System as of 06/02/2024

REPETITIVE LOSS

A repetitive loss property is a property for which two or more flood insurance claims of more than $1,000 have been paid by the NFIP within any 10-year period since 1978. An analysis of repetitive loss was completed to examine repetitive losses within the region.

According to February 2024 NFIP records, there are a total of 160 repetitive loss properties within Wake County, of which 64 are insured and 96 are uninsured. At the time of their first claim, 36 of these properties were non-residential and 124 were residential. There are 30 properties on the list classified as severe repetitive loss properties. A severe repetitive loss property is classified as such if it has four or more separate claim payments of more than $5,000 each (including building and contents payments) or two or more separate claim payments (building only) where the total of the payments exceeds the current value of the property.

Table 4.80 summarizes repetitive loss properties by jurisdiction as identified by FEMA through the NFIP.

Table 4.80 – Repetitive Loss Properties by Jurisdiction

Jurisdiction	Total Number of RL Properties	Total Number of SRL Properties	Total Number of Losses
Raleigh	124	26	390
Apex	0	0	0
Cary	22	1	60
Fuquay-Varina	1	0	3
Garner	5	0	11
Holly Springs	0	0	0
Knightdale	1	0	3
Morrisville	0	0	0
Rolesville	0	0	0
Wake Forest	0	0	0
Wendell	1	1	2
Zebulon	0	0	0
Unincorporated Wake County	6	2	25
Total	**160**	**30**	**494**

Source: FEMA Open Source Data, February 2024
Note: As of September 2024, City of Raleigh staff indicated that several properties were removed from their repetitive loss list and the City's repetitive loss property count is now 115.

ENVIRONMENT

During a flood event, chemicals and other hazardous substances may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

CONSEQUENCE ANALYSIS

Table 4.81 summarizes the potential detrimental consequences of flood.

Table 4.81 – Consequence Analysis - Flood

Category	Consequences
Public	Localized impact expected to be severe for incident areas and moderate to light for other adversely affected areas.
Responders	First responders are at risk when attempting to rescue people from their homes. They are subject to the same health hazards as the public. Flood waters may prevent access to areas in need of response or the flood may prevent access to the critical facilities themselves which may prolong response time. Damage to personnel will generally be localized to those in the flood areas at the time of the incident and is expected to be limited.
Continuity of Operations (including Continued Delivery of Services)	Floods can severely disrupt normal operations, especially when there is a loss of power. Damage to facilities in the affected area may require temporary relocation of some operations. Localized disruption of roads, facilities, and/or utilities caused by incident may postpone delivery of some services.

Category	Consequences
Property, Facilities and Infrastructure	Buildings and infrastructure, including transportation and utility infrastructure, may be damaged or destroyed. Impacts are expected to be localized to the area of the incident. Severe damage is possible.
Environment	Chemicals and other hazardous substances may contaminate local water bodies. Wildlife and livestock deaths possible. The localized impact is expected to be severe for incident areas and moderate to light for other areas affected by the flood or HazMat spills.
Economic Condition of the Jurisdiction	Local economy and finances will be adversely affected, possibly for an extended period of time. During floods (especially flash floods), roads, bridges, farms, houses and automobiles are destroyed. Additionally, the local government must deploy firemen, police and other emergency response personnel and equipment to help the affected area. It may take years for the affected communities to be re-built and business to return to normal.
Public Confidence in the Jurisdiction's Governance	Ability to respond and recover may be questioned and challenged if planning, response, and recovery are not timely and effective.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes flood hazard risk by jurisdiction. To account for increased risk of flood due to stormwater and flash flooding, communities with between 2 and 12 flash flood events in the period from 2007-2023 were assigned a probability rating of 3, and communities with over 12 flash flood events during this period were assigned a probability rating of 4. Communities with 10% or more of their land area in the SFHA were assigned a spatial extent of 3. All other factors do not vary by jurisdiction.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	4	3	3	3	3	3.3	H
Apex	3	3	2	3	3	2.8	M
Cary	3	3	2	3	3	2.8	M
Fuquay-Varina	3	3	2	3	3	2.8	M
Garner	2	3	2	3	3	2.5	M
Holly Springs	3	3	2	3	3	2.8	M
Knightdale	2	3	2	3	3	2.5	M
Morrisville	4	3	2	3	3	3.1	H
Raleigh	4	3	2	3	3	3.1	H
Rolesville	2	3	2	3	3	2.5	M
Wake Forest	3	3	2	3	3	2.8	M
Wendell	2	3	2	3	3	2.5	M
Zebulon	3	3	2	3	3	2.8	M

4.5.6 HURRICANE AND TROPICAL STORM

HAZARD BACKGROUND

Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in the Atlantic basin is about six.

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane.

Warning Time: 1 – More than 24 hours

Duration: 2 – Less than 24 hours

LOCATION

Hurricanes and tropical storms can occur anywhere within the Wake County planning area. While coastal areas are most vulnerable to hurricanes, their wind and rain impacts can be felt hundreds of miles inland.

EXTENT

Hurricane intensity is classified by the Saffir-Simpson Scale (Table 4.82), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

Table 4.82 – Saffir-Simpson Scale

Category	Maximum Sustained Wind Speed (MPH)	Types of Damage
1	74–95	Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

Category	Maximum Sustained Wind Speed (MPH)	Types of Damage
2	96–110	Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111–129	Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130–156	Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	157 +	Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as "major" hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table 4.83 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

Table 4.83 – Hurricane Damage Classifications

Storm Category	Damage Level	Description of Damages	Photo Example
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.	
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.	

Storm Category	Damage Level	Description of Damages	Photo Example
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland.	
4	EXTREME	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.	
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.	

Source: National Hurricane Center; Federal Emergency Management Agency

Hurricane Fran is illustrative of the potential impact of hurricanes on the Wake County planning area. In Wake County alone, Fran caused oved $900 million in residential and commercial property damage and at least one death. Additional losses included infrastructure damages and power outages.

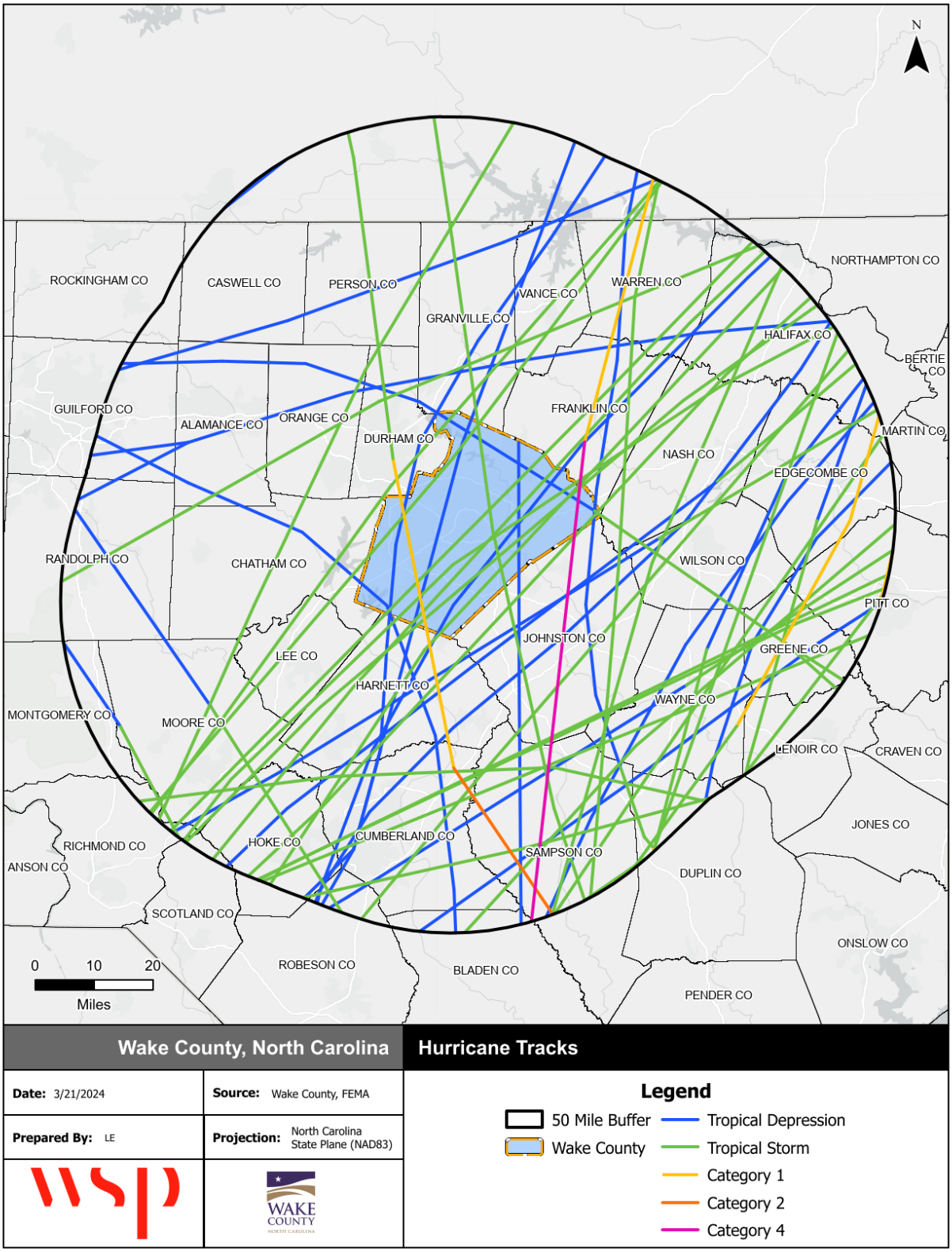
Impact: 3 – Critical

Spatial Extent: 4 – Large

HISTORICAL OCCURRENCES

According to the Office of Coastal Management's Tropical Cyclone Storm Segments data, which is a subset of the International Best Track Archive for Climate Stewardship (IBTrACS) dataset, 49 hurricanes and tropical storms have passed within 50 miles of Wake County since 1900. These storms tracks are shown in Figure 4.21. The date, storm name, storm category, and maximum wind speed of each event are detailed in Table 4.84.

Figure 4.21 – Hurricane Tracks within 50 miles of Wake County since 1900



Source: NOAA Office of Coastal Management

Table 4.84 – Hurricane and Tropical Storm Tracks Passing within 50 Miles of Wake County, 1900-2023

Date	Storm Name	Storm Category	Max Wind Speed (MPH)
6/16/1902	Unnamed	Tropical Storm	43
9/14/1904	Unnamed	Tropical Storm	69
8/31/1911	Unnamed	Tropical Depression	25
6/14/1912	Unnamed	Tropical Storm	40
9/3/1913	Unnamed	Tropical Storm	54
5/16/1916	Unnamed	Tropical Storm	40
9/6/1916	Unnamed	Tropical Storm	46
9/23/1920	Unnamed	Tropical Storm	40
9/30/1924	Unnamed	Tropical Storm	69
9/19/1928	Unnamed	Category 1	81
10/2/1929	Unnamed	Tropical Storm	58
9/6/1935	Unnamed	Tropical Storm	58
8/2/1944	Unnamed	Tropical Storm	60
10/20/1944	Unnamed	Tropical Storm	54
9/18/1945	Unnamed	Tropical Storm	54
9/25/1947	Unnamed	Tropical Storm	40
9/13/1949	Unnamed	Tropical Depression	29
10/15/1954	Hazel	Category 4	132
8/17/1955	Diane	Tropical Storm	66
7/10/1959	Cindy	Tropical Storm	40
7/23/1964	Unnamed	Tropical Depression	23
8/31/1964	Cleo	Tropical Depression	35
10/16/1964	Isbell	Tropical Storm	56
6/16/1965	Unnamed	Tropical Storm	43
6/9/1968	Abby	Tropical Depression	29
5/26/1970	Alma	Tropical Storm	46
10/1/1971	Ginger	Tropical Storm	52
9/15/1976	Unnamed	Tropical Depression	35
8/18/1985	Danny	Tropical Depression	29
9/8/1987	Unnamed	Tropical Depression	0
7/13/1996	Bertha	Category 1	75
9/6/1996	Fran	Category 2	97
7/24/1997	Danny	Tropical Storm	40
9/4/1998	Earl	Tropical Storm	58
9/5/1999	Dennis	Tropical Storm	48
9/19/2000	Gordon	Tropical Depression	25
9/23/2000	Helene	Tropical Storm	40
8/30/2004	Gaston	Tropical Depression	35
6/14/2006	Alberto	Tropical Storm	40
9/1/2006	Ernesto	Tropical Storm	58
9/6/2008	Hanna	Tropical Storm	62
6/7/2013	Andrea	Tropical Storm	46
5/11/2015	Ana	Tropical Depression	35
10/11/2018	Michael	Tropical Storm	54
10/20/2019	Nestor	Tropical Storm	46
8/4/2020	Isaias	Category 1	92
6/21/2021	Claudette	Tropical Storm	46

Date	Storm Name	Storm Category	Max Wind Speed (MPH)
7/8/2021	Elsa	Tropical Storm	52
10/1/2022	Ian	Tropical Storm	58

*Reports the most intense category that occurred within 50 miles of Wake County, not for the storm event overall.
Source: Office of Coastal Management, 2024. https://marinecadastre.gov/data/

The above list of storms is not an exhaustive list of hurricanes that have affected Wake County. Several storms, including Hurricane Floyd and Tropical Storm Hermine passed further than 50 miles away from Wake County yet had strong enough wind or rain impacts to affect the county. NCEI identified a total of 13 Storms with hurricane and tropical storm force winds that impacted Wake County from 1996 through 2023 as noted in Table 4.85.

Table 4.85 – Recorded Winds in Wake County, 1996-2023

Date	Type	Storm	Fatalities	Injuries	Property Damage	Crop Damage
7/12/1996	Hurricane (Typhoon)	Hurricane Bertha	0	0	$0	$0
9/5/1996	Hurricane (Typhoon)	Hurricane Fran	3	0	$0	$0
8/27/1998	Hurricane (Typhoon)	Hurricane Bonnie	0	0	$0	$0
9/4/1999	Hurricane (Typhoon)	Hurricane Dennis	0	0	$0	$0
9/15/1999	Hurricane (Typhoon)	Hurricane Floyd	0	0	$0	$0
9/18/2003	Hurricane (Typhoon)	Hurricane Isabel	0	0	$890,000	$0
9/1/2006	Tropical Storm	Tropical Storm Ernesto	0	0	$0	$0
9/2/2016	Tropical Storm	Tropical Storm Hermine	0	0	$20,000	$0
9/13/2018	Tropical Storm	Hurricane Florence	0	0	$1,000,000	$0
10/11/2018	Tropical Storm	Tropical Storm Michael	0	1	$200,000	$0
9/5/2019	Tropical Storm	Hurricane Dorian	0	0	$1,500	$0
8/4/2020	Tropical Storm	Hurricane Isaias	0	0	$250,000	$0
9/30/2022	Tropical Storm	Hurricane Ian	0	0	$1,000,000	$0
		Total	**3**	**1**	**$3,361,500**	**$0**

Source: NCEI

Hurricane Fran (1996) – In the RAH county warning area along, the damage exceeded 2 billion dollars. Damage to crops, livestock, farm equipment/buildings was over 400 million. The agricultural damage was the greatest in Sampson, Johnston, and Wayne counties. Several hundred thousand trees were uprooted or broken. Tens of thousands of homes were damaged by falling trees. In the path of the storm's center, almost every neighborhood was affected. The copious rainfall produced many severe flash and river floods. Along the Crabtree Creek in Raleigh, which crested at its highest since 1973, hundreds of new cars from local dealerships floated in 6 feet of water. Scores of businesses reported heavy damage at the area's largest shopping center.

Hurricane Dennis (1999) – The remnants of Dennis finally moved inland across the central portion of the state. Its main impact was to end the drought in the eastern half of the state. The Triangle received from 6 to 8 inches of rain with Chapel Hill peaking out at 12 inches. The I-40 corridor of counties also got dumped on with totals in the 6- to 10-inch range. This water caused considerable urban and lowland flooding. Several main stem rivers also went into flood. The winds with the remnants of Dennis were generally not a significant problem. There were many old, larger trees uprooted and widespread limb damage was reported. However, the wind and rain combination caused considerable crop damage.

Hurricane Floyd (1999) – Hurricane Floyd produced more human misery and environmental impact in North Carolina than any disaster in memory. The 15-20 inches of rain that fell across the eastern half of the state caused every river and stream to flood. Many rivers set new flood records. Whole communities

were underwater for days, even weeks in some areas. Thousands of homes were lost. Crop damage was extensive. The infrastructure of the eastern counties, mainly roads, bridges, water plants, etc., was heavily damaged. By the end of 1999, $1.5 billion had already been spent, with estimates that the cost would reach $3-4 billion. The counties within the Raleigh county warning area probably sustained more than half of the state total. Even worse, was the loss of life, mainly due to flooding. Many Carolinians did not heed the call to evacuate and many more drove into flooded streams and rivers. In the central part of the state, 21 people lost their lives. Also, the loss of livestock was significant, mainly swine and poultry.

Tropical Storm Ernesto (2006) – Tropical Storm Ernesto produced high winds county wide. There were numerous reports form emergency officials of downed trees and large tree limbs.

Tropical Storm Hermine (2016) – Tropical Storm Hermine produced heavy rain across portions of central North Carolina. However, due to dry antecedent conditions, no flooding occurred despite rainfall amounts of up to 3 to 5 inches across southeastern portions of central North Carolina. Given the rain and gusty winds associated with Hermine there were numerous reports of trees down and wind damage and resultant power outages. A large tree fell through the roof of a house near New Hill.

Tropical Storm Michael (2018) - Tropical Storm Michael moved through North Carolina on Thursday, October 11th. Michael brought heavy rain and strong damaging winds to central North Carolina. While heavy rainfall of 3 to 6 inches produced minor flash flooding across the area, it was high wind gusts of 40 to 60 mph that caused the biggest problems, knocking down score of trees, leading to blocked roadways and thousands without power.

Hurricane Isaias (2020) - Hurricane Isaias made landfall in southeast North Carolina, then moved north through coastal North Carolina. Significant rain fell across the Coastal Plain, Sandhills and eastern Piedmont of North Carolina as Isaias moved northward through the state along with gusty winds up to 50 to 60 miles per hour. Isaias produced two to five inches of rain across much of eastern NC, resulting in flash flooding, as well as minor flooding along the Neuse River.

Hurricane Ian (2022) - Hurricane Ian made landfall along the South Carolina coast near Georgetown during the early afternoon hours of September 30, 2022. Widespread wind gusts over tropical storm force and heavy rainfall occurred across much of central North Carolina through the afternoon and evening hours. There were numerous reports of wind damage and power outages as a result of the storm.

PROBABILITY OF FUTURE OCCURRENCE

Probability: 3 – Likely

In the 27-year period from 1996 through 2023, 13 hurricanes and tropical storms have impacted the Wake County area, which equates to a 48 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. An additional 12 storms passed within 50 miles of Wake County during this period; these storms did not have significant wind impacts but may have brought heavy rains.

CLIMATE CHANGE

One of the primary factors contributing to the origin and growth of tropical storm and hurricanes systems is water temperature. Per the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6), tropical cyclone rainfall rates and intensities are projected to increase globally. Tropical cyclones that reach very intense levels (Category 4 and 5) are projected to increase due to global warming and high levels of atmospheric moisture content. According to the Fifth National Climate Assessment, between the years 2000 and 2021, 38 tropical cyclones caused over $1 trillion in losses and 6,200 deaths. While damages to coastal communities are expected to increase, with significant damages occurring where tropical cyclones make landfall, it is unclear how impacts and damages may change inland. It is also unclear whether these changes can be attributed to climate change as there are uncertainties and

research gaps on the variability of the natural climate.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Property at risk to hurricanes was estimated using data from the NCEM IRISK database, which was compiled in NCEM's Risk Management Tool. The vulnerability data displayed below is for wind-related damages. Hurricanes may also cause substantial damages from heavy rains and subsequent flooding, which is addressed in Section 4.5.5 Flood.

PEOPLE

The very young, the elderly and the handicapped are especially vulnerable to harm from hurricanes. For those who are unable to evacuate for medical reasons, there should be provision to take care of special-needs patients and those in hospitals and nursing homes. Many of these patients are either oxygen-dependent, insulin-dependent, or in need of intensive medical care. There is a need to provide ongoing treatment for these vulnerable citizens, either on the coast or by air evacuation to upland hospitals. The stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

PROPERTY

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes.

Hurricanes and tropical storms can also cause agricultural damages. For Wake County, USDA RMA reports losses of $2,868,207 from 2007-2023 due to hurricanes and tropical storms, which equates to an average annual loss of $168,718. Table 4.86 summarizes the crop losses due to drought in reported in the RMA system.

Table 4.86 – Crop Losses Resulting from Hurricanes and Tropical Storms, 2007-2023

Year	Determined Acres	Indemnity Amount
2010	55.11	$42,928.00
2011	419.90	$262,951.00
2016	398.59	$430,484.80
2018	2086.71	$1,858,323.85
2019	328.26	$66,882.00
2020	511.52	$149,256.50
2022	88.34	$38,480.10
2023	32.72	$18,901.25
Total	**3921.17**	**$2,868,207.50**

Source: USDA Risk Management Agency

The damage estimates for the 100-year hurricane wind event total $402,503,452, which equates to a loss ratio of less than 1 percent. These damage estimates account for only wind impacts and actual damages would likely be higher due to flooding. Therefore, the region would likely experience a higher overall loss ratio from the 100-year hurricane event and face difficulty recovering from such an event. Table 4.87 through Table 4.91 detail the estimated building damages from varying magnitudes of hurricane events.

Table 4.87 – Estimated Buildings Impacted by 25-Year Hurricane Wind Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,889	34%	119,048	93%	$13,488,813	6,336	5%	$2,546,490	2,270	2%	$1,960,095	127,654	100%	$17,995,398
Apex	14,915	3,677	25%	14,031	94%	$1,448,882	671	4%	$99,310	155	1%	$30,933	14,857	100%	$1,579,124
Cary	45,306	7,342	16%	42,705	94%	$5,413,382	1,872	4%	$843,439	462	1%	$185,816	45,039	99%	$6,442,637
Fuquay-Varina	11,070	2,056	19%	10,177	92%	$808,942	596	5%	$97,021	131	1%	$34,745	10,904	99%	$940,708
Garner	11,975	4,959	41%	11,012	92%	$679,897	687	6%	$105,640	181	2%	$30,352	11,880	99%	$815,890
Holly Springs	10,528	994	9%	9,908	94%	$843,825	248	2%	$74,394	68	1%	$24,125	10,224	97%	$942,344
Knightdale	7,144	1,672	23%	6,674	93%	$463,148	265	4%	$37,022	67	1%	$30,882	7,006	98%	$531,052
Morrisville	5,181	272	5%	4,779	92%	$514,220	340	7%	$307,695	48	1%	$15,502	5,167	100%	$837,417
Rolesville	2,103	804	38%	1,968	94%	$230,741	91	4%	$8,544	29	1%	$5,028	2,088	99%	$244,312
Wake Forest	10,547	1,454	14%	9,772	93%	$911,444	541	5%	$133,986	151	1%	$44,521	10,464	99%	$1,089,951
Wendell	3,728	1,525	41%	3,270	88%	$183,760	277	7%	$24,193	73	2%	$12,908	3,620	97%	$220,861
Zebulon	3,231	1,517	47%	2,806	87%	$178,686	336	10%	$55,992	84	3%	$14,120	3,226	100%	$248,798
Unincorporated Wake County	59,918	12,063	20%	55,619	93%	$5,110,535	3,183	5%	$540,700	403	1%	$98,608	59,205	99%	$5,749,843
TOTAL	**313,708**	**82,224**	**26%**	**291,769**	**93%**	**$30,276,275**	**15,443**	**5%**	**$4,874,426**	**4,122**	**1%**	**$2,487,635**	**311,334**	**99%**	**$37,638,335**

Source: NCEM Risk Management Tool

Table 4.88 – Estimated Buildings Impacted by 50-Year Hurricane Wind Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$49,909,794	6,336	5%	$9,686,922	2,270	2%	$8,825,505	128,042	100%	$68,422,222
Apex	14,915	3,715	25%	14,089	94%	$5,402,532	671	4%	$351,185	155	1%	$123,891	14,915	100%	$5,877,608
Cary	45,306	7,401	16%	42,944	95%	$20,437,014	1,872	4%	$3,555,396	462	1%	$751,377	45,278	100%	$24,743,787
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$3,268,956	596	5%	$398,906	131	1%	$135,414	11,065	100%	$3,803,276
Garner	11,975	4,982	42%	11,103	93%	$2,916,521	687	6%	$388,516	181	2%	$110,169	11,971	100%	$3,415,206
Holly Springs	10,528	994	9%	10,208	97%	$3,549,027	248	2%	$296,076	68	1%	$67,856	10,524	100%	$3,912,959
Knightdale	7,144	1,696	24%	6,811	95%	$1,751,201	265	4%	$140,602	67	1%	$117,162	7,143	100%	$2,008,965
Morrisville	5,181	274	5%	4,793	93%	$2,103,855	340	7%	$1,022,575	48	1%	$61,450	5,181	100%	$3,187,880
Rolesville	2,103	808	38%	1,983	94%	$813,404	91	4%	$31,923	29	1%	$12,881	2,103	100%	$858,207
Wake Forest	10,547	1,459	14%	9,852	93%	$3,977,196	541	5%	$549,214	151	1%	$160,595	10,544	100%	$4,687,005
Wendell	3,728	1,536	41%	3,378	91%	$756,442	277	7%	$76,005	73	2%	$47,616	3,728	100%	$880,063
Zebulon	3,231	1,519	47%	2,809	87%	$691,571	336	10%	$215,577	84	3%	$51,471	3,229	100%	$958,619
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$20,671,111	3,183	5%	$2,540,358	403	1%	$360,916	59,849	100%	$23,572,386
TOTAL	**313,708**	**82,750**	**26%**	**294,007**	**94%**	**$116,248,624**	**15,443**	**5%**	**$19,253,255**	**4,122**	**1%**	**$10,826,303**	**313,572**	**100%**	**$146,328,183**

Source: NCEM Risk Management Tool

Table 4.89 – Estimated Buildings Impacted by 100-Year Hurricane Wind Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$128,714,289	6,336	5%	$33,040,955	2,270	2%	$30,446,268	128,042	100%	$192,201,511
Apex	14,915	3,715	25%	14,089	94%	$13,779,622	671	4%	$1,214,735	155	1%	$483,311	14,915	100%	$15,477,668
Cary	45,306	7,401	16%	42,944	95%	$51,345,150	1,872	4%	$12,594,032	462	1%	$2,727,029	45,278	100%	$66,666,211
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$8,292,115	596	5%	$1,530,383	131	1%	$499,919	11,065	100%	$10,322,417
Garner	11,975	4,982	42%	11,103	93%	$7,781,221	687	6%	$1,425,997	181	2%	$412,885	11,971	100%	$9,620,103
Holly Springs	10,528	994	9%	10,209	97%	$8,952,887	248	2%	$1,127,366	68	1%	$222,403	10,525	100%	$10,302,655
Knightdale	7,144	1,696	24%	6,811	95%	$4,524,674	265	4%	$516,869	67	1%	$417,503	7,143	100%	$5,459,045
Morrisville	5,181	274	5%	4,793	93%	$5,766,554	340	7%	$2,981,303	48	1%	$228,286	5,181	100%	$8,976,143
Rolesville	2,103	808	38%	1,983	94%	$1,980,105	91	4%	$102,001	29	1%	$35,562	2,103	100%	$2,117,667
Wake Forest	10,547	1,459	14%	9,852	93%	$10,566,637	541	5%	$1,802,458	151	1%	$530,608	10,544	100%	$12,899,702
Wendell	3,728	1,536	41%	3,378	91%	$2,000,680	277	7%	$257,441	73	2%	$175,742	3,728	100%	$2,433,862
Zebulon	3,231	1,519	47%	2,809	87%	$1,746,454	336	10%	$850,410	84	3%	$212,507	3,229	100%	$2,809,370
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$52,682,542	3,183	5%	$9,266,015	403	1%	$1,268,542	59,849	100%	$63,217,098
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$298,132,930**	**15,443**	**5%**	**$66,709,965**	**4,122**	**1%**	**$37,660,565**	**313,573**	**100%**	**$402,503,452**

Source: NCEM Risk Management Tool

Table 4.90 – Estimated Buildings Impacted by 300-Year Hurricane Wind Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$525,481,784	6,336	5%	$150,437,575	2,270	2%	$136,549,743	128,042	100%	$812,469,103
Apex	14,915	3,715	25%	14,089	94%	$41,624,049	671	4%	$4,096,858	155	1%	$1,633,344	14,915	100%	$47,354,251
Cary	45,306	7,401	16%	42,944	95%	$196,048,226	1,872	4%	$36,098,632	462	1%	$10,263,618	45,278	100%	$242,410,477
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$65,731,958	596	5%	$16,079,668	131	1%	$5,409,440	11,065	100%	$87,221,066
Garner	11,975	4,982	42%	11,103	93%	$53,264,329	687	6%	$12,113,648	181	2%	$4,034,805	11,971	100%	$69,412,782
Holly Springs	10,528	994	9%	10,209	97%	$74,400,401	248	2%	$8,744,642	68	1%	$2,335,463	10,525	100%	$85,480,507
Knightdale	7,144	1,696	24%	6,811	95%	$33,099,261	265	4%	$4,220,584	67	1%	$3,013,398	7,143	100%	$40,333,242
Morrisville	5,181	274	5%	4,793	93%	$15,973,924	340	7%	$8,206,253	48	1%	$694,380	5,181	100%	$24,874,557
Rolesville	2,103	808	38%	1,983	94%	$4,909,682	91	4%	$263,350	29	1%	$96,399	2,103	100%	$5,269,432
Wake Forest	10,547	1,459	14%	9,852	93%	$25,792,988	541	5%	$4,674,382	151	1%	$1,555,115	10,544	100%	$32,022,485
Wendell	3,728	1,536	41%	3,378	91%	$12,979,785	277	7%	$2,415,799	73	2%	$1,545,144	3,728	100%	$16,940,728
Zebulon	3,231	1,519	47%	2,809	87%	$11,411,696	336	10%	$9,568,277	84	3%	$3,579,098	3,229	100%	$24,559,071
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$262,695,308	3,183	5%	$28,930,729	403	1%	$10,455,612	59,849	100%	$302,081,649
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$1,323,413,391**	**15,443**	**5%**	**$285,850,397**	**4,122**	**1%**	**$181,165,559**	**313,573**	**100%**	**$1,790,429,350**

Source: NCEM Risk Management Tool

Table 4.91 – Estimated Buildings Impacted by 700-Year Hurricane Wind Event

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$1,263,880,305	6,336	5%	$300,961,136	2,270	2%	$184,520,167	128,042	100%	$1,749,361,608
Apex	14,915	3,715	25%	14,089	94%	$135,413,105	671	4%	$9,579,766	155	1%	$4,643,345	14,915	100%	$149,636,216
Cary	45,306	7,401	16%	42,944	95%	$529,858,025	1,872	4%	$81,374,716	462	1%	$24,422,300	45,278	100%	$635,655,042
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$186,640,399	596	5%	$44,132,242	131	1%	$15,103,763	11,065	100%	$245,876,404
Garner	11,975	4,982	42%	11,103	93%	$152,591,639	687	6%	$30,688,285	181	2%	$11,073,419	11,971	100%	$194,353,344
Holly Springs	10,528	994	9%	10,209	97%	$223,412,091	248	2%	$20,332,093	68	1%	$6,801,399	10,525	100%	$250,545,583
Knightdale	7,144	1,696	24%	6,811	95%	$91,684,078	265	4%	$10,852,401	67	1%	$7,084,666	7,143	100%	$109,621,144
Morrisville	5,181	274	5%	4,793	93%	$51,258,144	340	7%	$24,297,787	48	1%	$1,996,181	5,181	100%	$77,552,112
Rolesville	2,103	808	38%	1,983	94%	$14,021,628	91	4%	$659,838	29	1%	$267,483	2,103	100%	$14,948,949
Wake Forest	10,547	1,459	14%	9,852	93%	$76,829,477	541	5%	$12,352,008	151	1%	$4,748,661	10,544	100%	$93,930,146
Wendell	3,728	1,536	41%	3,378	91%	$35,555,601	277	7%	$6,593,918	73	2%	$3,964,687	3,728	100%	$46,114,207
Zebulon	3,231	1,519	47%	2,809	87%	$30,979,732	336	10%	$26,383,888	84	3%	$10,715,389	3,229	100%	$68,079,009
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$712,807,272	3,183	5%	$66,384,972	403	1%	$26,407,077	59,849	100%	$805,599,322
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$3,504,931,496**	**15,443**	**5%**	**$634,593,050**	**4,122**	**1%**	**$301,748,537**	**313,573**	**100%**	**$4,441,273,086**

Source: NCEM Risk Management Tool

To supplement the IRISK assessment of property at risk from hurricane, the planning team also evaluated hurricane risk using FEMA's Hazus software, which estimates losses due to wind-related damage. Per this analysis, a 100-year hurricane event across the county would cause an estimated $1.08 billion in building related damages. The results of the Hazus loss estimate are summarized in Table 4.92.

Table 4.92 – Hazus Building-Related Loss Estimates by Hurricane Return Period, Countywide

Area	Residential	Commercial	Industrial	Others	Total
50-year Hurricane Event					
Building	$302,743,220	$5,154,940	$1,651,650	$7,033,000	$316,582,810
Content	$115,949,760	$162,400	$290,020	$1,396,380	$117,798,560
Inventory	$0	$19,220	$49,020	$75,000	$143,240
Total	**$418,692,980**	**$5,336,560**	**$1,990,690**	**$8,504,380**	**$434,524,610**
100-year Hurricane Event					
Building	$753,316,530	$15,486,930	$5,755,980	$22,361,430	$796,920,870
Content	$269,916,990	$1,455,000	$2,035,860	$5,890,950	$279,298,800
Inventory	$0	$369,570	$327,310	$732,580	$1,429,460
Total	**$1,023,233,520**	**$17,311,500**	**$8,119,150**	**$28,984,960**	**$1,077,649,130**
500-year Hurricane Event					
Building	$3,017,815,380	$99,675,360	$44,471,240	$116,976,510	$3,278,938,490
Content	$1,090,555,780	$26,796,730	$28,380,710	$42,454,490	$1,188,187,710
Inventory	$0	$5,656,220	$4,475,750	$5,420,170	$15,552,140
Total	**$4,108,371,160**	**$132,128,310**	**$77,327,700**	**$164,851,170**	**$4,482,678,340**
1000-year Hurricane Event					
Building	$4,791,515,130	$225,605,180	$93,147,780	$222,755,280	$5,333,023,370
Content	$1,779,726,900	$79,591,820	$65,308,390	$93,201,500	$2,017,828,610
Inventory	$0	$16,803,530	$10,163,650	$13,880,740	$40,847,920
Total	**$6,571,242,030**	**$322,000,530**	**$168,619,820**	**$329,837,520**	**$7,391,699,900**

Source: Hazus version 6.1

ENVIRONMENT

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

CONSEQUENCE ANALYSIS

Table 4.93 summarizes the potential negative consequences of hurricanes and tropical storms.

Table 4.93 – Consequence Analysis – Hurricane and Tropical Storm

Category	Consequences
Public	Impacts include injury or death, loss of property, outbreak of diseases, mental trauma and loss of livelihoods. Power outages and flooding are likely to displace people from their homes. Water can become polluted such that if consumed, diseases and infection can be easily spread. Residential, commercial, and public buildings, as well as critical infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed, resulting in cascading impacts on the public.

Category	Consequences
Responders	Localized impact expected to limit damage to personnel in the inundation area at the time of the incident.
Continuity of Operations (including Continued Delivery of Services)	Damage to facilities/personnel from flooding or wind may require temporary relocation of some operations. Operations may be interrupted by power outages. Disruption of roads and/or utilities may postpone delivery of some services. Regulatory waivers may be needed locally. Fulfillment of some contracts may be difficult. Impact may reduce deliveries.
Property, Facilities and Infrastructure	Structural damage to buildings may occur; loss of glass windows and doors by high winds and debris; loss of roof coverings, partial wall collapses, and other damages requiring significant repairs are possible in a major (category 3 to 5) hurricane.
Environment	Hurricanes can devastate wooded ecosystems and remove all the foliation from forest canopies, and they can change habitats so drastically that the indigenous animal populations suffer as a result. Specific foods can be taken away as high winds will often strip fruits, seeds and berries from bushes and trees. Secondary impacts may occur; for example, high winds and debris may result in damage to an above-ground fuel tank, resulting in a significant chemical spill.
Economic Condition of the Jurisdiction	Local economy and finances adversely affected, possibly for an extended period of time, depending on damages. Intangible impacts also likely, including business interruption and additional living expenses.
Public Confidence in the Jurisdiction's Governance	Likely to impact public confidence due to possibility of major event requiring substantial response and long-term recovery effort.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes hurricane and tropical storm hazard risk by jurisdiction. Most aspects of hurricane risk do not vary substantially by jurisdiction; however, impacts may be greater in more highly developed areas with greater amounts of impervious surface and higher exposure in terms of both property and population density. Additionally, mobile home units are more vulnerable to wind damage. While mobile home units do not comprise a significant proportion of any jurisdictions housing mix, Wake County, Cary, Morrisville, Wake Forest and Raleigh each have over 250 mobile home units in their jurisdiction and therefore may face more severe impacts from wind.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	3	4	4	1	2	3.2	H
Apex	3	3	4	1	2	2.9	M
Cary	3	4	4	1	2	3.2	H
Fuquay-Varina	3	3	4	1	2	2.9	M
Garner	3	3	4	1	2	2.9	M
Holly Springs	3	3	4	1	2	2.9	M
Knightdale	3	3	4	1	2	2.9	M
Morrisville	3	4	4	1	2	3.2	H
Raleigh	3	4	4	1	2	3.2	H
Rolesville	3	3	4	1	2	2.9	M
Wake Forest	3	4	4	1	2	3.2	H
Wendell	3	3	4	1	2	2.9	M
Zebulon	3	3	4	1	2	2.9	M

4.5.7 INFECTIOUS DISEASE

HAZARD BACKGROUND

Infectious, or communicable, diseases are conditions that result in clinically evident illness which are transmissible directly from one person to another or indirectly through vectors such as insects, air, water, blood, or other objects. Through the public health system and efforts including disease reporting, vaccinations, vector control, and effective treatments, many infectious diseases are well controlled in the United States and across North Carolina. However, control systems can fail, and when people come together from locations outside of the state, outbreaks can occur. Some of the most significant potential communicable diseases are described in this hazard profile. Serious infectious diseases usually do not occur on a regular or widespread basis, though some are more frequent.

Influenza (Flu) –Unlike most illnesses, the flu is especially dangerous because it is spread through the air. A classic definition of influenza is a respiratory infection with fever. Each year, flu infects humans and spreads around the globe. There are three types of influenza virus: Types A, B, and C. Type A is the most common, most severe, and the primary cause of flu epidemics. Type B cases occur sporadically and sometimes as regional or widespread epidemics. Type C cases are quite rare and hence sporadic, but localized outbreaks have occurred. Seasonal influenza usually is treatable, and the mortality rate remains low. Each year, scientists estimate which particular strain of flu is likely to spread, and they create a vaccine to combat it. A flu pandemic occurs when the virus suddenly changes or mutates and undergoes an ―antigenic shift, permitting it to attach to a person's respiratory system and leave the body's immune system defenseless against the invader. Whether natural or manmade, health officials say the threat of a dangerous new strain of flu virus in pandemic proportions is a very real possibility in the years ahead. Each year, there are hundreds of cases of influenza in North Carolina.

Norovirus – Norovirus is the leading cause of foodborne-disease outbreaks in the United States. The virus can cause diarrhea, vomiting, and stomach pain, and is easily spread from person to person through contaminated food or water and by surface-to-surface contact. Those living or staying in nursing homes and assisted living facilities and other healthcare facilities such as hospitals are particularly vulnerable. Norovirus could also be a threat in the event of large public gatherings such as sporting events, concerts, and festivals. North Carolina experiences norovirus outbreaks on an annual basis. No vaccine or treatment exists for the Norovirus, making it especially dangerous for the public in the event of an outbreak.

Coronavirus 2019 (COVID-19) – COVID-19 is caused by the Severe Acute Reparatory Syndrome Coronavirus 2 (SARS-CoV-2) virus and was first identified in Wuhan, China, in December 2019 before quickly spreading worldwide. COVID-19 is transmitted when people breathe in air contaminated by respiratory droplets and small airborne particles containing the virus. Of those people who develop symptoms noticeable enough to be classified as patients, 81% develop mild to moderate symptoms (up to mild pneumonia), while 14% develop severe symptoms, and 5% develop critical symptoms (respiratory failure, shock, etc.).

Tuberculosis – Tuberculosis, or TB, is the leading cause of infectious disease worldwide. It is caused by a bacteria called Mycobacterium tuberculosis that most often affects the lungs. TB is an airborne disease spread by coughing or sneezing from one person to another. The World Health Organization (WHO) estimates that one-third of the world's population, approximately two billion people, has latent TB, which means people have been infected by TB bacteria but are not yet ill with the disease and cannot transmit the disease. In 2015, 10.4 million people fell ill with TB and 1.8 million died from the disease (including 0.4 million among people with HIV). Over 95% of TB deaths occur in low- and middle- income countries.

Smallpox – Smallpox is a contagious, sometimes fatal, infectious disease. There is no specific treatment for smallpox disease, and the only prevention is vaccination. Smallpox is caused by the variola virus that

emerged in human populations thousands of years ago. It is generally spread by face- to-face contact or by direct contact with infected bodily fluids or contaminated objects (such as bedding or clothing). A person with smallpox is sometimes contagious with onset of fever, but the person becomes most contagious with the onset of rash. The rash typically develops into sores that spread over all parts of the body. The infected person remains contagious until the last smallpox scab is gone. Smallpox outbreaks have occurred periodically for thousands of years, but the disease is now largely eradicated after a worldwide vaccination program was implemented. After the disease was eliminated, routine vaccination among the general public was stopped. The last case of smallpox in the United States was in 1949.

St. Louis Encephalitis – In the United States, the leading type of epidemic flaviviral Encephalitis is St. Louis encephalitis (SLE), which is transmitted by mosquitoes that become infected by feeding on birds infected with the virus. SLE is the most common mosquito-transmitted pathogen in the United States. There is no evidence to suggest that the virus can be spread from person to person.

Meningitis – Meningitis is an infection of fluid that surrounds a person's spinal cord and brain. High fever, headache, and stiff neck are common symptoms of meningitis, which can develop between several hours to one to two days after exposure. Meningitis can be caused by either a viral or bacterial infection; however, a correct diagnosis is critically important, because treatments for the two varieties differ. Meningitis is transmitted through direct contact with respiratory secretions from an infected carrier. Primary risk groups include infants and young children, household contact with patients, and refugees. In the United States, periodic outbreaks continue to occur, particularly among adolescents and young adults. About 2,600 people in the United States get the disease each year. Generally, 10 to 14 percent of cases are fatal, and 11 to 19 percent of those who recover suffer from permanent hearing loss, mental retardation, loss of limbs, or other serious effects. Two vaccines are available in the United States.

Lyme Disease – Lyme disease was named after the town of Lyme, Connecticut, where an unusually large frequency of arthritis-like symptoms was observed in children in 1977. It was later found that the problem was caused by bacteria transmitted to humans by infected deer ticks, causing an average of more than 16,000 reported infections in the United States each year (however, the disease is greatly under-reported). Lyme disease bacteria are not transmitted from person to person. Following a tick bite, 80 percent of patients develop a red bullseye rash accompanied by tiredness, fever, headache, stiff neck, muscle aches, and joint pain. If untreated, some patients may develop arthritis, neurological abnormalities, and cardiac problems, weeks to months later. Lyme disease is rarely fatal. During early stages of the disease, oral antibiotic treatment is generally effective, while intravenous treatment may be required in more severe cases.

West Nile Virus - West Nile virus is a flavivirus spread by infected mosquitoes and is commonly found in Africa, West Asia, and the Middle East. It was first documented in the United States in 1999. Although it is not known where the United States virus originated, it most closely resembles strains found in the Middle East. It is closely related to St. Louis encephalitis and can infect humans, birds, mosquitoes, horses, and other mammals. Most people who become infected with West Nile virus will have either no symptoms or only mild effects. However, on rare occasions, the infection can result in severe and sometimes fatal illness. There is no evidence to suggest that the virus can be spread from person to person. West Nile virus occurs with low frequency and serious disease is rare.

Severe Acute Respiratory Syndrome - Severe acute respiratory syndrome (SARS) is a respiratory illness that has recently been reported in Asia, North America, and Europe. Although the cause of SARS is currently unknown, scientists have detected in SARS patients a previously unrecognized coronavirus that appears to be a likely source of the illness. In general, humans infected with SARS exhibit fevers greater than 100.4 F, headaches, an overall feeling of discomfort, and body aches. Some people also experience mild respiratory symptoms. After two to seven days, SARS patients may develop a dry cough and have trouble breathing. The primary way that SARS appears to spread is by close person-to-person contact; particularly by an infected person coughing or sneezing contaminated droplets onto another

person, with a transfer of those droplets to the victim's eyes, nose, or mouth.

Zika Virus - Discovered in the Zika forest of Uganda in 1947, the Zika virus is a member of the flavivirus family. It is transmitted to humans through the bite of an infected Aedes species mosquito (Ae. aegypti and Ae. albopictus). Zika virus can also be transmitted from an infected pregnant woman to her baby during pregnancy and can result in serious birth defects, including microcephaly. Less commonly, the virus can be spread through intercourse or blood transfusion. However, most people infected with the Zika virus do not become sick.

Ebola – Previously known as Ebola hemorrhagic fever, Ebola is a rare and deadly disease caused by infection with one of the Ebola virus species. It was first discovered in 1976 near the Ebola River in what is now the Democratic Republic of the Congo. Since then, outbreaks have appeared sporadically in Africa, but the virus is largely contained and a vaccine is in development.

Today, a large percentage of the world's population is clustered in cities, making rapid spread of disease more possible. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

Warning Time: 1 – More than 24 hours

Duration: 4 – More than one week

LOCATION

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

EXTENT

Extent is largely dependent on the type of disease and on the effect that it has on the population. Extent can be defined by the number and distribution of people infected, which could reach thousands within the county depending on the disease. An especially severe influenza pandemic or other major disease outbreak could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Impact: 3 – Critical

Spatial Extent: 4 – Large

Table 4.94 describes the World Health Organization's six main phases to a pandemic flu as part of their planning guidance.

Table 4.94 – World Health Organization's Pandemic Flu Phases

Phase	Description
1	No animal influenza virus circulating among animals have been reported to cause infection in humans.
2	An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat.

Phase	Description
3	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts.
4	Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified.
5	The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region.
6	In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region.
Post-Peak Period	Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.
Post-Pandemic Period	Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance.

Source: World Health Organization

HISTORICAL OCCURRENCES

INFLUENZA PANDEMICS

Since the early 1900s, four lethal pandemics have swept the globe: Spanish Flu of 1918-1919; Asian Flu of 1957-1958; Hong Kong Flu of 1968-1969; and Swine Flu of 2009-2010. The Spanish Flu was the most severe pandemic in recent history. The number of deaths was estimated to be 50-100 million worldwide and 675,000 in the United States. Its primary victims were mostly young, healthy adults. The 1957 Asian Flu pandemic killed about 70,000 people in the United States, mostly the elderly and chronically ill. The 1968 Hong Kong Flu pandemic killed 34,000 Americans. The 2009 Swine Flu caused 12,469 deaths in the United States. These historic pandemics are further defined in the following paragraphs along with several "pandemic scares".

Spanish Flu (H1N1 virus) of 1918-1919 – In 1918, the Spanish Flu swept the world in three waves during a two-year period. The first reported case occurred at Camp Funston (Fort Riley), Kansas, where 60,000 soldiers trained to be deployed overseas. Within four months, the virus traversed the globe, as American soldiers brought the virus to Europe. The first wave sickened thousands of people and caused many deaths (46 died at Camp Funston), but it was considered mild compared to the second and deadliest wave, which struck in the autumn of 1918 and killed millions. At Camp Funston alone, there were 14,000 cases and 861 deaths reported during the first three weeks of October 1918. Outbreaks caused by a new variant exploded almost simultaneously in many locations including France, Sierra Leone, Boston, and New York City, where more than 20,000 people died that fall. The flu gained its name from Spain, which was one of the hardest hit countries. From there, the flu went through the Middle East and around the world, eventually returning to the United States along with the troops.

Of the 57,000 Americans who died in World War I, 43,000 died from the Spanish Flu. At one point, more than 10 percent of the American workforce was bedridden. By a conservative estimate, a fifth of the world's population suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died. At the height of the flu outbreak during the winter of 1918-1919, at least 20% of North Carolinians were infected by the disease. Nearly 14,000 North Carolinians died from Spanish Flu.

Asian Flu (H2N2 virus) of 1957-1958 – This influenza pandemic was first identified in February 1957. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. Several small outbreaks occurred in the United States during the summer of 1957, with infection rates highest among school children, young adults, and pregnant women; however, the elderly had the

highest rates of death. A second wave of infections occurred early the following year, which is typical of many pandemics.

Hong Kong Flu (H3N2 virus) of 1968-1969 – This influenza pandemic was first detected in early 1968 in Hong Kong. The first cases in the United States were detected in September 1968, although widespread illness did not occur until December. This became the mildest pandemic of the twentieth century, with those over the age of 65 the most likely to die. People infected earlier by the Asian Flu virus may have developed some immunity against the Hong Kong Flu virus. Also, this pandemic peaked during school holidays in December, limiting student-related infections.

Swine Flu (H1N1 virus) of 2009–2010 – This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, or Swine Flu, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic. The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

OTHER INFECTIOUS DISEASE OUTBREAKS

St. Louis Encephalitis, 1964-2005 – Between 1964 and 2005, there were 4,651 confirmed cases of SLE in the United States. Seventy-five of these cases were in Missouri. According to the U.S. Geological Survey, there was one case of SLE in Missouri in 2006. It should be noted, however, that less than 1 percent of SLE infections are clinically apparent, so the vast majority of infections remain undiagnosed. Illnesses range from mild headaches and fever to convulsions, coma, and paralysis. The last major outbreak of SLE occurred in the Midwest from 1974 to 1977, when over 2,500 cases were reported in 35 states. The most recent outbreak of St. Louis encephalitis was in 1999 in New Orleans, Louisiana, with 20 reported cases. The disease is generally milder in children than in adults, with the elderly at highest risk for severe illness and death. Approximately 3 to 30 percent of cases are fatal; no vaccine against SLE exists.

Lyme Disease, 2015 – In the United States, Lyme disease is mostly found in the northeastern, mid-Atlantic, and upper north-central regions, and in several counties in northwestern California. In 2015, 95-percent of confirmed Lyme Disease cases were reported from 14 states: Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and Wisconsin. Lyme disease is the most commonly reported vector-borne illness in the United States. In 2015, it was the sixth most common nationally notifiable disease. However this disease does not occur nationwide and is concentrated heavily in the northeast and upper Midwest.

Severe Acute Respiratory Syndrome, 2003 – During November 2002-July 2003, a total of 8,098 probable SARS cases were reported to the World Health Organization (WHO) from 29 countries. In the United States, only 8 cases had laboratory evidence of infection. In North Carolina, there was one confirmed SARS case – a man in Orange County tested positive in June 2003. SARS transmission was declared contained in July 2003.

Zika Virus, 2015 – In May 2015, the Pan American Health Organization issued an alert noting the first confirmed case of a Zika virus infection in Brazil. Per the CDC, in 2015 and 2016, large outbreaks of Zika virus occurred in the Americas, resulting in an increase in travel-associated cases in US states, widespread transmission in Puerto Rico and the US Virgin Islands, and limited local transmission in Florida and Texas. In 2017, the number of Zika virus cases in the U.S. started to decline, and there have been no reports of Zika virus transmission by mosquitoes in the continental U.S. since 2018. Local transmission of Zika virus was not identified in North Carolina, through there were travel-related cases between 2016-2018.

Ebola, 2014-2016 – In March 2014, West Africa experienced the largest outbreak of Ebola in history. Wide spread transmission was found in Liberia, Sierra Leone, and Guinea with the number of cases totaling 28,616 and the number of deaths totaling 11,310. In the United States, four cases of Ebola were confirmed in 2014 including a medical aid worker returning to New York from Guinea, two healthcare workers at Texas Presbyterian Hospital who provided care for a diagnosed patient, and the diagnosed patient who traveled to Dallas, Texas from Liberia. All three healthcare workers recovered. The diagnosed patient passed away in October 2014. In March 2016, the WHO terminated the public health emergency for the Ebola outbreak in West Africa.

Coronavirus Disease (COVID-19), 2020 – The COVID-19 pandemic resulted in the only disaster declaration (DR-4487-NC) for an infectious disease event in the 21st century for North Carolina. COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. Per the North Carolina Department of Health and Humana Services (NCDHHS), COVID-19 was first reported in North Carolina in March 2020.

NCDHHS archived its COVID-19 data dashboards in Spring of 2023. As of May 10, 2023, there had been over 3.5 million reported cases of COVID-19 and over 29,000 deaths in North Carolina. As of April 26, 2023, 68% of the North Carolina population had received at least one COVID-19 vaccine dose.

Per the State Hazard Mitigation Plan, COVID-19 mitigation measures such as wearing face masks, staying home, hand washing, school closures, reduce travel, increased ventilation of indoor spaces, and physical distancing likely contributed to a decline in the incidence of illness, hospitalizations, and deaths from COVID-19 and other contagious diseases. This includes a profound reduction in influenza cases in North Carolina, from 186 deaths from influenza in the 2019-2020 season to seven deaths from influenza in the 2020-2021 season.

PROBABILITY OF FUTURE OCCURRENCE

It is difficult to predict the future probability or impact of infectious diseases. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. The most common and probable pandemic or endemic disease in the state has shown to be influenza; based on historical data, it is relatively unlikely (between 1 and 33.3 percent annual probability) that North Carolina will experience an outbreak of infectious diseases in the near future. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Probability: 1 – Unlikely

CLIMATE CHANGE

According to the U.S. Global Change Research Program, the influences of climate change on public health are significant and varied. The influences range from the clear threats of temperature extremes and severe storms to less obvious connections related to insects. Climate and weather can also affect water and food quality in particular areas, with implications for public health.

Hot days can be unhealthy—even dangerous. High air temperatures can cause heat stroke and dehydration and affect people's cardiovascular and nervous systems. Heat stress is expected to increase as climate change brings hotter summer temperatures and more humidity. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor.

Higher temperatures and wetter conditions tend to increase mosquito and tick activity, leading to an increased risk of zoonotic diseases. Mosquitos are known to carry diseases such as West Nile virus

(WNV), La Crosse/California encephalitis, Jamestown Canyon virus, St. Louis encephalitis, and Eastern equine encephalitis. The two major concerns associated with warmer and wetter conditions are that the mosquito species already found in North Carolina and the diseases that they carry will become more prevalent, and that new species carrying unfamiliar diseases will start to appear for the first time.

Warmer winters with fewer hard freezes in areas that already see WNV-carrying mosquitos are likely to observe both a higher incidence of WNV and a longer WNV season, ultimately leading to an increase in human cases. Non-native mosquito species may move into North Carolina if the climate becomes more suitable for them, bringing with them diseases such as Jamestown Canyon virus, Chikungunya, and Dengue Fever. Ticks are also well-known disease vectors in North Carolina, carrying pathogens such as Lyme disease, anaplasmosis, Ehrlichiosis, Powassan virus, and Babesiosis, and could be affected by changing temperatures.

Communities must contend with the human health impacts related to the increased prevalence of infectious diseases. Public health officials will need to focus on spreading information and enacting pest and disease reduction.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Vulnerability to infectious disease was assessed based on past occurrences nationally and internationally as well as publicly available information on these vulnerabilities.

PEOPLE

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the last two pandemics in 1957 and 1968 as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people would have immunity to a new virus.

Approximately twenty percent of people exposed to West Nile Virus through a mosquito bite develop symptoms related to the virus; it is not transmissible from one person to another. Preventive steps can be taken to reduce exposure to mosquitos carrying the virus; these include insect repellent, covering exposed skin with clothing and avoiding the outdoors during twilight periods of dawn and dusk, or in the evening when the mosquitos are most active.

PROPERTY

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Staffing shortages could affect the function of critical facilities.

ENVIRONMENT

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the

use of some areas, and may require remediation.

CONSEQUENCE ANALYSIS

Table 4.95 summarizes the potential consequences of infectious disease.

Table 4.95 – Consequence Analysis – Infectious Disease

Category	Consequences
Public	Adverse impact expected to be severe for unprotected personnel and moderate to light for protected personnel.
Responders	Adverse impact expected to be severe for unprotected personnel and uncertain for trained and protected personnel, depending on the nature of the incident.
Continuity of Operations (including Continued Delivery of Services)	Danger to personnel in the area of the incident may require relocation of operations and lines of succession execution. Disruption of lines of communication and destruction of facilities may extensively postpone delivery of services.
Property, Facilities and Infrastructure	Access to facilities and infrastructure in the area of the incident may be denied until decontamination completed.
Environment	Incident may cause denial or delays in the use of some areas. Remediation needed.
Economic Condition of the Jurisdiction	Local economy and finances adversely affected, possibly for an extended period of time.
Public Confidence in the Jurisdiction's Governance	Ability to respond and recover may be questioned and challenged if planning, response, and recovery not timely and effective.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes infectious disease risk by jurisdiction. Infectious disease risk is uniform across the planning area.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	1	3	4	1	4	2.5	M
Apex	1	3	4	1	4	2.5	M
Cary	1	3	4	1	4	2.5	M
Fuquay-Varina	1	3	4	1	4	2.5	M
Garner	1	3	4	1	4	2.5	M
Holly Springs	1	3	4	1	4	2.5	M
Knightdale	1	3	4	1	4	2.5	M
Morrisville	1	3	4	1	4	2.5	M
Raleigh	1	3	4	1	4	2.5	M
Rolesville	1	3	4	1	4	2.5	M
Wake Forest	1	3	4	1	4	2.5	M
Wendell	1	3	4	1	4	2.5	M
Zebulon	1	3	4	1	4	2.5	M

4.5.8 LANDSLIDE

HAZARD BACKGROUND

A landslide is the downhill movement of masses of soil and rock, driven by gravity. Landslides occur when susceptible rock, earth, or debris moves down a slope under the force of gravity and water. They can be triggered by natural changes, such as heavy rains, snow melt, fires, and earthquakes; and human-caused changes, such as slope or drainage modifications. Landslides may be very small or very large and can move at slow to very high speeds.

There are several types of landslides: rock falls, rock topple, slides, and flows. Rock falls are rapid movements of bedrock, which result in bouncing or rolling. A topple is a section or block of rock that rotates or tilts before falling to the slope below. Slides are movements of soil or rock along a distinct surface of rupture, which separates the slide material from the more stable underlying material. Mudflows, sometimes referred to as mudslides, mudflows, lahars or debris avalanches, are fast-moving rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as heavy rainfall or rapid snowmelt, changing the soil into a flowing river of mud or "slurry." Slurry can flow rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. As the flows reach flatter ground, the mudflow spreads over a broad area where it can accumulate in thick deposits.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly.

Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, and developed hillsides where leach-field septic systems are used. Areas that are typically considered safe from landslides include areas that have not moved in the past, relatively flat-lying areas away from sudden changes in slope, and areas at the top or along ridges set back from the tops of slopes.

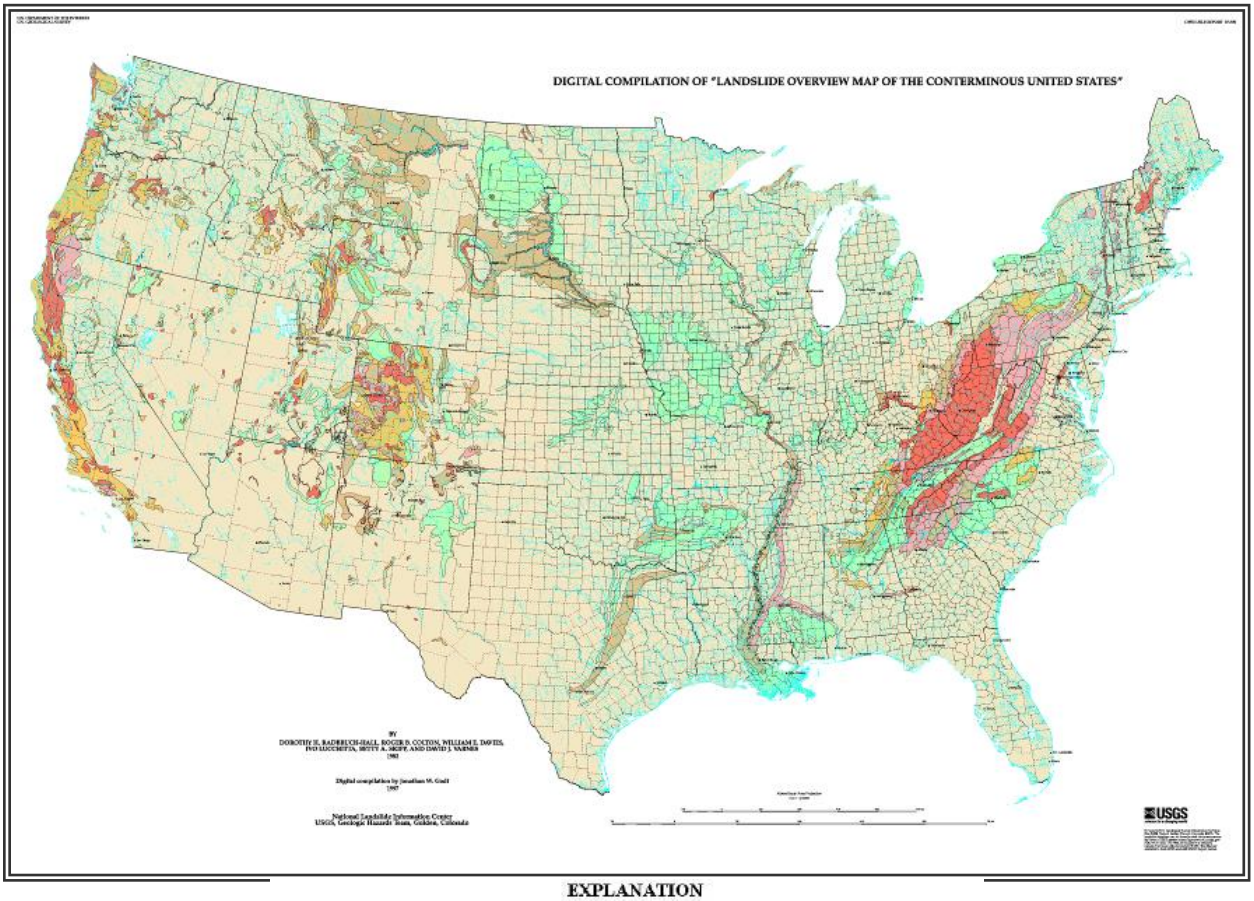
Warning Time: 3 – 6 to 12 hours

Duration: 1 – Less than 6 hours

LOCATION

The U.S. Geological Survey (USGS) has produced landslide susceptibility and incidence mapping of the U.S., as shown in Figure 4.22. The USGS determines susceptibility based on the probable degree of response to cutting or loading of slopes or to anomalously high precipitation. Incidence is measured by the rate of past occurrences. According to the USGS definition and mapping, most of Wake County faces low susceptibility and incidence of landslide. However, areas along the western border of county, including portions of Apex, Cary, and Morrisville, face moderate susceptibility to and incidence of landslide.

Figure 4.22 – Landslide Incidence and Susceptibility



Source: USGS

EXTENT

Landslide extent can be defined by susceptibility and incidence, which are defined and depicted in Figure 4.22. Event magnitude is also dependent on topography; landslide risk is higher in areas with steeper slopes. Given the gentle topography of most of the county, the magnitude of any landslides in the planning area would be minor.

The event that occurred in Holly Springs in 2003 defines the potential extent of damages that may occur because of landslide in Wake County. This event caused damages to multiple nearby homes but did not

result in any deaths or injuries.

Impact: 1 – Minor

Spatial Extent: 1 – Negligible

HISTORICAL OCCURRENCES

According to the North Carolina Department of Environmental Quality (NC DEQ), two recent landslides have occurred in Wake County and caused significant property damage. These event narratives from NC DEQ are reported below:

- *Interstate I-540, Wake County (summer 2000)* — While landslides are more frequent in the mountainous part of North Carolina, landslides also occur in other parts of the state. One landslide example occurred in the summer of 2000 along Interstate I-540 in Raleigh in Wake County.
- *Holly Springs, Wake County (summer 2003)* — Piedmont earth movements have affected homes as well. In May 2003 a soil embankment failure in Holly Springs, Wake County, North Carolina, affected a number of homes.

Figure 4.23 shows the location of all past landslide occurrences recorded by NC DEQ since 1995. Past landslide events have all occurred on the western side of the county, which is consistence with the susceptibility and incidence mapping produced by USGS. There have been two events in Raleigh, one in Cary, three in Apex, one in Holly Springs, and one in the unincorporated county.

The following event details were recorded in the NC Geological Survey's movement history records. Note that not all recorded landslide occurrences have an associated event narrative.

Cary, 1995 – Movement occurred in winter and spring of 1995 in Cary that appears to be threatening an apartment complex.

Southeast Durham, 1996 – A slide caused road damage, blocked a drainage ditch, and damaged a cut slope. I-540 and US-70 were affected.

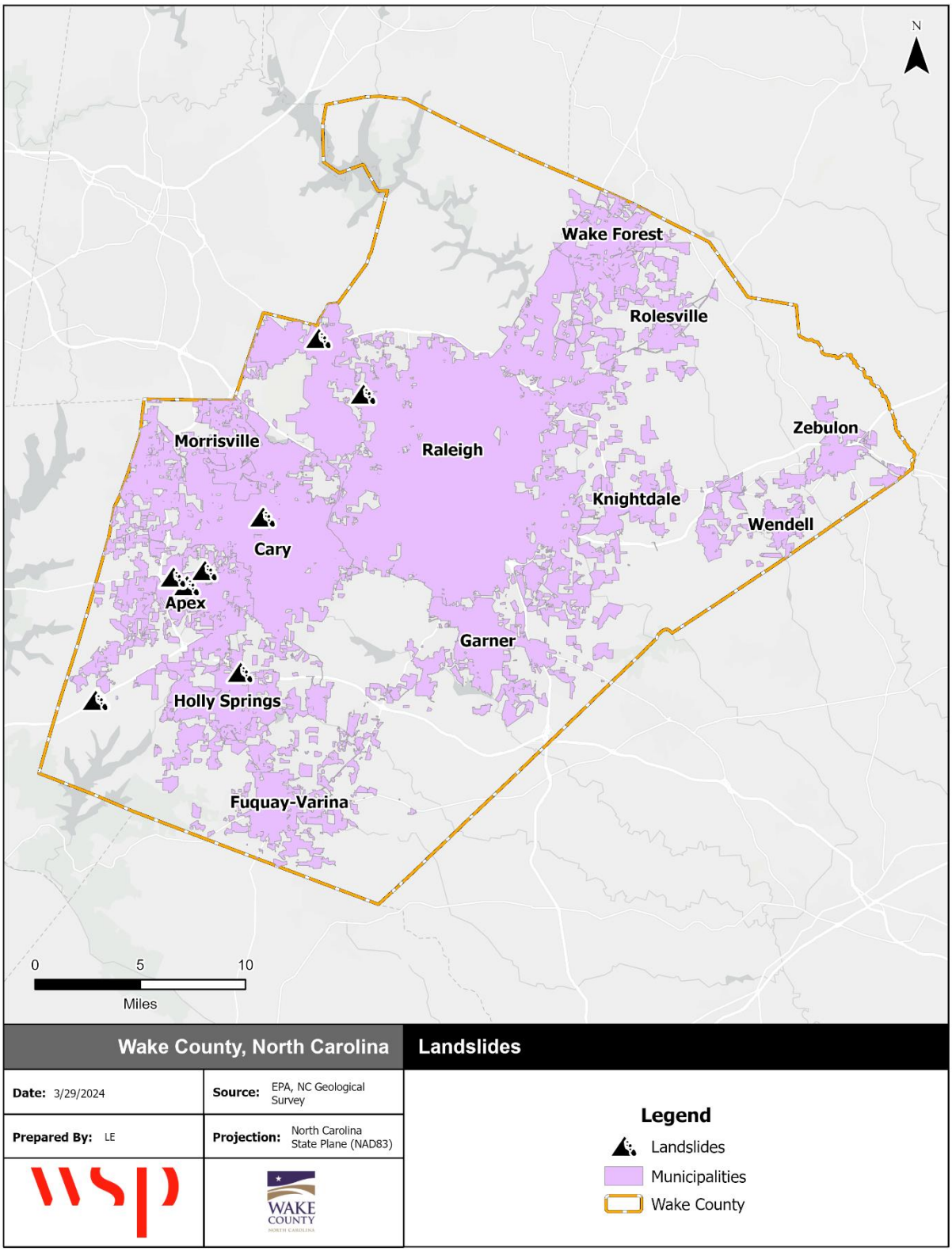
Apex, April 1998 – Evidence of failure seen on September 30, 1999. Failure was possibly associated with Hurricane Floyd.

West Raleigh, 1999 – Movement began in the winter of 1999 and caused road damage. Sediment covered Lynn Road. The slope was since stabilized with a gabion wall.

Holly Springs, 2003 – Damage caused to three homes in a subdivision. Scarp noted at the homes foundation.

Apex, 2006 – Movement occurred during Tropical Storm Alberto, however slow movement was noted by a neighbor approximately 4-6 weeks prior to failure. The damage threatened a retaining wall and a sewer line.

Figure 4.23 – Past Landslide Locations



Source: NC Geological Survey

PROBABILITY OF FUTURE OCCURRENCE

From 1995 through 2023 there have been eight landslide events in the planning area, which equates to an annual probability of 27.6 percent. This probability applies to Wake County and jurisdictions in western Wake County but reflects only the probability of a minor event. Jurisdictions in eastern Wake County that do not have any historical occurrences or susceptibility are unlikely to experience any landslide events in the future. Across all areas of the county, the probability of a severe landslide event is unlikely.

Probability: 1 – Unlikely

CLIMATE CHANGE

Water triggers landslides, and per the Fifth National Climate Assessment, frequency and intensity of heavy precipitation events is expected to increase across the country. Additionally, increases in temperatures and precipitation totals are expected in the Southeast. Increased flooding may also result from more intense tropical cyclone; researchers have noted the occurrence of more intense storms bringing greater rainfall totals, a trend that is expected to continue as ocean and air temperatures rise. More rainfall falling in more intense incidents could contribute to an increase in landslide events.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

This assessment of vulnerability to landslide in Wake County was based solely on records of past events. Data on susceptibility is limited for the planning area and only available in an area-wide aggregate.

PEOPLE

People are unlikely to sustain serious physical harm as a result of landslides in Wake County. Impacts would be relatively minor and highly localized. An individual using an impacted structure or infrastructure at the time of a landslide event may sustain minor injuries.

PROPERTY

Landslides are infrequent in Wake County and occur in small, highly localized instances relative to the general area of risk. Additionally, these events are generally small scale in terms of the magnitude of impacts. As a result, it is difficult to estimate the property at risk to landslide. On average, a landslide event in the planning area may cause minor to moderate property damage to one or more buildings or cause localized damage to infrastructure. A landslide event may also result in the need for debris removal.

ENVIRONMENT

Because landslides are essentially a mass movement of sediment, they may result in changes to terrain, damage to trees in the slide area, changes to drainage patterns, and increases in sediment loads in nearby waterways. Landslides in Wake County are unlikely to cause any more severe impacts.

CONSEQUENCE ANALYSIS

Table 4.96 summarizes the potential negative consequences of landslide.

Table 4.96 – Consequence Analysis - Landslide

Category	Consequences
Public	Any impacts to the public are expected to be minor. Individuals may sustain injuries if they are in an affected structure or using affected infrastructure when the event occurs.
Responders	Impacts to responders are unlikely. Personnel responsible for debris cleanup or roadway closures may face increased risk.
Continuity of Operations (including Continued Delivery of Services)	Landslide is unlikely to affect continuity of operations in Wake County.
Property, Facilities and Infrastructure	Buildings and infrastructure may incur minor damages as a result of landslide; however, vulnerability in Wake County is low.
Environment	Environmental impacts are expected to be minimal. Landslide may cause terrain and drainage changes and may temporarily increase sediment loads in nearby waterways.
Economic Condition of the Jurisdiction	Economic impacts are not expected.
Public Confidence in the Jurisdiction's Governance	Any landslide occurring in Wake County is unlikely to be severe and would not be expected to affect public confidence.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes landslide hazard risk by jurisdiction. Probability was determined to be slightly higher for jurisdictions in western Wake County where USGS mapping indicates there is moderate susceptibility and incidence. It should be noted that this probability rating reflects a low-consequence event and that the probability of a significant landslide is unlikely across the entire county. All other factors do not vary across jurisdictions.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	2	1	1	3	1	1.5	L
Apex	2	1	1	3	1	1.5	L
Cary	2	1	1	3	1	1.5	L
Fuquay-Varina	1	1	1	3	1	1.2	L
Garner	1	1	1	3	1	1.2	L
Holly Springs	2	1	1	3	1	1.5	L
Knightdale	1	1	1	3	1	1.2	L
Morrisville	2	1	1	3	1	1.5	L
Raleigh	2	1	1	3	1	1.5	L
Rolesville	1	1	1	3	1	1.2	L
Wake Forest	1	1	1	3	1	1.2	L
Wendell	1	1	1	3	1	1.2	L
Zebulon	1	1	1	3	1	1.2	L

4.5.9 SEVERE WEATHER (THUNDERSTORM WINDS, LIGHTNING & HAIL)

HAZARD BACKGROUND

THUNDERSTORM WINDS

Thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of greater than 35,000 ft. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth‘s surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of air that spreads out at earth‘s surface and causes strong winds associated with thunderstorms.

There are four ways in which thunderstorms can organize: single cell, multi-cell cluster, multi-cell lines (squall lines), and supercells. Even though supercell thunderstorms are most frequently associated with severe weather phenomena, thunderstorms most frequently organize into clusters or lines. Warm, humid conditions are favorable for the development of thunderstorms. The average single cell thunderstorm is approximately 15 miles in diameter and lasts less than 30 minutes at a single location. However, thunderstorms, especially when organized into clusters or lines, can travel intact for distances exceeding 600 miles.

Thunderstorms are responsible for the development and formation of many severe weather phenomena, posing great hazards to the population and landscape. Damage that results from thunderstorms is mainly inflicted by downburst winds, large hailstones, and flash flooding caused by heavy precipitation. Stronger thunderstorms are capable of producing tornadoes and waterspouts. While conditions for thunderstorm conditions may be anticipated within a few hours, severe conditions are difficult to predict. Regardless of severity, storms generally pass within a few hours.

Warning Time: 4 – Less than six hours

Duration: 1 – Less than six hours

LIGHTNING

Lightning is a sudden electrical discharge released from the atmosphere that follows a course from cloud to ground, cloud to cloud, or cloud to surrounding air, with light illuminating its path. Lightning’s unpredictable nature causes it to be one of the most feared weather elements.

All thunderstorms produce lightning, which often strikes outside of the area where it is raining and is known to fall more than 10 miles away from the rainfall area. When lightning strikes, electricity shoots through the air and causes vibrations creating the sound of thunder. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. According to the CDC, on average, 28 people in the United States die each year from lightning strikes. Lightning strikes can also start building fires and wildland fires, and damage electrical systems and equipment.

The watch/warning time for a given storm is usually a few hours. There is no warning time for any given lightning strike. Lightning strikes are instantaneous. Storms that cause lightning usually pass within a few hours.

Warning Time: 4 – Minimal or no warning time (less than 6 hours warning)

Duration: 1 – Less than six hours

HAIL

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere causing them to freeze. The raindrops form into small frozen droplets and then continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen rain droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 mph, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 mph. The largest hailstone recorded in the United States was found in Vivian, South Dakota on July 23, 2010; it measured eight inches in diameter, almost the size of a soccer ball. While soccer-ball-sized hail is the exception, but even small pea sized hail can do damage.

Hailstorms in North Carolina cause damage to property, crops, and the environment, and kill and injure livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans; occasionally, these injuries can be fatal.

The onset of thunderstorms with hail is generally rapid. However, advancements in meteorological forecasting allow for some warning. Storms usually pass in a few hours.

Warning Time: 4 – Less than 6 hours

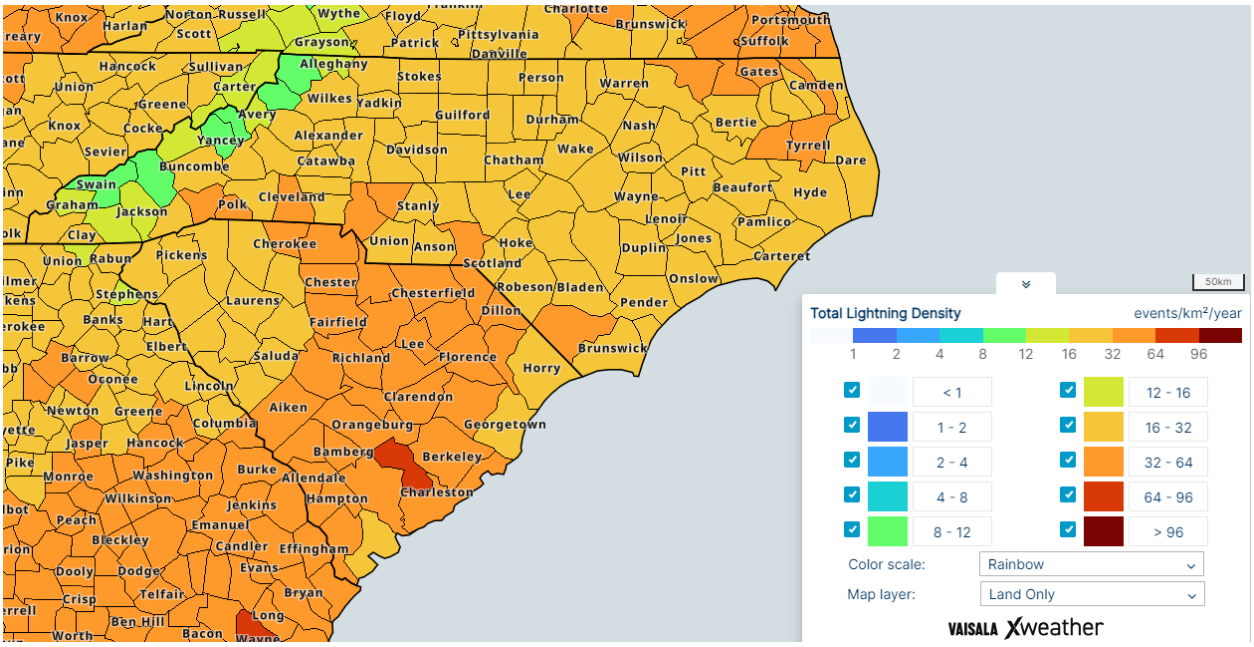
Duration: 1 – Less than 6 hours

LOCATION

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. The scope of lightning and hail is generally defined to the footprint of its associated thunderstorm. The entirety of Wake County shares equal risk to the threat of severe weather.

According to the Vaisala Interactive Global Lightning Density Map, shown in Figure 4.24, the majority of Wake County is located in an area that experiences 16 to 32 lightning events per square mile per year. It should be noted that future lightning occurrences may exceed these figures.

Figure 4.24 – Total Lightning Density (2016-2022)



Source: Vaisala Interactive Global Lightning Density Map

EXTENT

THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. NCEI divides wind events into several types including High Wind, Strong Wind, Thunderstorm Wind, Tornado and Hurricane. For this severe weather risk assessment, High Wind, Strong Wind and Thunderstorm Wind data was collected. Hurricane Wind and Tornadoes are addressed as individual hazards. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event in the county occurred on January 11, 2014 with a measured gust of 86 mph at Raleigh-Durham International Airport and estimated gusts of 86 mph elsewhere across the county. The event caused one fatality, four injuries, and an estimated $1.35 million in property damage.

Impact: 2 – Limited

Spatial Extent: 4 – Large

LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL is a common parameter that is part of fire weather forecasts nationwide.

Table 4.97 – Lightning Activity Level Scale

Lightning Activity Level Scale	
LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning

Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

Impact: 1 – Minor

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall. All of Wake County is uniformly exposed to the threat of lightning.

Spatial Extent: 1 – Negligible

HAIL

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4.98 indicates the hailstone measurements utilized by the National Weather Service.

Table 4.98 – Hailstone Measurement Comparison Chart

Average Diameter	Corresponding Household Object
0.25 inch	Pea
0.5 inch	Marble/Mothball
0.75 inch	Dime/Penny
0.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball

Average Diameter	Corresponding Household Object
1.75 inch	Golf ball
2.0 inch	Hen egg
2.5 inch	Tennis ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table 4.99 describes typical intensity and damage impacts of the various sizes of hail.

Table 4.99 – Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
Hard Hail	5-9	0.2-0.4	Pea	No damage
Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	31-40	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	76-90	3.0-3.5	Large orange > softball	Severe damage to aircraft bodywork
Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 1998 and 2023 in Wake County was a little over 1" in diameter; the second largest hailstone was 2.75", recorded on September 1, 2017. This storm resulted in a recorded $10 million in property damage per NCEI. The largest hailstone ever recorded in the U.S. fell in Vivian, SD on June 23, 2010, with a diameter of 8 inches and a circumference of 18.62 inches.

Impact: 1 – Minor

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. Wake

County is uniformly exposed to severe thunderstorms; therefore, the entire planning area is equally exposed to hail which may be produced by such storms. However, large-scale hail tends to occur in a more localized area within the storm.

Spatial Extent: 2 – Small

HISTORICAL OCCURRENCES

THUNDERSTORM WINDS

Between January 1, 1998 and December 31, 2023, the NCEI recorded 540 separate incidents of thunderstorm winds, occurring on 253 separate days. These events caused $4,308,250 in recorded property damage, 14 injuries and 2 fatalities. The recorded gusts averaged 58.3 mph, with the highest gusts recorded at 86 mph. Gusts of 86 mph were recorded six times in the county, all during a storm on January 11, 2014. Of these events, 200 caused property damage. Wind gusts with property damage recorded averaged $21,541 in damage, with two gusts causing a reported $1,000,000 in damage each (in Wilbon on January 11, 2014 and in Morrisville on June 13, 2013). These incidents are recorded below:

Table 4.100 – Recorded Thunderstorm Winds with Property Damages in Wake County, 1998-2023

Location	Date	Time	Wind Speed (mph)	Fatalities	Injuries	Property Damage
FUQUAY SPGS	4/19/1998	1835	58	0	0	$25000
BAYLEAF	8/15/2008	1512	58	0	0	$15000
WILDERS GROVE	7/1/2009	2246	58	0	0	$2000
RALEIGH	7/1/2009	2246	58	0	0	$1000
HOLLY SPGS	7/31/2009	1250	58	0	0	$100000
KNIGHTDALE	6/13/2010	1640	58	0	0	$1000
MILLBROOK	7/29/2010	2135	58	0	0	$1000
ZEBULON	11/17/2010	35	58	0	0	$7000
ROYAL MILLS	3/23/2011	1907	58	0	0	$20000
APEX	4/5/2011	300	58	0	0	$30000
ASBURY	5/9/2012	1523	58	0	0	$2000
PURNELL	6/29/2012	2208	58	0	0	$5000
BARHAM	7/1/2012	1410	58	0	0	$1000
MILLBROOK	7/3/2012	1915	58	0	0	$2000
BANKS	7/3/2012	2007	58	0	0	$2000
COLLEGE VIEW	7/4/2012	1612	58	0	0	$5000
RALEIGH	7/4/2012	1530	58	0	0	$1000
WILDERS GROVE	7/5/2012	1440	58	0	0	$3000
EAGLE ROCK	7/5/2012	1506	58	0	0	$3000
MACEDONIA	7/5/2012	1454	58	0	0	$2000
APEX	7/6/2012	1635	58	0	0	$2000
HOLLY SPGS	7/9/2012	1435	58	0	0	$3000
VARINA	7/9/2012	1351	58	0	0	$500
RALEIGH	7/24/2012	1449	58	0	0	$10000
APEX	7/24/2012	1433	58	0	0	$7000
METHOD	7/24/2012	1455	58	0	0	$5000
ECHO HGTS	7/24/2012	1449	58	0	0	$2000
AUBURN	7/24/2012	1451	58	0	0	$2000

Location	Date	Time	Wind Speed (mph)	Fatalities	Injuries	Property Damage
BAYLEAF	8/8/2012	1759	58	0	0	$750
GREEN LEVEL	4/19/2013	1735	58	0	0	$7000
MORRISVILLE	6/13/2013	1630	70	0	0	$1000000
BRENTWOOD	7/24/2013	1640	58	0	0	$2000
MACEDONIA	8/10/2013	1615	58	0	0	$5000
WILBON	1/11/2014	1352	86	0	0	$1000000
(RDU)RALEIGH-DURHAM	1/11/2014	1403	86	0	0	$350000
(RDU)RALEIGH-DURHAM	6/11/2014	1615	58	0	0	$5000
PURNELL	6/19/2014	1645	58	0	0	$500
APEX	7/15/2014	1610	58	0	0	$1000
APEX	7/15/2014	1618	58	0	0	$500
LEESVILLE	8/12/2014	1816	58	0	0	$2000
MACEDONIA	8/18/2014	1850	58	0	0	$1000
(RDU)RALEIGH-DURHAM	8/20/2014	1655	58	0	0	$25000
GARNER	8/20/2014	1800	58	0	0	$10000
GARNER	8/20/2014	1757	58	0	0	$2000
CARY	6/17/2015	2123	58	0	0	$15000
PET XRDS	6/20/2015	1950	58	0	0	$20000
PET XRDS	6/20/2015	1950	58	0	0	$20000
WILLIAMS XRDS	6/26/2015	1500	58	0	0	$1000
AUBURN	7/13/2015	629	58	0	0	$5000
MC CULLERS	7/13/2015	630	58	0	0	$2000
MORRISVILLE	7/21/2015	1815	58	0	0	$1000
COLLEGE VIEW	2/16/2016	604	58	0	0	$15000
STARMOUNT	2/24/2016	1746	58	0	0	$50000
FUQUAY SPGS	3/14/2016	1358	58	0	0	$5000
MACEDONIA	4/28/2016	1638	58	0	0	$10000
LASSITER	4/28/2016	1730	58	0	0	$1000
LASSITER	5/2/2016	1605	58	0	0	$2500
CARALEIGH	6/4/2016	1840	58	0	0	$1500
(RDU)RALEIGH-DURHAM	6/5/2016	1815	59	0	0	$2500
ROCKTON	6/23/2016	0	58	0	0	$2500
BONSAL	6/29/2016	1815	58	0	0	$2000
RALEIGH	6/29/2016	1909	58	0	0	$1500
KNIGHTDALE	7/19/2016	2140	58	0	0	$2500
WILDERS GROVE	9/30/2016	911	58	0	0	$5000
BROOKHAVEN	5/11/2017	2039	58	0	0	$75000
RALEIGH	6/16/2017	1857	58	0	0	$10000
VARINA	6/16/2017	1820	58	0	0	$500
WENDELL ARPT	7/8/2017	1812	58	0	0	$2000
MILLBROOK	7/13/2017	1830	58	0	0	$10000

Location	Date	Time	Wind Speed (mph)	Fatalities	Injuries	Property Damage
FUQUAY SPGS	7/16/2017	1628	58	0	0	$500
LEESVILLE	7/23/2017	1720	58	0	0	$8000
LASSITER	8/23/2017	1453	58	0	0	$10000
BROOKHAVEN	9/1/2017	1721	58	0	0	$4000
WILLOW SPGS	4/15/2018	2105	58	0	0	$10000
RALEIGH ARPT	5/10/2018	1930	58	0	0	$5000
BAYLEAF	6/10/2018	2310	58	0	0	$2000
RALEIGH	7/6/2018	1516	58	0	0	$5000
RALEIGH	7/6/2018	1517	58	0	0	$5000
WENDELL	7/28/2018	1758	58	0	0	$1500
KNIGHTDALE WNDLL ARP	7/28/2018	1745	58	0	0	$500
APEX	8/2/2018	1412	58	0	0	$10000
SOUTH RALEIGH ARPT	8/3/2018	1412	58	0	0	$1500
HOLLY SPGS	8/8/2018	1732	58	0	0	$500
CARALEIGH	9/27/2018	1855	58	0	0	$2500
ASBURY	4/8/2019	1857	58	0	0	$15000
SIX FORKS	4/8/2019	1752	58	0	0	$1000
WILLOW	4/12/2019	1756	58	0	0	$5000
RALEIGH	4/14/2019	2348	58	0	0	$4000
RALEIGH ARPT	4/15/2019	16	58	0	0	$5000
PET XRDS	4/19/2019	1625	58	0	0	$5000
GARNER	4/19/2019	1616	58	0	0	$500
WILLOW SPGS	5/4/2019	1918	58	1	1	$10000
WILDERS GROVE	6/20/2019	1524	58	0	0	$1500
RALEIGH	6/30/2019	1623	58	0	0	$100000
WILDERS GROVE	6/30/2019	1631	58	0	0	$25000
MILLBROOK	6/30/2019	1623	58	0	0	$20000
RALEIGH	6/30/2019	1623	58	0	0	$15000
WILDERS GROVE	6/30/2019	1631	58	0	0	$5000
WILLOW	7/4/2019	1543	58	0	0	$15000
AUBURN	7/4/2019	1508	58	0	0	$2000
AUBURN	7/11/2019	1818	58	0	0	$3000
SIX FORKS	7/11/2019	1813	58	0	0	$1000
CAMP POLK	7/16/2019	1333	58	0	0	$2000
MILLBROOK	8/1/2019	1348	58	0	0	$5000
WILDERS GROVE	8/1/2019	1417	58	0	0	$5000
HOLLY SPGS	8/7/2019	2310	58	0	0	$10000
APEX	8/7/2019	2318	58	0	0	$3000
APEX	8/7/2019	2311	58	0	0	$2000
MACEDONIA	8/7/2019	2321	58	0	0	$1000
KNIGHTDALE	8/8/2019	12	58	0	0	$2000
RALEIGH	8/19/2019	1523	58	0	0	$5000

Location	Date	Time	Wind Speed (mph)	Fatalities	Injuries	Property Damage
KNIGHTDALE WNDLL ARP	8/19/2019	1600	58	0	0	$2000
FORESTVILLE	8/22/2019	1423	58	0	0	$15000
PURNELL	8/22/2019	1409	58	0	0	$10000
RALEIGH	8/22/2019	1800	58	0	0	$10000
BRENTWOOD	8/22/2019	1805	58	0	0	$1500
MC CULLERS	10/31/2019	1949	58	0	0	$2500
WESTOVER	1/12/2020	15	58	0	0	$10000
ASBURY	1/12/2020	14	58	0	0	$2500
BARHAM	2/6/2020	1425	58	0	0	$250000
NEUSE	2/6/2020	1410	58	0	0	$50000
BROOKHAVEN	2/6/2020	1407	58	0	0	$20000
HOPKINS	2/6/2020	1426	58	0	0	$10000
CARY	2/6/2020	1400	58	0	0	$5000
CARALEIGH	2/6/2020	1416	58	0	0	$2500
BARHAM	2/6/2020	1417	58	0	0	$2500
SIX FORKS	2/6/2020	1406	58	0	0	$1500
SIX FORKS	2/6/2020	1410	58	0	0	$1500
BARHAM	2/6/2020	1417	58	0	0	$1500
WILLIAMS XRDS	2/6/2020	1440	58	0	0	$1000
WILDERS GROVE	4/8/2020	1853	58	0	0	$2500
ECHO HGTS	4/13/2020	651	58	0	0	$60000
MC CULLERS	4/13/2020	640	58	0	0	$50000
MC CULLERS	4/13/2020	635	58	0	0	$20000
RALEIGH	4/13/2020	650	58	0	0	$20000
GARNER	4/13/2020	635	58	0	0	$10000
LASSITER	4/13/2020	655	58	0	0	$10000
BAYLEAF	4/26/2020	1928	58	0	0	$25000
BAYLEAF	4/26/2020	1930	58	0	0	$1500
EAGLE ROCK	6/30/2020	1430	58	0	0	$15000
BANKS	7/13/2020	1855	58	0	0	$5000
KNIGHTDALE WNDLL ARP	7/18/2020	1450	58	0	0	$20000
ROCKTON	7/23/2020	1343	58	0	0	$20000
ROCKTON	7/23/2020	1347	58	0	0	$20000
MC CULLERS	7/23/2020	1624	58	0	0	$10000
ROCKTON	7/23/2020	1410	58	0	0	$5000
CARY	7/24/2020	1820	58	0	0	$3000
ZEBULON	8/6/2020	1451	58	0	0	$5000
LEESVILLE	9/25/2020	1915	58	0	0	$10000
MILLBROOK	3/27/2021	1605	58	0	0	$5000
APEX	7/1/2021	2045	58	0	0	$5000
MACEDONIA	7/9/2021	1700	58	0	0	$5000
KNIGHTDALE	4/26/2022	1515	58	0	0	$25000
GREEN LEVEL	4/26/2022	1438	58	0	0	$2500

Location	Date	Time	Wind Speed (mph)	Fatalities	Injuries	Property Damage
BAYLEAF	5/23/2022	1516	58	0	0	$5000
AUBURN	5/27/2022	1638	58	0	0	$10000
GARNER	5/27/2022	1634	58	0	0	$5000
ECHO HGTS	6/8/2022	1812	58	0	0	$10000
WILDERS GROVE	6/16/2022	1650	58	0	0	$2500
ECHO HGTS	6/16/2022	1648	58	0	0	$1000
CARALEIGH	6/16/2022	1648	58	0	0	$1000
ECHO HGTS	6/16/2022	1648	58	0	0	$1000
ECHO HGTS	6/16/2022	1652	58	0	0	$1000
WILDERS GROVE	6/16/2022	1652	58	0	0	$1000
GARNER	6/16/2022	1652	58	0	0	$1000
GARNER	6/17/2022	1741	58	0	0	$25000
FUQUAY SPGS	6/17/2022	1739	58	0	0	$10000
MACEDONIA	6/17/2022	1728	58	0	1	$5000
NEUSE	6/17/2022	1731	58	0	0	$5000
ECHO HGTS	6/17/2022	1743	58	0	0	$5000
CARY	6/17/2022	1725	58	0	0	$1000
MC CULLERS	6/17/2022	1733	58	0	0	$1000
PET XRDS	7/6/2022	1745	58	0	0	$5000
PET XRDS	7/6/2022	1759	58	0	0	$5000
WAKE XRDS	7/6/2022	1800	58	0	0	$5000
AUBURN	7/7/2022	1644	58	0	0	$10000
RALEIGH	7/7/2022	1730	58	0	0	$5000
MC CULLERS	7/25/2022	2042	58	0	0	$5000
AUBURN	7/26/2022	1417	58	0	0	$10000
LEESVILLE	7/26/2022	1339	58	0	0	$5000
MILLBROOK	7/29/2022	1934	58	0	0	$5000
GARNER	8/10/2022	1617	58	0	0	$10000
ASBURY	8/11/2022	1758	58	0	0	$5000
MC CULLERS	9/12/2022	1839	58	0	0	$10000
BAYLEAF	4/30/2023	1350	58	0	0	$2500
GARNER	5/16/2023	2212	58	0	0	$20000
SIX FORKS	6/16/2023	1646	58	0	0	$5000
CARY	6/26/2023	2137	58	0	0	$30000
BROOKHAVEN	6/26/2023	2135	58	0	0	$5000
MACEDONIA	6/26/2023	2145	58	0	0	$5000
LEESVILLE	7/7/2023	1628	58	0	0	$5000
HOLLAND	7/7/2023	1805	58	0	0	$5000
CAMP POLK	7/9/2023	1241	58	0	0	$5000
WILDERS GROVE	7/9/2023	1252	58	0	0	$5000
SOUTH RALEIGH ARPT	7/9/2023	1258	58	0	0	$5000
RALEIGH	7/9/2023	1309	58	0	0	$5000
MILLBROOK	8/7/2023	1837	58	0	0	$7500
RALEIGH ARPT	8/7/2023	1825	58	0	0	$5000

Location	Date	Time	Wind Speed (mph)	Fatalities	Injuries	Property Damage
PURNELL	8/15/2023	1536	58	0	0	$1500
WILLOW SPGS	9/8/2023	1446	58	0	0	$5000
			Total	**1**	**2**	**$4,308,250**

Source: NCEI

In addition to recorded thunderstorm wind events, NCEI reports 22 high wind and strong wind events during this same period that caused $2,678,000 in property damage. Of all 562 wind events during this period, there were 8 incidents that directly caused deaths or injuries. These incidents are recorded below:

Table 4.101 – Recorded Wind Events with Injuries and/or Fatalities, 1998-2023

Location	Event Type	Date	Wind Speed (mph)	Fatalities	Injuries	Property Damage
Raleigh	Thunderstorm Wind	8/21/2007	58	0	8	$0
Neuse	Thunderstorm Wind	1/11/2014	86	1	2	$0
Forestville	Thunderstorm Wind	1/11/2014	86	0	1	$0
Brookhaven	Thunderstorm Wind	1/11/2014	86	0	1	$0
Wake (Zone)	Strong Wind	10/8/2016	39	1	0	$500,000
Willow Spgs	Thunderstorm Wind	5/4/2019	58	1	1	$10,000
Wake (Zone)	Strong Wind	2/7/2020	40	0	1	$15,000
Macedonia	Thunderstorm Wind	6/17/2022	58	0	1	$5,000
			Total	**3**	**15**	**$530,000**

Source: NCEI

LIGHTNING

According to NCEI data, there were 41 lightning strikes reported between 1998 and 2023. Of these, 33 recorded property damage totaling over $2.69 million, four directly caused fatalities, and one injury. Event narratives indicate in some cases that property damage occurred but was not estimated; therefore, actual property damage amounts are higher. No crop damage was recorded by these strikes. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred in Wake County. Table 4.102 details NCEI-recorded lightning strikes from 1998 through 2023.

Table 4.102 – Recorded Lightning Strikes in Wake County, 1998-2023

Location	Date	Time	Fatalities	Injuries	Property Damage
Wake Forest	1/16/1998	1900	0	0	$35,000
Cary	5/3/1998	1650	0	0	$50,000
Falls	7/24/1999	1515	1	0	$0
Cary	9/3/2000	1820	0	0	$0
Fuquay Springs	6/22/2001	1614	0	0	$0
Wendell	8/22/2003	1405	0	0	$450,000
Cary	3/7/2005	1240	0	0	$20,000
Knightdale	7/13/2005	2342	1	0	$0
Raleigh	4/3/2006	900	0	0	$0
Raleigh	4/22/2006	1200	0	0	$0
Raleigh	8/15/2008	1500	0	0	$200,000

Location	Date	Time	Fatalities	Injuries	Property Damage
Forestville	7/1/2009	2215	0	0	$5,000
Holly Springs	6/2/2010	1420	0	0	$1,000,000
Willow	6/2/2010	1440	0	0	$25,000
Upchurch	6/15/2010	1810	0	0	$50,000
Upchurch	6/22/2010	1815	0	0	$125,000
Macedonia	7/16/2010	1944	0	0	$10,000
Knightdale	7/17/2010	1200	0	0	$10,000
Wilders Grove	7/17/2010	1308	0	0	$10,000
Leesville	7/20/2010	1757	0	0	$15,000
Falls	7/20/2010	1830	0	0	$10,000
Apex	7/27/2010	1146	0	0	$5,000
Six Forks	7/29/2010	2120	0	0	$2,000
Holly Springs	7/29/2010	2245	0	0	$300,000
Cary	2/28/2011	1910	0	0	$5,000
Cary	2/28/2011	1910	0	0	$5,000
Cary	7/24/2011	1425	0	0	$15,000
Wyatt	5/9/2012	1545	0	0	$5,000
Morrisville	7/6/2012	1600	0	0	$5,000
Upchurch	7/6/2012	1625	0	0	$5,000
Varina	2/19/2014	500	0	0	$30,000
Macedonia	4/9/2015	1915	1	0	$0
Auburn	7/13/2015	640	0	0	$25,000
Knightdale	7/28/2018	1330	1	1	$0
Lassiter	8/22/2019	1830	0	0	$50,000
Raleigh Arpt	7/23/2020	1744	0	0	$25,000
Bayleaf	5/6/2022	1508	0	0	$12,000
Fawlers	8/10/2022	1606	0	0	$25,000
South Raleigh Arpt	3/2/2023	405	0	0	$100,000
Cario	4/7/2023	600	0	0	$50,000
Brookhaven	7/7/2023	1744	0	0	$20,000
		Total	**4**	**1**	**$2,699,000**

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Wake County:

July 24, 1999 – A 24-year-old male was stepping from a boat to a dock when he was struck by lightning; he never regained consciousness and died the next day.

July 13, 2005 – A smoldering tree which had been struck by lightning a few hours earlier fell, killing a firefighter.

April 9, 2015 – A 28-year-old male was struck and killed by lightning in the parking lot of a shopping center.

July 28, 2018 - A 41-year-old male was struck by lightning and was taken to the hospital to be treated for his injuries. The victim subsequently passed away from his injuries.

March 2, 2023 - A home was reported on fire from a lightning strike along Walnut Cove Drive.

Twenty of the 27 incidents recorded by the NCEI included property damage, which was mostly recorded

as fire damage ignited by lightning. The highest rate of property damage recorded for a single incident was $1,000,000.

HAIL

NCEI records 298 separate hail incidents across 116 days between January 1, 1998 and December 31, 2023 in Wake County. Of these, three events were reported to have caused property damage and none caused death, injury or crop damage. The largest diameter hail recorded in the County was 4" in Raleigh on March 28, 2005; the average hail size in all storms was a little over one inch in diameter.

Table 4.103 – Summary of Hail Occurrences by Jurisdiction

Location	Number of Occurrences	Average Hail Diameter
Apex	21	1.19"
Cary	19	1.02"
Fuquay-Varina	15	1.13"
Garner	13	1.14"
Holly Springs	10	.88"
Knightdale	7	.96"
Morrisville	14	1.12"
Raleigh	50	1.08"
Rolesville	6	1.04"
Wake Forest	9	1.11"
Wendell	4	.75"
Zebulon	4	1.03"
Unincorporated Wake County	126	1.12"

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

June 15, 1998 – Dime size hail fell in north Raleigh. This storm also produced very heavy rain and frequent lightning across much of northern Wake County from near the RDU Airport to Falls Lake and north Raleigh.

July 10, 2003 – Tobacco fields were damaged by large hail.

March 28, 2005 – 3.5 to 4 inch elongated hail reported at I-540 and Falls of Neuse Road. 3 inch hail reported at Strickland and Falls of Neuse Roads. 2 inch hail reported in Five Points. Golf ball sized hail reported at Cameron Village, Atlantic and New Hope Church Roads, North Raleigh Community Hospital, Green and Lee Spring Roads, and Durant and Falls of Neuse Roads. Ping pong ball sized hail reported on Wake Forest Road. Quarter to half dollar sized hail reported on Highwoods Road.

April 15, 2007 – Quarter size hail reported between Angier and Fuquay-Varina.

July 1, 2012 – A lee side surface trough interacted with a very unstable atmosphere and produced clusters of showers and thunderstorms. Some of these storms became severe and produce large hail and damaging winds across all of central North Carolina.

September 1, 2017 – The remnants of Harvey increased the southwesterly flow over Central North Carolina as it moved northeastward through Tennessee and Kentucky. In the wake of the northward moving warm front, a cold front moved into and stalled over Central North Carolina providing lift in the strongly sheared, moist environment. The resulting thunderstorms became severe, producing damaging wind gusts, large hail and flash flooding.

April 8, 2020 - The combination of warm moist air and the passage of a mid level disturbance from the northwest produced multiple clusters and line segments of strong to severe storms moving across northern

portions of central North Carolina during the late afternoon into the evening. The storms produced multiple reports of wind damage, large hail and one measured wind gusts of 58 mile per hour.

March 28, 2021 - A line of showers and embedded thunderstorms in the morning hours of March 28th over eastern Tennessee and western North Carolina pushed eastward ahead of a strong cold front. These storms intensified during the afternoon hours across portions of central North Carolina, producing several reports of trees down and quarter size hail.

PROBABILITY OF FUTURE OCCURRENCE

Based on historical occurrences recorded by NCEI for the 25-year period from 1998 through 2023, Wake County averages 21.6 thunderstorm wind events per year. Over this same period, 41 lightning events were reported as having caused death, injury, or property damage, which equates to an average of 1.64 damaging lightning strikes per year.

The average hailstorm in Wake County occurs in late afternoon and has a hail stone with a diameter of an inch. Over the 25-year period from 1998 through 2023, Wake County experienced 298 reported hail incidents; this averages almost 12 reported incidents per year somewhere in the planning area, or a 100% chance that the County will experience a hail incident each year.

Based on these historical occurrences, there is a 100% chance that the County will experience severe weather each year. The probability of a damaging impacts is highly likely.

Probability: 4 – Highly Likely

CLIMATE CHANGE

Per the Fifth National Climate Assessment, "The complexes of thunderstorms that bring substantial precipitation to the central United States during the warm season have become more frequent and longer-lasting over the past two decades." As temperatures rise, the weather environments that give rise to severe thunderstorms in the spring and fall will increase. These changes are likely to lengthen the severe thunderstorm season throughout the Southeast during the cool-season months. Hail and lightning are often associated with thunderstorms and are predicted to follow a similar trend. Short-lived severe weather such as thunderstorm events are difficult to observe and the direct correlation of these events to climate change are still incomplete.

NASA measures thunderstorm potential with an index called the Convective Available Potential Energy (CAPE) index. This measures how warm and moist the air is, which is a major contributing factor in thunderstorm/tornado formation. NASA projects that by the period of 2072-2099, the CAPE in the southeastern United States will increase dramatically. Parts of North Carolina are in an area that will likely experience the greatest increase in CAPE in the United States and all of the state is likely to experience at least some increase.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Population and property at risk to wind events was estimated using data from the NCEM IRISK database, which was compiled in NCEM's Risk Management Tool.

PEOPLE

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes.

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damages. According to the 2022 American Community Survey (ACS) 5-Year Estimates, 12,462 occupied housing units (2.7 percent) in Wake County are classified as "mobile homes or other types of housing." Using the 2022 ACS persons per household estimate of 2.75, the population at risk due to their housing type was estimated at 34,270 residents. Individual who work outdoors may also face increased risk.

Since 1998, the NCEI records four fatalities and one injury attributed to lightning in Wake County. NCEI records 3 fatalities and 15 injuries attributed to wind events in Wake County. There are no injuries or fatalities attributed to hail.

PROPERTY

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Wake County, the vast majority of recorded property damage was due to structure fires.

NCEI records lightning impacts over 22 years (1998-2023), with $2,699,000 in property damage recorded (no incidents were recorded in 2016, 2017, or 2021). Historically, this has resulted in $122,681 in property impacts annually in Wake County. The average impact from lightning per incident in Wake County is $65,829.

General damages to property from hail are direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between January 1, 1998 and December 31, 2023 in Wake County, NCEI reported $110 million in property damage as a direct result of hail. This averages to $4.4 million per year in reported damages due to hail, though it should be noted that the $110 million in recorded damage was all due to only three separate storms during this time.

According to a National Insurance Crime Bureau (NICB) study of insurance claims from the Insurance Services Office (ISO) ClaimSearch database, between 2017 and 2019, North Carolina saw 58,342 separate hail damage claims. It should be noted that property damage due to hail is usually insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damages in Wake County, thus the NCEI is still used to form a baseline.

When strong enough, wind events can cause significant direct damage to buildings and infrastructure. NCEM's IRISK database estimates damages from increasing magnitudes of wind events, detailed in Table 4.104 through Table 4.107.

Table 4.104 – Estimated Buildings Impacted by 50-Year Thunderstorm Winds

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$81,661,646	6,336	5%	$18,361,597	2,270	2%	$17,101,748	128,042	100%	$117,124,991
Apex	14,915	3,715	25%	14,089	94%	$8,797,770	671	4%	$666,483	155	1%	$249,865	14,915	100%	$9,714,118
Cary	45,306	7,401	16%	42,944	95%	$33,033,201	1,872	4%	$6,952,794	462	1%	$1,479,415	45,278	100%	$41,465,409
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$5,365,625	596	5%	$800,123	131	1%	$267,003	11,065	100%	$6,432,752
Garner	11,975	4,982	42%	11,103	93%	$4,947,010	687	6%	$761,435	181	2%	$215,958	11,971	100%	$5,924,403
Holly Springs	10,528	994	9%	10,208	97%	$5,838,284	248	2%	$593,888	68	1%	$119,841	10,524	100%	$6,552,013
Knightdale	7,144	1,696	24%	6,811	95%	$2,898,039	265	4%	$275,811	67	1%	$228,035	7,143	100%	$3,401,885
Morrisville	5,181	274	5%	4,793	93%	$3,567,760	340	7%	$1,774,735	48	1%	$122,300	5,181	100%	$5,464,795
Rolesville	2,103	808	38%	1,983	94%	$1,299,072	91	4%	$58,848	29	1%	$21,500	2,103	100%	$1,379,420
Wake Forest	10,547	1,459	14%	9,852	93%	$6,734,588	541	5%	$1,033,008	151	1%	$297,223	10,544	100%	$8,064,819
Wendell	3,728	1,536	41%	3,378	91%	$1,276,274	277	7%	$140,810	73	2%	$93,416	3,728	100%	$1,510,499
Zebulon	3,231	1,519	47%	2,809	87%	$1,135,076	336	10%	$437,177	84	3%	$104,479	3,229	100%	$1,676,733
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$34,185,517	3,183	5%	$5,119,120	403	1%	$692,778	59,849	100%	$39,997,415
TOTAL	**313,708**	**82,750**	**26%**	**294,007**	**94%**	**$190,739,862**	**15,443**	**5%**	**$36,975,829**	**4,122**	**1%**	**$20,993,561**	**313,572**	**100%**	**$248,709,252**

Source: NCEM Risk Management Tool

Table 4.105 – Estimated Buildings Impacted by 100-Year Thunderstorm Winds

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$128,714,289	6,336	5%	$33,040,955	2,270	2%	$30,446,268	128,042	100%	$192,201,511
Apex	14,915	3,715	25%	14,089	94%	$13,779,622	671	4%	$1,214,735	155	1%	$483,311	14,915	100%	$15,477,668
Cary	45,306	7,401	16%	42,944	95%	$51,345,150	1,872	4%	$12,594,032	462	1%	$2,727,029	45,278	100%	$66,666,211
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$8,292,115	596	5%	$1,530,383	131	1%	$499,919	11,065	100%	$10,322,417
Garner	11,975	4,982	42%	11,103	93%	$7,781,221	687	6%	$1,425,997	181	2%	$412,885	11,971	100%	$9,620,103
Holly Springs	10,528	994	9%	10,209	97%	$8,952,887	248	2%	$1,127,366	68	1%	$222,403	10,525	100%	$10,302,655
Knightdale	7,144	1,696	24%	6,811	95%	$4,524,674	265	4%	$516,869	67	1%	$417,503	7,143	100%	$5,459,045
Morrisville	5,181	274	5%	4,793	93%	$5,766,554	340	7%	$2,981,303	48	1%	$228,286	5,181	100%	$8,976,143
Rolesville	2,103	808	38%	1,983	94%	$1,980,105	91	4%	$102,001	29	1%	$35,562	2,103	100%	$2,117,667
Wake Forest	10,547	1,459	14%	9,852	93%	$10,566,637	541	5%	$1,802,458	151	1%	$530,608	10,544	100%	$12,899,702
Wendell	3,728	1,536	41%	3,378	91%	$2,000,680	277	7%	$257,441	73	2%	$175,742	3,728	100%	$2,433,862
Zebulon	3,231	1,519	47%	2,809	87%	$1,746,454	336	10%	$850,410	84	3%	$212,507	3,229	100%	$2,809,370
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$52,682,542	3,183	5%	$9,266,015	403	1%	$1,268,542	59,849	100%	$63,217,098
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$298,132,930**	**15,443**	**5%**	**$66,709,965**	**4,122**	**1%**	**$37,660,565**	**313,573**	**100%**	**$402,503,452**

Source: NCEM Risk Management Tool

Table 4.106 – Estimated Buildings Impacted by 300-Year Thunderstorm Winds

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$346,920,919	6,336	5%	$94,071,611	2,270	2%	$75,588,129	128,042	100%	$516,580,659
Apex	14,915	3,715	25%	14,089	94%	$37,746,433	671	4%	$3,510,927	155	1%	$1,567,112	14,915	100%	$42,824,472
Cary	45,306	7,401	16%	42,944	95%	$142,533,175	1,872	4%	$33,341,124	462	1%	$7,796,364	45,278	100%	$183,670,662
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$21,053,251	596	5%	$5,023,305	131	1%	$1,637,108	11,065	100%	$27,713,665
Garner	11,975	4,982	42%	11,103	93%	$18,621,802	687	6%	$4,345,869	181	2%	$1,339,071	11,971	100%	$24,306,742
Holly Springs	10,528	994	9%	10,209	97%	$22,641,894	248	2%	$3,369,973	68	1%	$728,400	10,525	100%	$26,740,268
Knightdale	7,144	1,696	24%	6,811	95%	$11,151,915	265	4%	$1,533,206	67	1%	$1,160,829	7,143	100%	$13,845,949
Morrisville	5,181	274	5%	4,793	93%	$15,973,924	340	7%	$8,206,253	48	1%	$694,380	5,181	100%	$24,874,557
Rolesville	2,103	808	38%	1,983	94%	$4,809,445	91	4%	$263,350	29	1%	$96,399	2,103	100%	$5,169,195
Wake Forest	10,547	1,459	14%	9,852	93%	$25,792,988	541	5%	$4,674,382	151	1%	$1,555,115	10,544	100%	$32,022,485
Wendell	3,728	1,536	41%	3,378	91%	$4,722,639	277	7%	$797,232	73	2%	$545,523	3,728	100%	$6,065,394
Zebulon	3,231	1,519	47%	2,809	87%	$4,092,035	336	10%	$2,920,006	84	3%	$895,839	3,229	100%	$7,907,880
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$125,340,906	3,183	5%	$24,088,330	403	1%	$3,963,426	59,849	100%	$153,392,662
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$781,401,326**	**15,443**	**5%**	**$186,145,568**	**4,122**	**1%**	**$97,567,695**	**313,573**	**100%**	**$1,065,114,590**

Source: NCEM Risk Management Tool

Table 4.107 – Estimated Buildings Impacted by 700-Year Thunderstorm Winds

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$628,588,213	6,336	5%	$161,945,081	2,270	2%	$115,839,165	128,042	100%	$906,372,458
Apex	14,915	3,715	25%	14,089	94%	$70,400,785	671	4%	$5,949,454	155	1%	$2,742,930	14,915	100%	$79,093,169
Cary	45,306	7,401	16%	42,944	95%	$269,656,415	1,872	4%	$53,121,526	462	1%	$13,082,531	45,278	100%	$335,860,473
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$37,666,982	596	5%	$9,371,231	131	1%	$3,113,939	11,065	100%	$50,152,152
Garner	11,975	4,982	42%	11,103	93%	$31,569,913	687	6%	$7,498,064	181	2%	$2,414,103	11,971	100%	$41,482,080
Holly Springs	10,528	994	9%	10,209	97%	$41,442,069	248	2%	$5,620,142	68	1%	$1,364,634	10,525	100%	$48,426,845
Knightdale	7,144	1,696	24%	6,811	95%	$19,359,471	265	4%	$2,615,372	67	1%	$1,921,880	7,143	100%	$23,896,724
Morrisville	5,181	274	5%	4,793	93%	$29,152,922	340	7%	$14,472,769	48	1%	$1,217,612	5,181	100%	$44,843,303
Rolesville	2,103	808	38%	1,983	94%	$8,295,647	91	4%	$423,875	29	1%	$165,725	2,103	100%	$8,885,247
Wake Forest	10,547	1,459	14%	9,852	93%	$44,789,310	541	5%	$7,746,348	151	1%	$2,790,105	10,544	100%	$55,325,762
Wendell	3,728	1,536	41%	3,378	91%	$7,860,005	277	7%	$1,444,310	73	2%	$953,122	3,728	100%	$10,257,437
Zebulon	3,231	1,519	47%	2,809	87%	$6,860,827	336	10%	$5,531,967	84	3%	$1,915,189	3,229	100%	$14,307,983
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$215,470,110	3,183	5%	$37,812,489	403	1%	$7,210,759	59,849	100%	$260,493,359
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$1,411,112,669**	**15,443**	**5%**	**$313,552,628**	**4,122**	**1%**	**$154,731,694**	**313,573**	**100%**	**$1,879,396,992**

Source: NCEM Risk Management Tool

Severe weather can also cause significant agricultural losses. Between 2007-2023, the sum of claims paid for crop damage due to hail and wind damages in Wake County was $1,442,272.26, or an average of $84,839.54 in losses every year. Table 4.108 summarizes the crop losses due to drought in reported in the RMA system.

Table 4.108 – Crop Losses Resulting from Severe Weather, 2007-2023

Year	Cause Description	Determined Acres	Indemnity Amount
2007	Hail	137.10	$263,755.00
2008	Hail	25.80	$61,333.00
2009	Hail	91.78	$133,582.00
2012	Hail	16.56	$11,728.00
2015	Hail	33.10	$34,456.00
2016	Hail	382.98	$132,304.30
2017	Hail	202.71	$198,752.00
2019	Hail	14.46	$34,996.99
2020	Hail	134.328	$356,122.4
2023	Hail	10	$17,392.6
	Hail Subtotal	**1,048.82**	**$835,910.30**
2012	Wind/Excess Wind	16.50	$13,756.00
2014	Wind/Excess Wind	7.92	$12,110.40
2015	Wind/Excess Wind	9.62	$21,951.00
2016	Wind/Excess Wind	174.55	$401,954.45
2018	Wind/Excess Wind	32.412	$ 50,828.40
2019	Wind/Excess Wind	24.75	$ 1,637.11
2020	Wind/Excess Wind	74.4	$ 53,439.60
2023	Wind/Excess Wind	40.4	$ 50,685.00
	Wind Subtotal	**380.52**	**$606,361.96**
	TOTAL	**1,429.37**	**$1,442,272.26**

Source: USDA Risk Management Agency

ENVIRONMENT

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

CONSEQUENCE ANALYSIS

Table 4.109 summarizes the potential negative consequences of severe weather.

Table 4.109 – Consequence Analysis – Severe Weather (Thunderstorm Winds, Lightning, and Hail)

Category	Consequences
Public	Injuries; fatalities
Responders	Injuries; fatalities; potential impacts to response capabilities due to storm impacts

Category	Consequences
Continuity of Operations (including Continued Delivery of Services)	Potential impacts to continuity of operations due to storm impacts; delays in providing services
Property, Facilities and Infrastructure	Possibility of structure fire ignition; potential for disruptions in power and communications infrastructure; destruction and/or damage to any exposed property, especially windows, cars and siding; mobile homes see increased risk
Environment	Potential fire ignition from lightning; hail damage to wildlife and foliage
Economic Condition of the Jurisdiction	Lightning damage contingent on target; can severely impact/destroy critical infrastructure and other economic drivers
Public Confidence in the Jurisdiction's Governance	Public confidence is not generally affected by severe weather events.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes severe weather hazard risk by jurisdiction. Most aspects of severe weather risk do not vary substantially by jurisdiction; however, wind and hail impacts may be greater in more highly developed areas with higher exposure in terms of both property and population density. Additionally, mobile home units are more vulnerable to wind damage. While mobile home units do not comprise a significant proportion of any jurisdictions housing mix, Wake County, Wake Forest, Morrisville, Cary, and Raleigh each have over 250 mobile home units in their jurisdiction and therefore may face more severe impacts from wind. Where priority ratings vary between thunderstorm wind, lightning, and hail for impact and spatial extent, these scores represent an average rating with greater weight given to thunderstorm wind because it occurs much more frequently.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	4	2	3	4	1	2.9	M
Apex	4	1	3	4	1	2.6	M
Cary	4	2	3	4	1	2.9	M
Fuquay-Varina	4	1	3	4	1	2.6	M
Garner	4	1	3	4	1	2.6	M
Holly Springs	4	1	3	4	1	2.6	M
Knightdale	4	1	3	4	1	2.6	M
Morrisville	4	2	3	4	1	2.9	M
Raleigh	4	2	3	4	1	2.9	M
Rolesville	4	1	3	4	1	2.6	M
Wake Forest	4	2	3	4	1	2.9	M
Wendell	4	1	3	4	1	2.6	M
Zebulon	4	1	3	4	1	2.6	M

4.5.10 SEVERE WINTER STORM

HAZARD BACKGROUND

A winter storm can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Events may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Some winter storms might be large enough to affect several states, while others might affect only localized areas. Occasionally, heavy snow might also cause significant property damages, such as roof collapses on older buildings.

All winter storm events have the potential to present dangerous conditions to the affected area. Larger snowfalls pose a greater risk, reducing visibility due to blowing snow and making driving conditions treacherous. A heavy snow event is defined by the National Weather Service as an accumulation of 4 of more inches in 12 hours or less. A blizzard is the most severe form of winter storm. It combines low temperatures, heavy snow, and winds of 35 miles per hour or more, which reduces visibility to a quarter mile or less for at least 3 hours. Winter storms are often accompanied by sleet, freezing rain, or an ice storm. Such freeze events are particularly hazardous as they create treacherous surfaces.

Ice storms are defined as storms with significant amounts of freezing rain and are a result of cold air damming (CAD). CAD is a shallow, surface-based layer of relatively cold, stably-stratified air entrenched against the eastern slopes of the Appalachian Mountains. With warmer air above, falling precipitation in the form of snow melts, then becomes either super-cooled (liquid below the melting point of water) or re-freezes. In the former case, super-cooled droplets can freeze on impact (freezing rain), while in the latter case, the re-frozen water particles are ice pellets (or sleet). Sleet is defined as partially frozen raindrops or refrozen snowflakes that form into small ice pellets before reaching the ground. They typically bounce when they hit the ground and do not stick to the surface. However, it does accumulate like snow, posing similar problems and has the potential to accumulate into a layer of ice on surfaces. Freezing rain, conversely, usually sticks to the ground, creating a sheet of ice on the roadways and other surfaces. All of the winter storm elements – snow, low temperatures, sleet, ice, etcetera – have the potential to cause significant hazard to a community. Even small accumulations can down power lines and trees limbs and create hazardous driving conditions and disrupt communication and power for days.

Advancements in meteorology and forecasting usually allow for mostly accurate forecasting a few days in advance of an impending storm. Most storms have a duration of a few hours; however, impacts can last a few days after the initial incident until cleanup is completed.

Warning Time: 1 – More than 24 hours

Duration: 3 – Less than 1 week

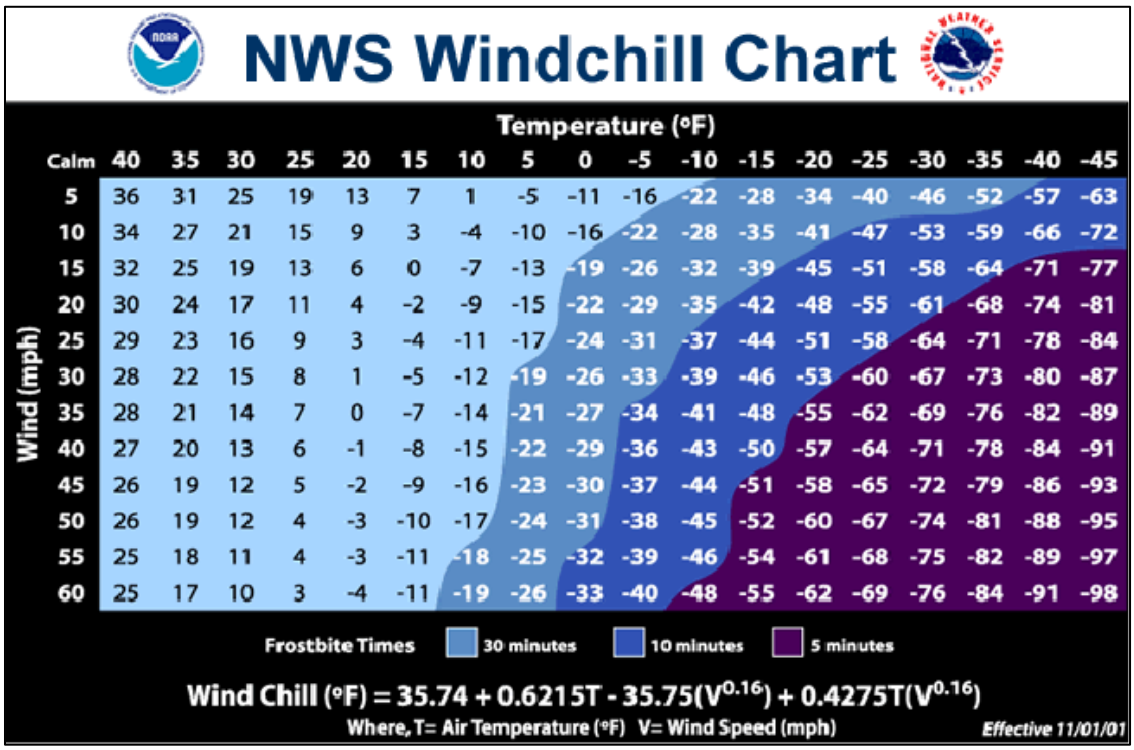
LOCATION

Severe winter storms are usually a countywide or regional hazard, impacting the entire county at the same time. The risk of a severe winter storm occurring is uniform across the County.

EXTENT

Severe winter storms often involve a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure 4.25, provides a formula for calculating the dangers of winter winds and freezing temperatures.

Figure 4.25 – NWS Wind Chill Temperature Index



Source: http://www.nws.noaa.gov/om/winter/windchill.shtml

The greatest snowfall amount recorded in the Wake County planning area was 17.8 inches, recorded on March 2, 1927 at the Raleigh weather station.

Impact: 2 – Limited

Spatial Extent: 4 – Large

The entirety of North Carolina is susceptible to winter storm and freeze events. Some ice and winter storms may be large enough to affect several states, while others might affect limited, localized areas. The degree of exposure typically depends on the normal expected severity of local winter weather. Wake County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, the entire County has uniform exposure to a winter storm.

HISTORICAL OCCURRENCES

To get a full picture of the range of impacts of a severe winter storm, data for the following weather types as defined by the National Weather Service (NWS) Raleigh Forecast Office and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures

reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.

- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24 hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

Summarized impacts from data collected for 1998 through 2023 are included in Table 4.110. Cumulatively, severe winter storms caused over $1 million in property damage. In this timeframe, the county experienced no fatalities, injuries or crop damage from severe winter storm, though these types of impacts are possible in future events. No blizzard, cold/wind chill, extreme cold/wind chill, frost/freeze, or sleet events were recorded. Impacts in Wake County by incident are recorded in Table 4.111.

Table 4.110 – Total Severe Winter Storm Impacts in Wake County, 1998-2023

Event Type	Number of Recorded Incidents	Total Fatalities	Total Injuries	Total Property Damage	Total Crop Damage
Winter Storm	28	0	0	$1,000,000	$0
Winter Weather	29	0	0	$40,000	$0
Ice Storm	1	0	0	0	$0
Heavy Snow	2	0	0	0	$0
Total	**60**	**0**	**0**	**$1,040,000**	**$0**

Source: NCEI

Table 4.111 – Recorded Severe Winter Storm Impacts in Wake County, 1998-2023

Date	Event Type	Fatalities	Injuries	Property Damage	Crop Damage
1/19/1998	Heavy Snow	0	0	0	0
11/19/2000	Heavy Snow	0	0	0	0
12/23/1998	Ice Storm	0	0	0	0
1/18/2000	Winter Storm	0	0	0	0
1/20/2000	Winter Storm	0	0	0	0
1/22/2000	Winter Storm	0	0	0	0

Date	Event Type	Fatalities	Injuries	Property Damage	Crop Damage
1/24/2000	Winter Storm	0	0	0	0
1/28/2000	Winter Storm	0	0	0	0
11/19/2000	Heavy Snow	0	0	0	0
1/3/2002	Winter Storm	0	0	0	0
12/4/2002	Winter Storm	0	0	0	0
2/16/2003	Winter Storm	0	0	0	0
2/27/2003	Winter Storm	0	0	0	0
1/26/2004	Winter Storm	0	0	0	0
2/15/2004	Winter Storm	0	0	0	0
2/26/2004	Winter Storm	0	0	0	0
12/26/2004	Winter Storm	0	0	0	0
1/18/2007	Winter Weather	0	0	0	0
2/1/2007	Winter Weather	0	0	0	0
12/7/2007	Winter Weather	0	0	30,000	0
1/17/2008	Winter Weather	0	0	0	0
1/20/2009	Winter Storm	0	0	0	0
3/2/2009	Winter Storm	0	0	0	0
12/18/2009	Winter Weather	0	0	0	0
1/29/2010	Winter Storm	0	0	0	0
2/12/2010	Winter Storm	0	0	0	0
3/2/2010	Winter Storm	0	0	0	0
12/4/2010	Winter Weather	0	0	0	0
12/16/2010	Winter Weather	0	0	0	0
12/25/2010	Winter Storm	0	0	0	0
1/10/2011	Winter Weather	0	0	0	0
12/26/2013	Winter Weather	0	0	0	0
1/21/2014	Winter Weather	0	0	0	0
1/28/2014	Winter Storm	0	0	0	0
2/11/2014	Winter Weather	0	0	0	0
2/12/2014	Winter Storm	0	0	0	0
3/3/2014	Winter Weather	0	0	0	0
3/17/2014	Winter Weather	0	0	0	0
1/13/2015	Winter Weather	0	0	0	0
2/16/2015	Winter Storm	0	0	0	0
2/24/2015	Winter Weather	0	0	0	0
2/25/2015	Winter Storm	0	0	$1,000,000	0
3/1/2015	Winter Weather	0	0	0	0
1/22/2016	Winter Storm	0	0	0	0
2/7/2016	Winter Weather	0	0	$10,000	0
2/15/2016	Winter Weather	0	0	0	0
1/7/2017	Winter Storm	0	0	0	0
12/8/2017	Winter Weather	0	0	0	0
1/3/2018	Winter Weather	0	0	0	0
1/17/2018	Winter Storm	0	0	0	0
3/12/2018	Winter Weather	0	0	0	0
3/21/2018	Winter Weather	0	0	0	0

Date	Event Type	Fatalities	Injuries	Property Damage	Crop Damage
12/9/2018	Winter Storm	0	0	0	0
2/20/2020	Winter Weather	0	0	0	0
1/28/2021	Winter Weather	0	0	0	0
1/31/2021	Winter Weather	0	0	0	0
2/12/2021	Winter Weather	0	0	0	0
2/18/2021	Winter Weather	0	0	0	0
1/16/2022	Winter Weather	0	0	0	0
1/21/2022	Winter Storm	0	0	0	0
1/29/2022	Winter Weather	0	0	0	0
	Total	**0**	**0**	**$1,010,000**	**0**

Source: NCEI

Several storm impacts from NCEI are summarized below:

December 7, 2007 – A brief period of light freezing rain fell across central North Carolina. Most of the freezing rain accumulation occurred from southern Wake County, east to Smithfield and north to Wilson, Rock Mount and Roanoke Rapids. Portions of Interstate 40 and Highway 70 in Johnston County were closed due to numerous accidents. Over 150 automobile accidents were reported across central North Carolina due to icy bridges. The storm caused $415,000 in damage across the region; Wake County itself suffered $30,000 in recorded damage.

February 25-26, 2015 – As a low pressure system tracked along the southeast coast, wintry precipitation spread into central North Carolina. Much of the impacted area received 2-4 inches of snow and sleet, with norther counties receiving up to 7-9 inches. In addition to the snow, some areas also saw ice accumulations. The heavy, wet snow caused extensive power outages, with some outages extending beyond 24 hours. In Wake County, snowfall/sleet amounts of 2 to 6 inches fell across the county. The heavy wet snow caused widespread power outages from falling trees and power lines. At the peak of the storm, over 92,000 customers were without power in the county.

February 7, 2016 – A deepening low pressure system tracking along the southeast coast spread precipitation into the eastern portions of North Carolina. A trace to a couple tenths of an inch of snow and sleet fell across Wake County. This brief burst of wintry weather caused numerous traffic accidents.

March 12, 2018 - A vigorous upper-level trough and associated mid-level deformation band produced one to four inches of wet snow across northern portions of the North Carolina Piedmont. Across the eastern Piedmont and central Coastal Plain counties, snowfall amounts were less, averaging between half an inch to an inch.

January 28, 2021 - A strong upper-level disturbance and a developing storm system spread rain across central NC during the early evening of January 27th. Initially the precipitation fell as rain with surface temperatures in the mid-40s to lower 50s. As the precipitation persisted and intensified, colder air aloft made it to the surface resulting in a changeover to snow after midnight before the precipitation ended by daybreak. A total of 2 to 5 inches of snow was observed near the Virginia border, with 2 to 3 inches of snow observed in the Triangle and Triad areas, and only a trace or no snow across the south.

January 16, 2022 - A storm system moved from the central Plains into the Southeast, bringing widespread wintry precipitation to the central Piedmont of central North Carolina. A mix of snow, sleet, freezing rain and rain was observed across the region, with 3-5 inches of snow and sleet accumulation across the Triad, and around 0.10 to 0.20 inch of ice accrual from freezing rain across the Triangle, and a light glaze of ice across the Coastal Plain. This resulted in difficult travel across the Piedmont, with numerous accidents across the northwest Piedmont, where the heavies snow fell.

Wake County received six emergency declarations and presidential disaster declarations since 1968 for

incidents related to severe winter storms. As a state, North Carolina received ten disaster declarations related to severe winter storms during this timeframe.

Table 4.112 – Emergency & Disaster Declarations in Wake County due to Severe Winter Storms

Disaster Number	Date	Disaster Type	Incident Start	Incident End
234	1968	Severe Ice Storm	2/10/1968	2/10/1968
3033	1977	Snow	3/2/1977	3/2/1977
3110	1993	Severe Snow and Winter Storm	3/13/1993	3/17/1993
1087	1996	Blizzard	1/6/1996	1/12/1996
1312	2000	Severe Winter Storm	1/24/2000	2/1/2000
1448	2003	Severe Ice Storm	12/4/2002	12/6/2002

Source: FEMA, March 7, 2024

PROBABILITY OF FUTURE OCCURRENCE

NCEI records 60 severe winter storm related events during the 25-year period from 1998 through 2023, which is an average of 2.4 events per year or more than 100 percent probability in any given year.

Probability: 4 – Highly Likely

CLIMATE CHANGE

Per the 2023 North Carolina Hazard Mitigation Plan, there is uncertainty associated with climate change impacts on future severe winter storms. Global temperature rise could cause shorter and warmer winters in many areas; however, the likelihood of dangerously low temperatures may increase due to continuing trends of temperature extremes. Warmer winters, however, mean that precipitation that would normally fall as snow may begin to fall as rain or freezing rain instead.

VULNERABILITY ASSESSMENT

PEOPLE

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

PROPERTY

According to reported data of storm impacts recorded by the NCEI, between 1998 and 2023 Wake County experienced $1.04 million in property damage related to the impacts of severe winter storm. Based on this data, Wake County experiences average annual losses of $41,600 due to severe winter storm events.

ENVIRONMENT

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while a local resident is out driving or walking underneath it.

CONSEQUENCE ANALYSIS

Table 4.113 summarizes the potential negative consequences of severe winter storm.

Table 4.113 – Consequence Analysis – Severe Winter Storm

Category	Consequences
Public	Localized impact expected to be severe for affected areas and moderate to light for other less affected areas.
Responders	Adverse impact expected to be severe for unprotected personnel and moderate to light for trained, equipped, and protected personnel.
Continuity of Operations (including Continued Delivery of Services)	Localized disruption of roads and/or utilities caused by incident may postpone delivery of some services.
Property, Facilities and Infrastructure	Localized impact to facilities and infrastructure in the areas of the incident. Power lines and roads most adversely affected.
Environment	Environmental damage to trees, bushes, etc.
Economic Condition of the Jurisdiction	Local economy and finances may be adversely affected, depending on damage.
Public Confidence in the Jurisdiction's Governance	Ability to respond and recover may be questioned and challenged if planning, response, and recovery not timely and effective.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes severe winter storm hazard risk by jurisdiction. Severe winter storm risk does not vary substantially by jurisdiction because these events are typically regional in nature.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	4	2	4	1	3	3.0	H
Apex	4	2	4	1	3	3.0	H
Cary	4	2	4	1	3	3.0	H
Fuquay-Varina	4	2	4	1	3	3.0	H
Garner	4	2	4	1	3	3.0	H
Holly Springs	4	2	4	1	3	3.0	H
Knightdale	4	2	4	1	3	3.0	H
Morrisville	4	2	4	1	3	3.0	H
Raleigh	4	2	4	1	3	3.0	H
Rolesville	4	2	4	1	3	3.0	H
Wake Forest	4	2	4	1	3	3.0	H
Wendell	4	2	4	1	3	3.0	H
Zebulon	4	2	4	1	3	3.0	H

4.5.11 TORNADO

HAZARD BACKGROUND

According to the Glossary of Meteorology (AMS 2020), a tornado is "a violently rotating column of air extending vertically from the surface to the base of a cumuliform cloud, often with near-surface circulating debris/dust when over land or spray when over water. Although its presence is not required, a funnel cloud is often visible and may partly or fully extend from the cloud base to the ground." Tornadoes can appear from any direction. Most move from southwest to northeast, or west to east. Some tornadoes have changed direction amid path, or even backtracked.

Tornadoes are commonly produced by land falling tropical cyclones. Those making landfall along the Gulf coast traditionally produce more tornadoes than those making landfall along the Atlantic coast. Tornadoes that form within hurricanes are more common in the right front quadrant with respect to the forward direction but can occur in other areas as well. According to the NOAA, more than half of the landfalling hurricanes will spawn at least one tornado. Tornadoes are more likely to be spawned within 24 hours of landfall and are usually within 30 miles of the tropical cyclone's center.

Tornadoes have the potential to produce winds in excess of 200 mph (EF5 on the Enhanced Fujita Scale) and can be very expansive – some in the Great Plains have exceeded two miles in width. Tornadoes associated with tropical cyclones, however, tend to be of lower intensity (EF0 to EF2) and much smaller in size than ones that form in the Great Plains.

Source: NOAA National Weather Service

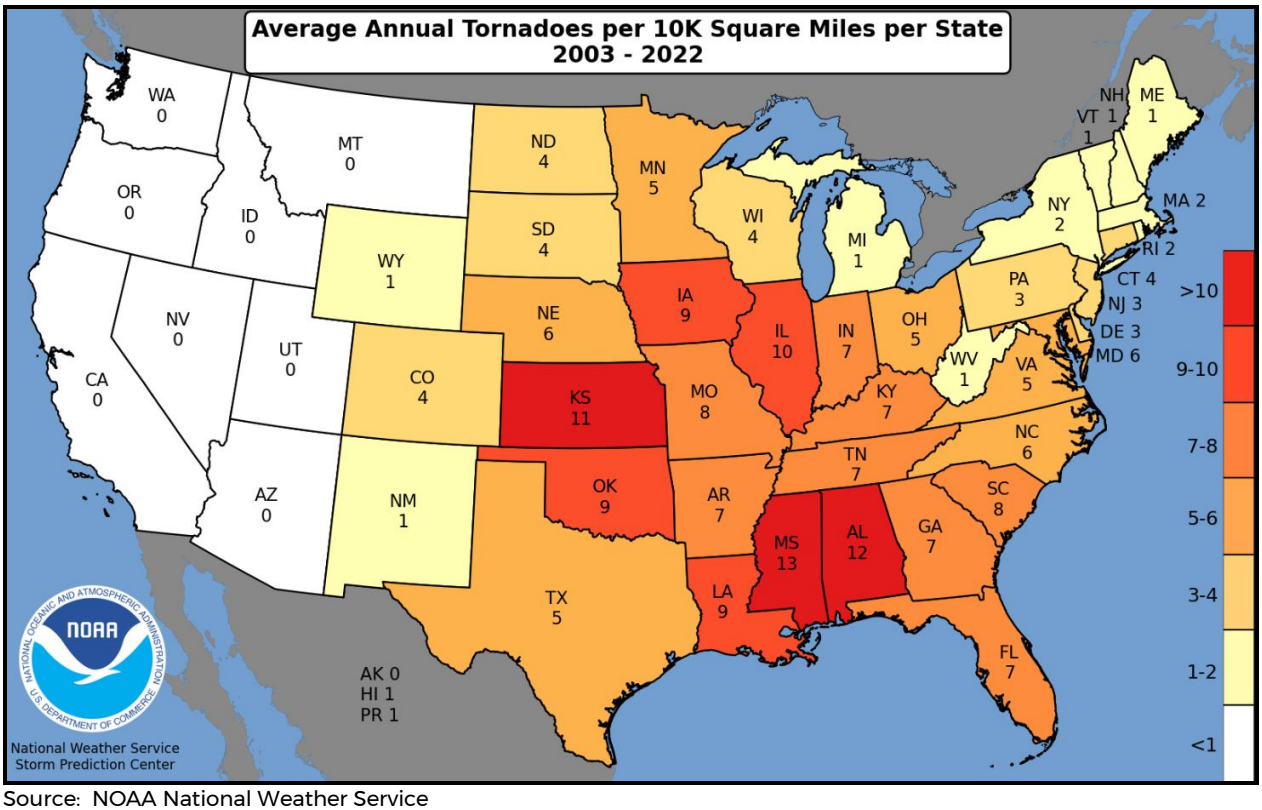
Warning Time: 4 – Less than 6 hours

Duration: 1 – Less than 6 hours

According to the NOAA Storm Prediction Center (SPC), the United States experiences an average of

1,248 tornadoes per year with the highest concentration of tornadoes occurring in the region surrounding Oklahoma, Texas, and Kansas. Although the Great Plains region of the Central United States does favor the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"), the southeast experiences tornado threats throughout the cooler months of the year before they move to the central plains during May and June. The below figure shows tornado activity in the United States based on the number of recorded tornadoes per 10,000 square miles.

Figure 4.26 – Tornado Activity in the U.S.

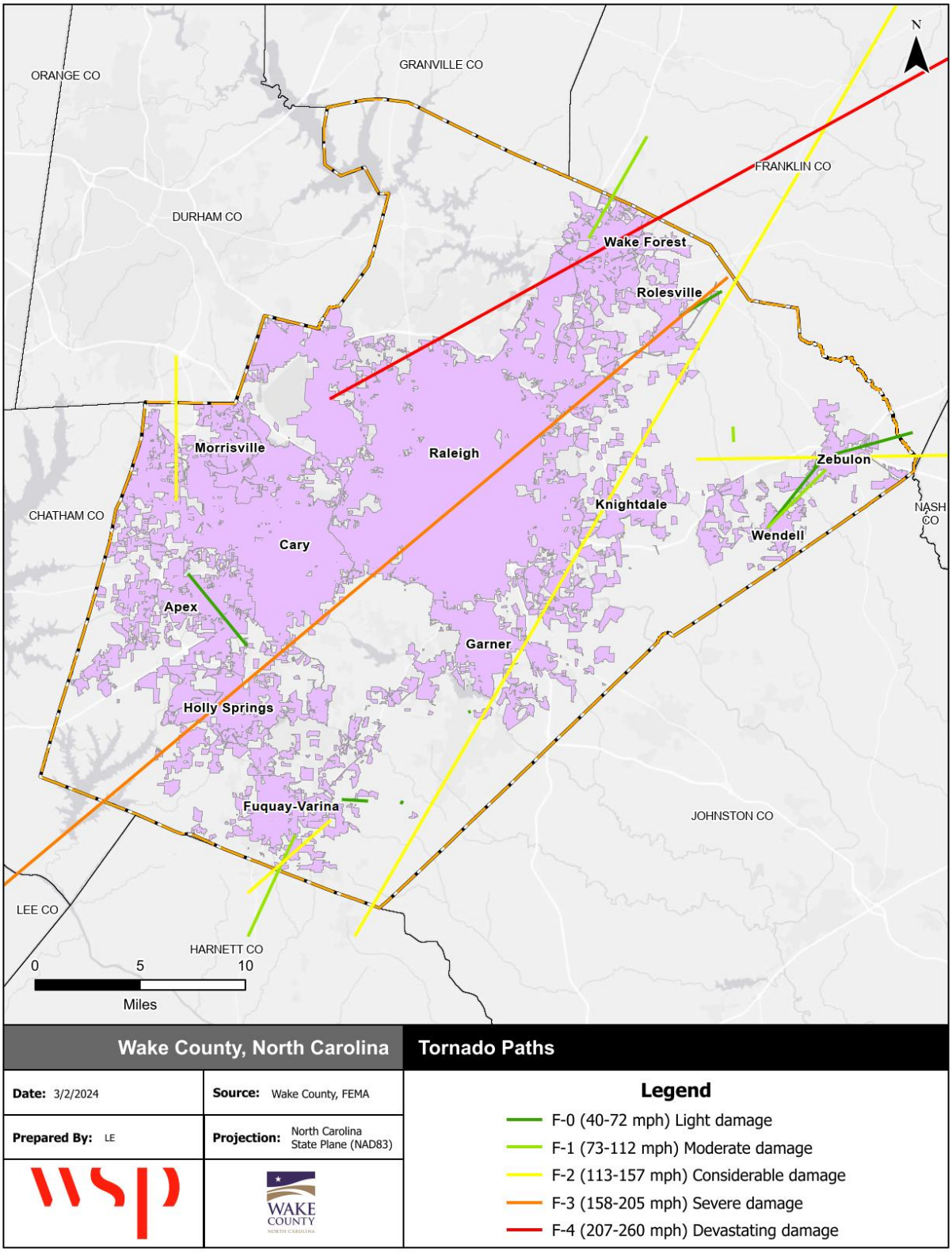


Source: NOAA National Weather Service

LOCATION

Figure 4.27 reflects the tracks of past tornados that passed through Wake County from 1950 through 2023 according to data from the NOAA/National Weather Service Storm Prediction Center.

Figure 4.27 – Tornado Paths Through Wake County, 1950-2023



Source: NOAA/NWS Storm Prediction Center

Tornados can occur anywhere in the County. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado isn't increased in one area of the county versus another. All of Wake County is uniformly exposed to this hazard.

EXTENT

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis, better correlation between damage and wind speed. It is also more precise because it takes into account the materials affected and the construction of structures damaged by a tornado. Table 4.114 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

Table 4.114 – Enhanced Fujita Scale

EF Number	3 Second Gust (mph)	Damage
0	65-85	**Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
1	96-110	**Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
2	111-135	**Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
3	136-165	**Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
4	166-200	**Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
5	Over 200	**Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur.

The most intense tornado to pass through Wake County was an F4 in 1988; this tornado also had the longest path (83 miles) and resulted in the most injuries (105 people). An EF3 tornado in 2011 resulted in the most fatalities, killing four people, and injuring 67. Additionally, this tornado caused $115 million in recordable property damage.

Impact: 3 – Critical

Spatial Extent: 2 – Small

HISTORICAL OCCURRENCES

NCEI storm reports were reviewed from 1988 through 2023 to assess whether recent trends varied from the longer historical record. According to NCEI, Wake County experienced 22 tornado incidents between 1988 and 2023, causing 6 fatalities, 201 injuries, $370 million in property damage and $25,000 in crop damage. Table 4.113 shows historical tornadoes in Wake County during this time period.

Table 4.115 – Recorded Tornadoes in Wake County, 1988-2023

Location	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Wake Co.	3/26/1988	F0	0	0	$0	$0
Wake Co.	11/28/1988	F4	2	105	$250,000,000	$0
Wake Co.	10/23/1990	F1	0	0	$0	$0
Raleigh	3/27/1993	F0	0	0	$0	$0
Wendell	4/15/1996	F0	0	0	$10,000	$0
Wendell	4/15/1996	F1	0	26	$3,000,000	$0
Cary	7/12/1996	F0	0	0	$50,000	$0
Holly Springs	3/20/1998	F0	0	0	$0	$0
Garner	3/20/1998	F2	0	2	$650,000	$0
Raleigh	3/20/1998	F0	0	0	$15,000	$0
Cary	6/1/2001	F0	0	0	$0	$0
Apex	9/27/2004	F0	0	0	$0	$0
Garner	9/14/2007	EF0	0	0	$0	$0
Rockton	4/25/2010	EF0	0	0	$250,000	$25,000
Rolesville	3/6/2011	EF0	0	1	$100,000	$0
Burt	4/16/2011	EF3	4	67	$115,000,000	$0
Zebulon	9/18/2012	EF0	0	0	$0	$0
South Raleigh Airport	3/29/2014	EF0	0	0	$8,000	$0
Williams Crossroads	3/29/2014	EF0	0	0	$5,000	$0
Knightdale	4/15/2018	EF1	0	0	$150,000	$0
Knightdale	5/13/2019	EF2	0	0	$1,000,000	$0
Willow Springs	7/23/2019	EF0	0	0	$50,000	$0
Total			**6**	**201**	**$ 370,288,000**	**$25,000**

Source: NCEI

Specific incidents with some level of impact include:

March 20, 1998 – a cell of tornadoes broke out during the 6 pm hour, with a tornado each in Holly Springs, Garner and Raleigh. In Garner, several trees fell on homes and outbuildings. The tornado touched down of Highway 70 near a church; the roof of one section was taken off and the steeple was blown off the chapel. The debris from the church took out windows at a car lot across the street. A block away, the wind removed several large siding sheets from a business. The storm caused two direct injuries and $650,000 in damages. The storm produced another tornado six miles to the northeast on the east side of Raleigh. Damage began just off US64 at Wake Medical Center and the Tower Shopping Center. Cars were overturned, trees were damaged and a steal-beamed billboard was twisted. The tornado then crossed the highway where it lifted the roof off the business office of a tree nursery, damaged two sheds and destroyed five greenhouses. Insulation and debris was strewn up in the trees well away from the tornado's path.

November 28, 1988 – A powerful tornado touched down in Umstead State Park in the northwest part of Raleigh, three miles southeast of the center of Raleigh-Durham Airport. The tornado tracked across one of the most densely populated parts of the City of Raleigh, destroying hundreds of homes and damaging thousands of others. Two people were killed in Raleigh. The strongest damage, mostly F3 with some very

weak F4, occurred along a 4-mile-long portion of the path extending northeast from where it crossed U.S. Highway 70, four miles east of Raleigh Airport. Numerous businesses along U.S. Highway 70 were destroyed, including a K-mart.

The tornado destroyed a total of 426 residences and 78 businesses. It damaged 2,057 residences, leaving 978 people homeless. Four people were killed and 154 were injured; total damage was near $77.2 million. The track of the tornado was almost continuous for 83 miles.

Outside of the above time period, NCEI also records an F2 tornado on November 2, 1966, that caused nine injuries and $250,000 in damage.

November 2, 1966 – In the area east and south of Raleigh, two homes and five house trailers were destroyed, three trailers and six homes severely damaged, and minor damage to approximately twenty other homes and business buildings, with trees twisted off and power poles broken.

April 25, 2010 – a storm produced a weak EF0 tornado near Zebulon in eastern Wake County. The tornado damaged buildings on its way east, where it caused minor damage to several businesses and vehicles in the Triangle East Center. The storm was responsible for $250,000 in property damage and $25,000 in crop damage.

March 6, 2011 – a weak EF-0 tornado touched down just northeast of downtown Rolesville along NC Highway 401 (Main Street). The tornado tracked to the northeast for two miles, causing damage to trees, homes and other infrastructure, resulting in $100,000 in property damage. An elderly man was injured from the tornado due to a house fire.

April 16, 2011 – A strong storm system produced nine tornadoes in the Raleigh CWA, including two EF3s and four EF2s. The tornadoes left eight dead with approximately 275 injuries. In Burt, an EF0 tornado entered southwest Wake County and tracked northeast, causing tree, roof and infrastructure damage. In total, 2,270 homes were damaged, including 67 homes that were destroyed and 184 homes that suffered major damage; additionally, 34 businesses were damaged. NCEI recorded four fatalities in a trailer park, 67 injuries and $115 million in property damage.

April 15, 2018 - A strong upper low moved from Iowa across the Lower Great Lakes region, with a deep trough taking on a negative tilt while swinging into North Carolina. An associated strong cold front approached western North Carolina that afternoon and pushed east and east-northeast across central North Carolina on the night of the 15th. A strengthening and backing flow at all levels led to a surge of moisture into NC. Moderate instability, strong deep layer shear, and high low-level storm-relative helicity were also present. The result was a quasi-linear convective system with embedded mesovortices, which produced widespread severe weather, including a tornado in Greensboro, as it moved through North Carolina.

May 13, 2019 - The tornado initially touched down just west of Rolesville Road near Tink's Place in eastern Wake County. The tornado initially produced widespread EF-1 damage with sporadic EF-2 damage noted on Weathers Road. Along the path to Weathers Road, numerous trees were either uprooted or snapped and mangled together, consistent with EF-1 damage. At Weathers Road, structural damage was noted as a single-family home had its exterior walls collapsed. Several metal farm buildings were also completely destroyed and strewn about a field. Sheet metal was wrapped around a nearby tree. An RV was flipped over numerous times landing crushed in an open field. In addition, another home had the windows blown out with roof damage. It was in this area that EF-2 damage was determined. The tornado continued tracking east and crossed Edgemont Road just north of HWY 264/64, then crossing HWY 264/64 where numerous trees were downed and snapped. Generally, EF-1 damage was noted here. The tornado then moved east into Zebulon along and near Highway 97 (West Gannon Avenue) where numerous trees snapped and uprooted. It continued east of Zebulon, crossing HWY 264/64 again, and going just north of the Five County Stadium. Generally, EF-0 and EF-1 damage was noted here.

PROBABILITY OF FUTURE OCCURRENCE

Probability of future occurrence was calculated based on past occurrences and was assumed to be uniform across the county.

In a thirty-five-year span between 1988 and 2023, Wake County experienced 21 separate tornado incidents over 18 separate days. This correlates to a 60 percent annual probability that the county will experience a tornado somewhere in its boundaries. Only four of these past tornado events was a magnitude EF2 or greater; therefore, the annual probability of a significant tornado event is approximately 11 percent.

Probability: 3 – Likely

CLIMATE CHANGE

There presently is not enough data or research to quantify the magnitude of change that climate change may have related to tornado frequency and intensity. However, evidence suggests that the new variations to the natural climate have the potential to alter the environment necessary for tornado formation. NOAA states that "tornado activity is dependent upon two things: the strength of atmospheric instability, which promotes rising air and thunderstorm formation; and vertical wind shear, which provides the necessary rotation for tornadic thunderstorms". Studies show that human-caused climate change is expected to increase atmospheric instability with rising temperatures and humidity that may cause an increase of days where weather conditions are suitable for tornado formation. Additionally, the National Climate Assessment Fifth Addition states that "while the average annual number of tornadoes appears to have remained relatively constant, there is evidence that tornado outbreaks have become more frequent, that tornado power has increased, that tornado activity is increasing in the fall, and that "Tornado Alley" has shifted eastward." Most of North Carolina, including Wake County, is seeing an upward trend in tornado frequency. Because of uncertainty with the influence of climate change on tornadoes, future updates to the mitigation plan should include the latest research on how the tornado hazard frequency and severity could change. The level of significance of this hazard should be revisited over time.

VULNERABILITY ASSESSMENT

PEOPLE

People and populations exposed to the elements are most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. According to the 2022 American Community Survey (ACS), 12,462 occupied housing units (2.7%) in Wake County are classified as "mobile homes." Based on an estimated average of 2.75 persons per household from the 2022 ACS, there are approximately 34,270 people in Wake County living in mobile homes.

Since 1950, the NCEI records four fatalities and 70 injuries attributed to tornadoes in Wake County; these fatalities and injuries were the result of tornadoes rated as low as EF0, illustrating the destructive power of tornadoes and the dangers they pose to exposed populations without proper shelter.

PROPERTY

General damages to property are both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1988, damaging tornadoes in the County are directly responsible for over $370 million worth of damage to property, and $25,000 worth of damage to crops, according to NCEI data.

Table 4.116 through Table 4.120 detail the estimated buildings impacted from tornado events of magnitudes ranging from EF0 to EF4. Note that these tables provide an estimate of building damages should all exposed property be impacted by an event of the stated magnitude. Actual damages resulting from a tornado event of each magnitude would be lower because the event would impact only a fraction of the county.

Table 4.116 – Estimated Buildings Impacted by EF0 Tornado

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$1,462,902,656	6,336	5%	$665,180,509	2,270	2%	$214,034,104	128,042	100%	$2,342,117,269
Apex	14,915	3,715	25%	14,089	94%	$175,118,796	671	4%	$38,951,016	155	1%	$11,478,560	14,915	100%	$225,548,372
Cary	45,306	7,401	16%	42,944	95%	$657,621,002	1,872	4%	$203,740,695	462	1%	$47,457,113	45,278	100%	$908,818,810
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$108,407,223	596	5%	$35,155,885	131	1%	$8,406,908	11,065	100%	$151,970,016
Garner	11,975	4,982	42%	11,103	93%	$103,663,128	687	6%	$47,520,768	181	2%	$11,042,172	11,971	100%	$162,226,068
Holly Springs	10,528	994	9%	10,209	97%	$140,248,731	248	2%	$25,912,734	68	1%	$9,443,424	10,525	100%	$175,604,889
Knightdale	7,144	1,696	24%	6,811	95%	$61,152,204	265	4%	$14,122,395	67	1%	$7,528,413	7,143	100%	$82,803,012
Morrisville	5,181	274	5%	4,793	93%	$78,337,848	340	7%	$53,973,286	48	1%	$3,355,118	5,181	100%	$135,666,253
Rolesville	2,103	808	38%	1,983	94%	$23,246,517	91	4%	$2,529,057	29	1%	$1,599,689	2,103	100%	$27,375,263
Wake Forest	10,547	1,459	14%	9,852	93%	$131,630,797	541	5%	$31,561,165	151	1%	$13,282,846	10,544	100%	$176,474,808
Wendell	3,728	1,536	41%	3,378	91%	$24,235,870	277	7%	$9,493,528	73	2%	$4,099,871	3,728	100%	$37,829,269
Zebulon	3,231	1,519	47%	2,809	87%	$19,944,368	336	10%	$23,787,654	84	3%	$4,898,092	3,229	100%	$48,630,114
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$704,182,907	3,183	5%	$114,961,476	403	1%	$21,233,488	59,849	100%	$840,377,871
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$3,690,692,047**	**15,443**	**5%**	**$1,266,890,168**	**4,122**	**1%**	**$357,859,798**	**313,573**	**100%**	**$5,315,442,014**

Source: NCEM Risk Management Tool

Table 4.117 – Estimated Buildings Impacted by EF1 Tornado

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$10,416,748,580	6,336	5%	$4,323,265,809	2,270	2%	$1,293,678,102	128,042	100%	$16,033,692,491
Apex	14,915	3,715	25%	14,089	94%	$1,269,323,363	671	4%	$251,876,837	155	1%	$58,277,193	14,915	100%	$1,579,477,394
Cary	45,306	7,401	16%	42,944	95%	$4,768,159,035	1,872	4%	$1,241,329,992	462	1%	$233,753,318	45,278	100%	$6,243,242,346
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$793,195,835	596	5%	$239,151,647	131	1%	$44,321,651	11,065	100%	$1,076,669,133
Garner	11,975	4,982	42%	11,103	93%	$745,557,084	687	6%	$303,719,474	181	2%	$56,578,357	11,971	100%	$1,105,854,914
Holly Springs	10,528	994	9%	10,209	97%	$1,030,937,699	248	2%	$178,508,372	68	1%	$42,724,835	10,525	100%	$1,252,170,906
Knightdale	7,144	1,696	24%	6,811	95%	$438,850,279	265	4%	$85,966,313	67	1%	$36,373,280	7,143	100%	$561,189,872
Morrisville	5,181	274	5%	4,793	93%	$552,947,796	340	7%	$361,606,818	48	1%	$17,676,783	5,181	100%	$932,231,397
Rolesville	2,103	808	38%	1,983	94%	$168,823,830	91	4%	$17,561,438	29	1%	$7,800,376	2,103	100%	$194,185,643
Wake Forest	10,547	1,459	14%	9,852	93%	$955,729,364	541	5%	$204,624,734	151	1%	$63,651,869	10,544	100%	$1,224,005,967
Wendell	3,728	1,536	41%	3,378	91%	$176,238,985	277	7%	$66,293,935	73	2%	$21,394,247	3,728	100%	$263,927,166
Zebulon	3,231	1,519	47%	2,809	87%	$144,155,732	336	10%	$165,861,367	84	3%	$23,959,049	3,229	100%	$333,976,148
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$5,162,388,219	3,183	5%	$740,366,479	403	1%	$120,990,417	59,849	100%	$6,023,745,115
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$26,623,055,801**	**15,443**	**5%**	**$8,180,133,215**	**4,122**	**1%**	**$2,021,179,477**	**313,573**	**100%**	**$36,824,368,492**

Source: NCEM Risk Management Tool

Table 4.118 – Estimated Buildings Impacted by EF2 Tornado

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$21,222,991,073	6,336	5%	$10,311,510,367	2,270	2%	$4,238,048,659	128,042	100%	$35,772,550,099
Apex	14,915	3,715	25%	14,089	94%	$2,471,504,494	671	4%	$602,301,471	155	1%	$175,552,970	14,915	100%	$3,249,358,936
Cary	45,306	7,401	16%	42,944	95%	$9,381,293,206	1,872	4%	$2,893,508,918	462	1%	$692,355,748	45,278	100%	$12,967,157,872
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$1,511,116,295	596	5%	$565,420,624	131	1%	$136,204,249	11,065	100%	$2,212,741,168
Garner	11,975	4,982	42%	11,103	93%	$1,457,940,926	687	6%	$711,512,671	181	2%	$171,283,720	11,971	100%	$2,340,737,317
Holly Springs	10,528	994	9%	10,209	97%	$1,960,725,525	248	2%	$415,854,092	68	1%	$120,135,873	10,525	100%	$2,496,715,490
Knightdale	7,144	1,696	24%	6,811	95%	$851,176,294	265	4%	$217,744,762	67	1%	$106,535,991	7,143	100%	$1,175,457,047
Morrisville	5,181	274	5%	4,793	93%	$1,146,781,961	340	7%	$813,377,540	48	1%	$54,304,009	5,181	100%	$2,014,463,510
Rolesville	2,103	808	38%	1,983	94%	$308,264,199	91	4%	$39,097,268	29	1%	$22,970,375	2,103	100%	$370,331,842
Wake Forest	10,547	1,459	14%	9,852	93%	$1,870,172,080	541	5%	$488,179,917	151	1%	$185,530,682	10,544	100%	$2,543,882,679
Wendell	3,728	1,536	41%	3,378	91%	$335,995,281	277	7%	$150,755,331	73	2%	$65,397,923	3,728	100%	$552,148,535
Zebulon	3,231	1,519	47%	2,809	87%	$276,061,118	336	10%	$380,733,481	84	3%	$70,681,456	3,229	100%	$727,476,055
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$9,639,880,900	3,183	5%	$1,605,584,715	403	1%	$386,111,623	59,849	100%	$11,631,577,238
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$52,433,903,352**	**15,443**	**5%**	**$19,195,581,157**	**4,122**	**1%**	**$6,425,113,278**	**313,573**	**100%**	**$78,054,597,788**

Source: NCEM Risk Management Tool

Table 4.119 – Estimated Buildings Impacted by EF3 Tornado

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$28,576,228,083	6,336	5%	$13,454,259,623	2,270	2%	$6,639,763,329	128,042	100%	$48,670,251,036
Apex	14,915	3,715	25%	14,089	94%	$3,087,090,453	671	4%	$738,585,218	155	1%	$271,331,342	14,915	100%	$4,097,007,013
Cary	45,306	7,401	16%	42,944	95%	$11,829,754,043	1,872	4%	$3,864,515,984	462	1%	$1,066,920,830	45,278	100%	$16,761,190,857
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$1,810,425,638	596	5%	$672,410,296	131	1%	$211,237,967	11,065	100%	$2,694,073,900
Garner	11,975	4,982	42%	11,103	93%	$1,857,319,426	687	6%	$853,420,096	181	2%	$264,960,887	11,971	100%	$2,975,700,409
Holly Springs	10,528	994	9%	10,209	97%	$2,322,112,560	248	2%	$478,484,526	68	1%	$183,376,900	10,525	100%	$2,983,973,985
Knightdale	7,144	1,696	24%	6,811	95%	$1,080,680,577	265	4%	$277,956,147	67	1%	$163,844,433	7,143	100%	$1,522,481,156
Morrisville	5,181	274	5%	4,793	93%	$1,591,480,162	340	7%	$999,330,152	48	1%	$84,214,790	5,181	100%	$2,675,025,104
Rolesville	2,103	808	38%	1,983	94%	$358,315,781	91	4%	$46,907,622	29	1%	$35,360,834	2,103	100%	$440,584,236
Wake Forest	10,547	1,459	14%	9,852	93%	$2,339,356,223	541	5%	$607,802,624	151	1%	$285,082,674	10,544	100%	$3,232,241,521
Wendell	3,728	1,536	41%	3,378	91%	$408,087,164	277	7%	$174,844,420	73	2%	$101,333,244	3,728	100%	$684,264,828
Zebulon	3,231	1,519	47%	2,809	87%	$341,178,453	336	10%	$433,564,833	84	3%	$108,842,785	3,229	100%	$883,586,070
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$11,249,304,466	3,183	5%	$2,064,796,683	403	1%	$602,584,400	59,849	100%	$13,916,685,549
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$66,851,333,029**	**15,443**	**5%**	**$24,666,878,224**	**4,122**	**1%**	**$10,018,854,415**	**313,573**	**100%**	**$101,537,065,664**

Source: NCEM Risk Management Tool

Table 4.120 – Estimated Buildings Impacted by EF4 Tornado

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	43,999	34%	119,436	93%	$29,467,691,301	6,336	5%	$13,955,020,120	2,270	2%	$7,059,218,456	128,042	100%	$50,481,929,877
Apex	14,915	3,715	25%	14,089	94%	$3,135,024,036	671	4%	$764,554,734	155	1%	$295,478,320	14,915	100%	$4,195,057,090
Cary	45,306	7,401	16%	42,944	95%	$12,033,926,207	1,872	4%	$4,040,134,449	462	1%	$1,167,820,191	45,278	100%	$17,241,880,847
Fuquay-Varina	11,070	2,135	19%	10,338	93%	$1,821,767,433	596	5%	$687,888,363	131	1%	$228,680,193	11,065	100%	$2,738,335,989
Garner	11,975	4,982	42%	11,103	93%	$1,894,788,588	687	6%	$880,357,811	181	2%	$288,113,216	11,971	100%	$3,063,259,615
Holly Springs	10,528	994	9%	10,209	97%	$2,329,887,185	248	2%	$489,333,936	68	1%	$204,016,646	10,525	100%	$3,023,237,767
Knightdale	7,144	1,696	24%	6,811	95%	$1,102,127,131	265	4%	$291,500,076	67	1%	$179,955,706	7,143	100%	$1,573,582,913
Morrisville	5,181	274	5%	4,793	93%	$1,650,698,135	340	7%	$1,025,653,699	48	1%	$91,177,528	5,181	100%	$2,767,529,362
Rolesville	2,103	808	38%	1,983	94%	$358,765,272	91	4%	$48,227,632	29	1%	$38,773,663	2,103	100%	$445,766,568
Wake Forest	10,547	1,459	14%	9,852	93%	$2,375,799,550	541	5%	$631,897,853	151	1%	$313,586,439	10,544	100%	$3,321,283,842
Wendell	3,728	1,536	41%	3,378	91%	$412,070,013	277	7%	$178,076,927	73	2%	$109,872,126	3,728	100%	$700,019,067
Zebulon	3,231	1,519	47%	2,809	87%	$345,924,425	336	10%	$440,394,977	84	3%	$119,281,522	3,229	100%	$905,600,924
Unincorporated Wake County	59,918	12,232	20%	56,263	94%	$11,257,229,506	3,183	5%	$2,121,319,961	403	1%	$645,297,453	59,849	100%	$14,023,846,920
TOTAL	**313,708**	**82,750**	**26%**	**294,008**	**94%**	**$68,185,698,782**	**15,443**	**5%**	**$25,554,360,538**	**4,122**	**1%**	**$10,741,271,459**	**313,573**	**100%**	**$104,481,330,781**

Source: NCEM Risk Management Tool

ENVIRONMENT

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

CONSEQUENCE ANALYSIS

Table 4.121 summarizes the potential negative consequences of tornado.

Table 4.121 – Consequence Analysis - Tornado

Category	Consequences
Public	Injuries; fatalities
Responders	Injuries; fatalities; potential impacts to response capabilities
Continuity of Operations (including Continued Delivery of Services)	Potential impacts to continuity of operations due to storm impacts; delays in providing services
Property, Facilities and Infrastructure	The weakest tornadoes, EF0, can cause minor roof damage, while strong tornadoes can destroy frame buildings and even badly damage steel reinforced concrete structures. Buildings are vulnerable to direct impact from tornadoes and also from wind borne debris. Mobile homes are particularly susceptible to damage during tornadoes.
Environment	Potential devastating impacts in storm's path
Economic Condition of the Jurisdiction	Contingent on tornado's path; can severely impact/destroy critical infrastructure and other economic drivers
Public Confidence in the Jurisdiction's Governance	Public confidence in the jurisdiction's governance may be influenced by severe tornado events if response and recovery are not timely and effective.

HAZARD SUMMARY BY JURISDICTION

The following table summarizes tornado hazard risk by jurisdiction. Tornado hazard risk does not vary substantially by jurisdiction.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	3	3	2	4	1	2.7	M
Apex	3	3	2	4	1	2.7	M
Cary	3	3	2	4	1	2.7	M
Fuquay-Varina	3	3	2	4	1	2.7	M
Garner	3	3	2	4	1	2.7	M
Holly Springs	3	3	2	4	1	2.7	M
Knightdale	3	3	2	4	1	2.7	M
Morrisville	3	3	2	4	1	2.7	M
Raleigh	3	3	2	4	1	2.7	M
Rolesville	3	3	2	4	1	2.7	M
Wake Forest	3	3	2	4	1	2.7	M
Wendell	3	3	2	4	1	2.7	M
Zebulon	3	3	2	4	1	2.7	M

4.5.12 WILDFIRE

HAZARD BACKGROUND

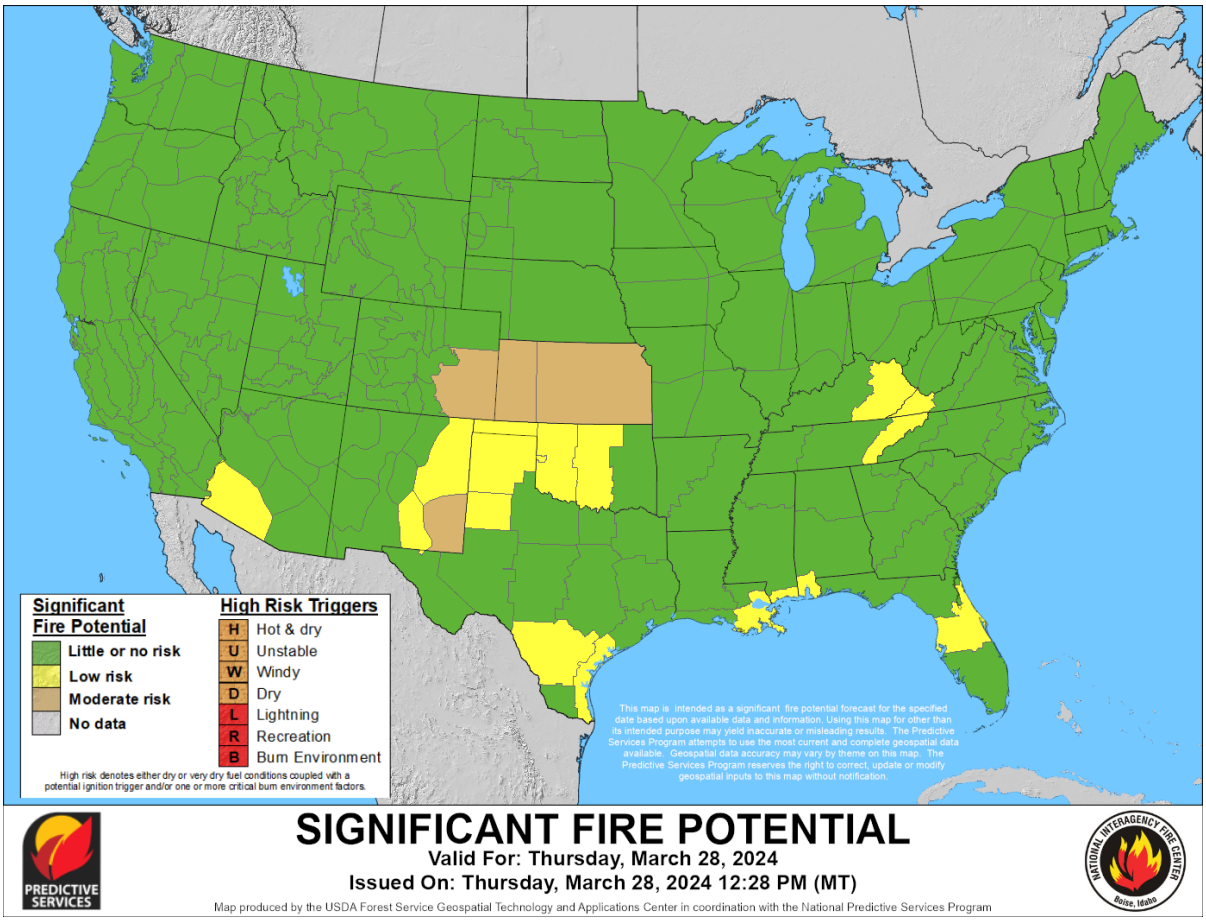
A wildfire is an uncontained fire that spreads through the environment. Wildfires have the ability to consume large areas, including infrastructure, property, and resources. When massive fires, or conflagrations, develop near populated areas, evacuations possibly ensue. Not only do the flames impact the environment, but the massive volumes of smoke spread by certain atmospheric conditions also impact the health of nearby populations. There are three general types of fire spread that are recognized.

- **Ground fires** – burn organic matter in the soil beneath surface litter and are sustained by glowing combustion.
- **Surface fires** – spread with a flaming front and burn leaf litter, fallen branches and other fuels located at ground level.
- **Crown fires** – burn through the top layer of foliage on a tree, known as the canopy or crown fires. Crown fires, the most intense type of fire and often the most difficult to contain, need strong winds, steep slopes and a heavy fuel load to continue burning.

Generally, wildfires are started by humans, either through arson or carelessness. Fire intensity is controlled by both short-term weather conditions and longer-term vegetation conditions. During intense fires, understory vegetation, such as leaves, small branches, and other organic materials that accumulate on the ground, can become additional fuel for the fire. The most explosive conditions occur when dry, gusty winds blow across dry vegetation.

Weather plays a major role in the birth, growth and death of a wildfire. In support of forecasting for fire weather, the National Weather Service (NWS) provides interactive maps that highlight regions of the U.S. that may be at higher risk for wildfire due to current and future weather conditions. This service aids federal and state land management agencies with the prevention, suppression, and management of forest and rangeland fires. As shown in Figure 4.28, the NWS Wildland Fire Outlook for March 28th, 2024 shows the state of North Carolina at “little or no risk” for fire potential based on current weather conditions.

Figure 4.28 – U.S. Wildland Fire Outlook



Source: National Weather Service

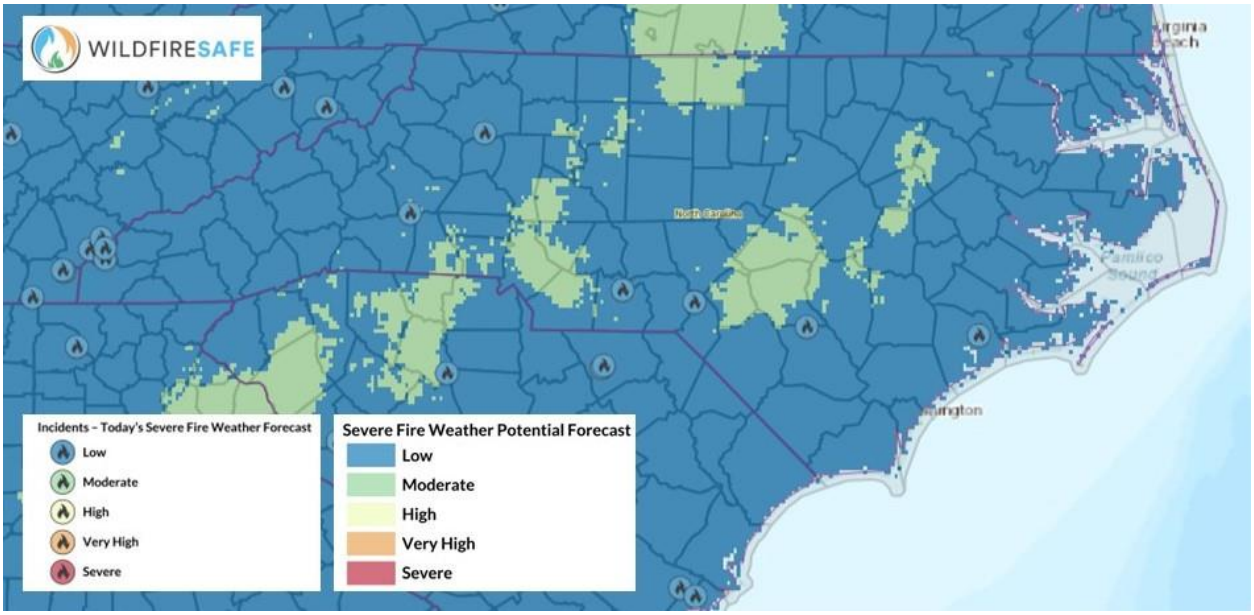
Weather conditions favorable to wildfire include drought, which increases flammability of surface fuels, and winds, which aid a wildfire's progress. The combination of wind, temperature, and humidity affects how fast wildland fires can spread. Rapid response can contain wildfires and limit their threat to property. Wake County experiences a variety of wildfire conditions found in the Keetch-Byram Drought Index, which is described in Table 4.122.

Table 4.122 – Keetch-Byram Drought Index Fire Danger Rating System

KBDI	Description
0-200	Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in sports and patches.
200-400	Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night.
400-600	Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.
600-800	Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity.

The WildfireSAFE platform was created through the United States Forest Service and pulls directly from the Wildland Fire Assessment System. The severe fire danger index for March 30th, 2024 is shown in Figure 4.29 along with current fire incidents. The severe fire weather potential forecast for Wake County at this time was mostly "low" with a small section in the southeast being rated as "moderate."

Figure 4.29 – Severe Fire Danger Index, March 2024



Source: USFS WildfireSAFE

Warning Time: 4 – Less than 6 hours

Duration: 3 – Less than 1 week

LOCATION

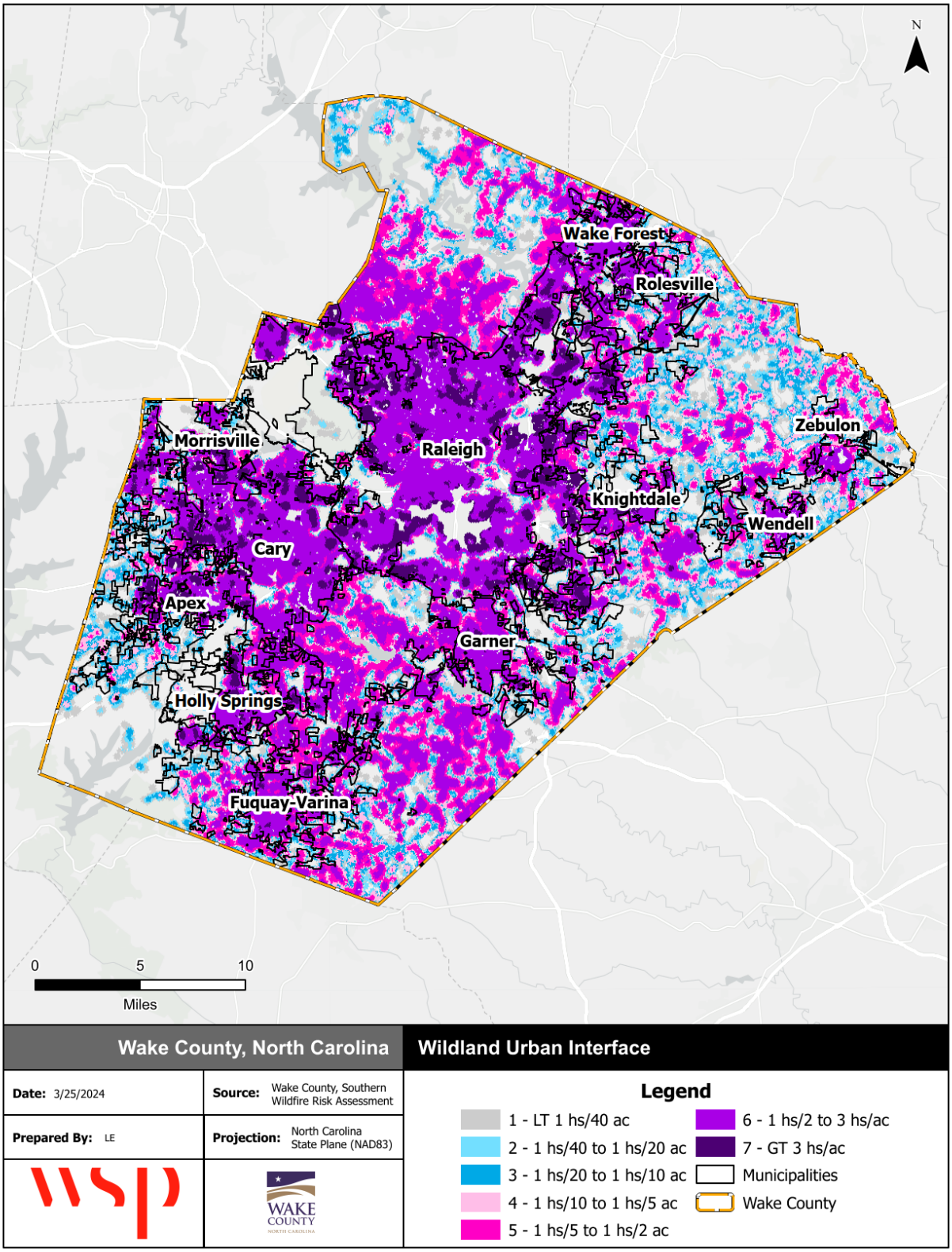
The location of wildfire risk can be defined by the acreage of Wildland Urban Interface (WUI). The WUI is described as the area where structures and other human improvements meet and intermingle with undeveloped wildland or vegetative fuels, and thus demarcates the spatial extent of wildfire risk. The WUI is essentially all the land in the county that is not heavily urbanized. The Southern Wildfire Risk Assessment (SWRA) estimates that 96 percent of the Wake County population lives within the WUI. The expansion of residential development from urban centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire. Table 4.123 details the extent of the WUI in Wake County, and Figure 4.30 maps the WUI.

Table 4.123 – Wildland Urban Interface, Population and Acres

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	943	0.1 %	42,264	9.7 %
	1hs/40ac to 1hs/20ac	1,975	0.2 %	33,966	7.8 %
	1hs/20ac to 1hs/10ac	5,417	0.6 %	44,195	10.1 %
	1hs/10ac to 1hs/5ac	13,722	1.6 %	52,629	12.1 %
	1hs/5ac to 1hs/2ac	49,907	5.8 %	76,843	17.6 %
	1hs/2ac to 3hs/1ac	511,813	59.1 %	161,031	36.9 %
	GT 3hs/1ac	281,706	32.5 %	24,990	5.7 %
	Total	**865,483**	**100.0 %**	**435,918**	**100.0 %**

Source: Southern Wildfire Risk Assessment

Figure 4.30 – Wildland Urban Interface, Wake County



Source: Southern Wildfire Risk Assessment

EXTENT

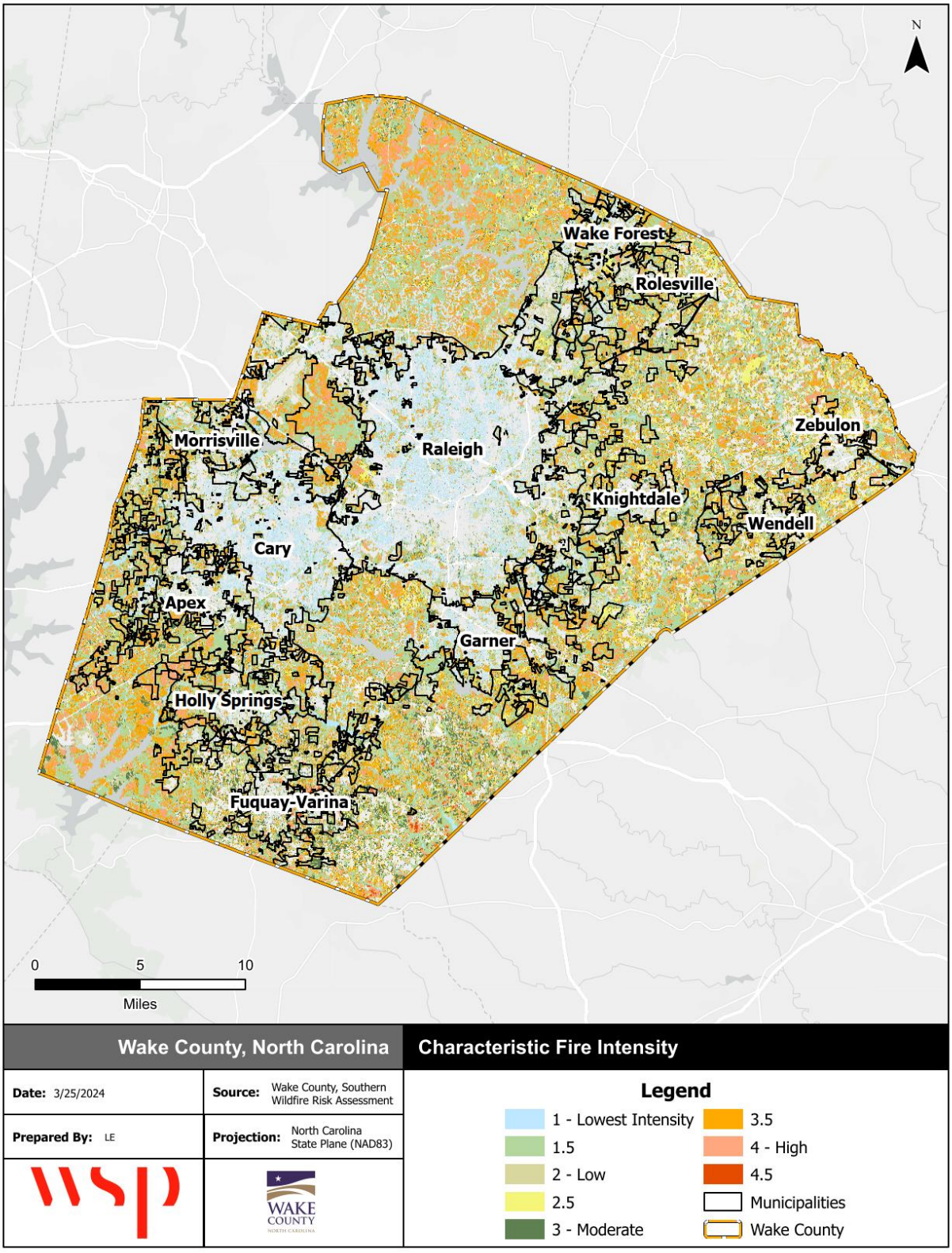
Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale consists of five classes, as defined by Southern Wildfire Risk Assessment. Figure 4.31 shows the potential fire intensity within the WUI across Wake County.

Table 4.124 – Fire Intensity Scale

Class	Description
1, Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
2, Low	Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
3, Moderate	Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
4, High	Large Flames, up to 30 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
5, Very High	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

Source: Southern Wildfire Risk Assessment

Figure 4.31 – Characteristic Fire Intensity, Wake County



Source: Southern Wildfire Risk Assessment

A small portion, approximately 7 percent, of Wake County may experience up to a Class 4 Fire Intensity, which poses significant harm or damage to life and property. Over 22 percent of Wake County may experience Class 3 Fire Intensity, which has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the county is either non-burnable (24.9%) or would face a Class 1 or Class 2 Fire Intensity (45.3%), which are easily suppressed.

Impact: 2 – Limited

Spatial Extent: 3 – Moderate

HISTORICAL OCCURRENCES

The North Carolina Forest Service (NCFS) began keeping records of fire occurrence on private and state-owned lands in 1928. Since this time, there has been an average of approximately 4,063 fires burning more than 104,000 acres annually. Recently, within the last 10 years, the State has averaged closer to 4,291 fires per year and 14,043 acres burned annually.

Table 4.125 lists past occurrences of wildfire in Wake County since 2009 as provided by the North Carolina Forest Service (NCFS) in March 2024. This data only accounts for occurrences within unincorporated Wake County, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

Table 4.125 – Records for Wildfire in Wake County, 2009-2023

Year	Number of Fires	Acreage Burned
2009	2	17.3
2010	21	130.2
2011	17	225.0
2012	13	101.0
2013	1	2.5
2014	3	5.1
2015	3	32.1
2016	23	75.4
2017	27	148.3
2018	11	40.2
2019	11	37.8
2020	3	7.5
2021	8	7.6
2022	13	38.3
2023	17	30.7
Total	**153**	**899**

Source: NC Forest Service

Wake County experienced prolonged periods of severe drought in 2010, 2011, 2021, 2022 as well as moderate drought in 2009, 2012, 2013, 2015, 2017, 2018, 2019, and 2023. These periods of drought may explain some of the annual variation in fires and acreage burned.

On average, Wake County experiences 10.2 fires and 59.9 acres burned annually from fires that require the North Carolina Forest Service to respond. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

PROBABILITY OF FUTURE OCCURRENCE

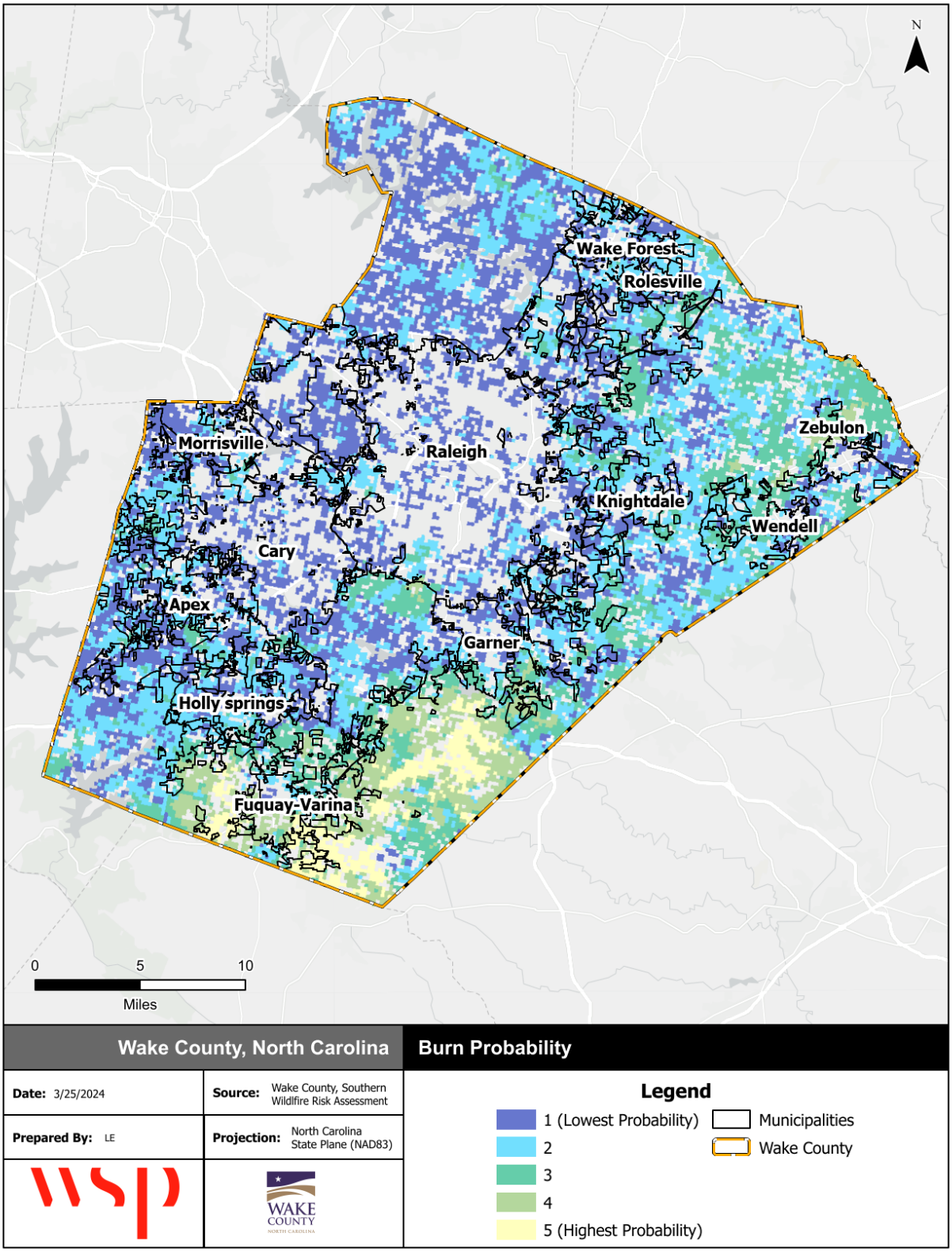
The Southern Wildfire Risk Assessment provides a Burn Probability analysis which predicts the probability of an area burning based on landscape conditions, weather, historical ignition patterns, and historical fire prevention and suppression efforts. Burn Probability data is generated by simulating fires under different weather, fire intensity, and other conditions. Values in the Burn Probability (BP) data layer indicate, for each pixel, the number of times that cell was burned by a modeled fire, divided by the total number of annual weather scenarios simulated. The simulations are calibrated to historical fire size distributions. The Burn Probability for Wake County is presented in Table 4.126 and illustrated in Figure 4.32.

Table 4.126 – Burn Probability, Wake County

Class	Acres	Percent
1	147,060	39.8 %
2	125,549	34.0 %
3	59,553	16.1 %
4	25,445	6.9 %
5	11,784	3.2 %
6	0	0.0 %
7	0	0.0 %
8	0	0.0 %
9	0	0.0 %
10	0	0.0 %
Total	**369,391**	**100.0 %**

Source: Southern Wildfire Risk Assessment

Figure 4.32 – Burn Probability, Wake County



Source: Southern Wildfire Risk Assessment

All of Wake County has a relatively low burn probability, with the highest probabilities reaching a rating of 5 or less. The areas of moderate burn probability are located primarily in the southeast of the county in Fuquay-Varina, Garner, and the unincorporated county, with an additional small cluster in the northeast in and around Zebulon. The probability of wildfire across the county is considered possible, defined as between a 1% and 10% annual chance of occurrence. While all jurisdictions fall within this threshold, the communities containing moderate burn probability, noted above, have a comparatively higher probability of occurrence.

Probability: 2 – Possible

CLIMATE CHANGE

Wildfires are usually prevalent with a combination of high temperatures and dry conditions, combustible fuels and an ignition source. Climate change has been linked to longer, warmer and drier conditions in the Southeast, exacerbating key potential conditions for a wildfire to spread.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Population and property at risk to wildfire was estimated using data from the NCEM IRISK database, which was compiled in NCEM's Risk Management Tool.

Within IRISK, wildfire hazard areas were determined using the Wildland Fire Susceptibility Index (WFSI). The following parameters were applied:

- Areas with a WFSI value of 0.01 – 0.05 were considered to be at moderate risk.
- Areas with a WFSI value greater than 0.05 were considered to be at high risk.
- Areas with a WFSI value less than 0.01 were considered to not be at risk.

The WFSI integrates the probability of an acre igniting and the expected final fire size based on the rate of spread in four weather percentile categories into a single measure of wildland fire susceptibility. Due to some necessary assumptions, mainly fuel homogeneity, it is not the true probability. But since all areas of the state have this value determined consistently, it allows for comparison and ordination of areas of the state as to the likelihood of an acre burning.

PEOPLE

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability. Table 4.127 details the population estimated to be at risk to wildfire according to the NCEM IRISK database.

Table 4.127 – Estimated Population Impacted by Wildfire

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Raleigh	476,892	14	0%	53,945	2	0%	26,904	1	0%
Apex	57,525	0	0%	5,963	0	0%	3,912	0	0%
Cary	164,869	0	0%	19,866	0	0%	9,432	0	0%
Fuquay-Varina	32,177	488	2%	4,432	86	2%	2,204	43	2%

Jurisdiction	Total Population	Population At Risk		All Elderly Population	Elderly Population At Risk		All Children Population	Children At Risk	
		Number	Percent		Number	Percent		Number	Percent
Garner	35,232	0	0%	5,015	0	0%	2,863	0	0%
Holly Springs	30,885	0	0%	2,685	0	0%	2,254	0	0%
Knightdale	29,077	92	0%	3,207	16	0%	1,917	10	1%
Morrisville	21,999	0	0%	1,533	0	0%	1,627	0	0%
Rolesville	12,236	0	0%	1,401	0	0%	919	0	0%
Wake Forest	*47,601	0	0%	4,777	0	0%	2,891	0	0%
Wendell	8,423	89	1%	1,361	15	1%	418	5	1%
Zebulon	5,751	67	1%	948	10	1%	437	5	1%
Unincorporated Wake County	230,494	468	0%	29,196	101	0%	14,301	50	0%
TOTAL	**1,143,763**	**1,218**	**0%**	**134,329**	**230**	**0%**	**70,079**	**114**	**0%**

Source: NCEM Risk Management Tool
*Note: NCEM's RMT reported Wake Forest's 2020 population estimate as 38,203. This figure has been updated to reflect the estimate of 47,601 reported directly from the U.S. Census Bureau. No other RMT values were changed.

PROPERTY

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Table 4.129 provides building counts and estimated damages for Critical Infrastructure and Key Resources (CIKR) buildings across all jurisdictions, by sector. The sectors facing the greatest risk to wildfire in Wake County are critical manufacturing, commercial facilities, food and agriculture, and transportation systems.

Table 4.128 details the buildings at risk to wildfire in Wake County.

Table 4.128 – Estimated Buildings Impacted by Wildfire

Jurisdiction	All Buildings	Number of Pre-FIRM Buildings At Risk		Residential Buildings At Risk			Commercial Buildings At Risk			Public Buildings At Risk			Total Buildings at Risk		
	Num	Num	% of Total	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages	Num	% of Total	Estimated Damages
Raleigh	128,062	5	0%	4	0%	$472,031	2	0%	$381,965	0	0%	$0	6	0%	$853,996
Apex	14,915	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Cary	45,306	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Fuquay-Varina	11,070	0	0%	202	2%	$42,875,574	3	0%	$7,290,895	0	0%	$0	205	2%	$50,166,469
Garner	11,975	0	0%	0	0%	$0	1	0%	$19,571,810	0	0%	$0	1	0%	$19,571,810
Holly Springs	10,528	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Knightdale	7,144	30	0%	34	0%	$3,182,975	3	0%	$157,144	0	0%	$0	37	1%	$3,340,119
Morrisville	5,181	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Rolesville	2,103	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Wake Forest	10,547	0	0%	0	0%	$0	0	0%	$0	0	0%	$0	0	0%	$0
Wendell	3,728	14	0%	38	1%	$4,977,285	0	0%	$0	0	0%	$0	38	1%	$4,977,285
Zebulon	3,231	27	1%	31	1%	$1,978,442	1	0%	$71,156	0	0%	$0	32	1%	$2,049,598
Unincorporated Wake County	59,918	77	0%	195	0%	$36,658,277	60	0%	$7,760,387	3	0%	$3,453,114	258	0%	$47,871,778
TOTAL PLAN	**313,708**	**153**	**0%**	**504**	**0%**	**$90,144,584**	**70**	**0%**	**$35,233,357**	**3**	**0%**	**$3,453,114**	**577**	**0%**	**$128,831,055**

Source: NCEM Risk Management Tool

Table 4.129 – Critical Infrastructure and Key Resources Buildings at Risk to Wildfire by Sector

Sector	Number of Buildings at Risk	Estimated Damages
Commercial Facilities	7	$11,385,851
Critical manufacturing	7	$24,434,636
Food and Agriculture	57	$2,484,018
Transportation Systems	2	$381,965
All Categories	**73**	**$38,686,470**

Source: NCEM Risk Management Tool

ENVIRONMENT

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

CONSEQUENCE ANALYSIS

Table 4.130 summarizes the potential detrimental consequences of wildfire.

Table 4.130 – Consequence Analysis - Wildfire

Category	Consequences
Public	In addition to the potential for fatalities, wildfire and the resulting diminished air quality pose health risks. Exposure to wildfire smoke can cause serious health problems within a community, including asthma attacks and pneumonia, and can worsen chronic heart and lung diseases. Vulnerable populations include children, the elderly, people with respiratory problems or with heart disease. Even healthy citizens may experience minor symptoms, such as sore throats and itchy eyes.
Responders	Public and firefighter safety is the first priority in all wildland fire management activities. Wildfires are a real threat to the health and safety of the emergency services. Most fire-fighters in rural areas are 'retained'. This means that they are part-time and can be called away from their normal work to attend to fires.
Continuity of Operations (including Continued Delivery of Services)	Wildfire events can result in a loss of power which may impact operations. Downed trees, power lines and damaged road conditions may prevent access to critical facilities and/or emergency equipment.
Property, Facilities and Infrastructure	Wildfires frequently damage community infrastructure, including roadways, communication networks and facilities, power lines, and water distribution systems. Restoring basic services is critical and a top priority. Efforts to restore roadways include the costs of maintenance and damage assessment teams, field data collection, and replacement or repair costs. Direct impacts to municipal water supply may occur through contamination of ash and debris during the fire, destruction of aboveground distribution lines, and soil erosion or debris deposits into waterways after the fire. Utilities and communications repairs are also necessary for equipment damaged by a fire. This includes power lines, transformers, cell phone towers, and phone lines.
Environment	Wildfires cause damage to the natural environment, killing vegetation and animals. The risk of floods and debris flows increases after wildfires due to the exposure of bare ground and the loss of vegetation. In addition, the secondary effects of wildfires, including erosion, landslides, introduction of invasive species, and changes in water quality, are often more disastrous than the fire itself.

Economic Condition of the Jurisdiction	Wildfires can have significant short-term and long-term effects on the local economy. Wildfires, and extreme fire danger, may reduce recreation and tourism in and near the fires. If aesthetics are impaired, local property values can decline. Extensive fire damage to trees can significantly alter the timber supply, both through a short-term surplus from timber salvage and a longer-term decline while the trees regrow. Water supplies can be degraded by post-fire erosion and stream sedimentation. Wildfires can also have positive effects on local economies. Positive effects come from economic activity generated in the community during fire suppression and post-fire rebuilding. These may include forestry support work, such as building fire lines and performing other defenses, or providing firefighting teams with food, ice, and amenities such as temporary shelters and washing machines.
Public Confidence in the Jurisdiction's Governance	Wildfire events may cause issues with public confidence because they have very visible impacts on the community. Public confidence in the jurisdiction's governance may be influenced by: • The jurisdiction's actions taken pre-disaster to mitigate and prepare for impacts, including the amount of public education provided • The jurisdiction's efforts to provide warning to residents • The jurisdiction's actions taken to respond to the event • The jurisdiction's actions taken to recover from the impacts and return impacted communities to the same or better state before the wildfire occurred

HAZARD SUMMARY BY JURISDICTION

The following table summarizes wildfire hazard risk by jurisdiction. Wildfire warning time and duration do not vary by jurisdiction. Spatial extent ratings were based on the proportion of area within the WUI; all jurisdictions have at least 50% of their area in the WUI and were assigned a rating of 3. Impact ratings were based on fire intensity data from SWRA. Jurisdictions with significant clusters of moderate to high fire intensity were assigned a rating of 3; all other jurisdictions were assigned a rating of 2. Probability ratings were determined based on burn probability data from SWRA. Jurisdictions with clusters of moderate burn probability were assigned a rating of 3; all other jurisdictions were assigned a probability of 2.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	3	3	3	4	3	3.1	H
Apex	2	2	3	4	3	2.5	M
Cary	2	2	3	4	3	2.5	M
Fuquay-Varina	3	2	3	4	3	2.8	M
Garner	3	2	3	4	3	2.8	M
Holly Springs	3	2	3	4	3	2.8	M
Knightdale	2	3	3	4	3	2.8	M
Morrisville	2	2	3	4	3	2.5	M
Raleigh	2	2	3	4	3	2.5	M
Rolesville	2	3	3	4	3	2.8	M
Wake Forest	2	2	3	4	3	2.5	M
Wendell	2	2	3	4	3	2.5	M
Zebulon	3	2	3	4	3	2.8	M

4.5.13 CYBER THREAT

HAZARD BACKGROUND

The State of North Carolina Hazard Mitigation Plan defines cyber-attacks as "deliberate attacks on information technology systems in an attempt to gain illegal access to a computer, or purposely cause damage." Cyber-attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks.

There are many types of cyber-attacks. Among the most common is a direct denial of service, or DDoS attack. This is when a server or website will be queried or pinged rapidly with information requests, overloading the system and causing it to crash.

Malware, or malicious software, can cause numerous problems once on a computer or network, from taking control of users' machines to discreetly sending out confidential information. Ransomware is a specific type of malware that blocks access to digital files and demands a payment to release them. Hospitals, school districts, state and local governments, law enforcement agencies, businesses, and even individuals can be targeted by ransomware. One 2017 study found ransomware payments over a two-year period totaled more than $16 million. Even if a victim is perfectly prepared with full offline data backups, recovery from a sophisticated ransomware attack typically costs far more than the demanded ransom. However according to a 2016 study by Kaspersky Lab, roughly one in five ransomware victims who pay their attackers are still not able to retrieve their data.

Cyber spying or espionage is the act of illicitly obtaining intellectual property, government secrets, or other confidential digital information, and often is associated with attacks carried out by professional agents working on behalf of a foreign government or corporation. According to cybersecurity firm Symantec, in 2016 "…the world of cyber espionage experienced a notable shift towards more overt activity, designed to destabilize and disrupt targeted organizations and countries."

Major data breaches - when hackers gain access to large amounts of personal, sensitive, or confidential information - have become increasingly common. The Symantec report says more than seven billion identities have been exposed in data breaches over the last eight years. In addition to networked systems, data breaches can occur due to the mishandling of external drives, as has been the case with losses of some state employee data.

Cybercrime can refer to any of the above incidents when motivated primarily by financial gain or other criminal intent. The most severe type of attack is cyber terrorism, which aims to disrupt or damage systems in order to cause fear, injury, and loss to advance a political agenda.

The FBI is the lead federal agency for investigating cyberattacks by criminals, overseas adversaries, and terrorists. In North Carolina, the Department of Information Technology is the lead agency that maintains Cybersecurity and Risk Management resources. The North Carolina State Bureau of Investigation's Computer Crime Unit helps law enforcement across North Carolina solve sophisticated crimes involving digital evidence.

Warning Time: 4 – Less than six hours

Duration: 4 – More than one week

LOCATION

Cyber disruption events can occur and/or impact virtually any location where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching

effects beyond the location of the targeted system; disruptions that occur far outside the state can still impact people, businesses, and institutions within Wake County.

HISTORICAL OCCURRENCES

In May 2021, the Colonial Pipeline was shut down by a ransomware attack that infected the pipeline's digital systems. Attackers stole data and subsequently infected the Colonial Pipeline IT network with ransomware. Colonial Pipeline shut down the pipeline to prevent the ransomware from spreading and paid hackers to regain control of the system. The pipeline moves oil from the Gulf of Mexico to East Coast states and is one of the largest in the U.S. The attack led to an emergency declaration by President Biden. The shutdown caused a temporary jet fuel shortage, affecting airlines, and resulted in panic buying at gas stations in many states.

In September 2021, Wake County Public Schools' phone service provider experienced a cyber attack, causing a partial outage of the phone service that impacted several schools.

In May 2023, Raleigh Housing Authority (RHA) was hit by a cyber attack that shut down computer systems and business operations. The RHA served almost 6,000 residents.

Also in May 2023, more than a dozen North Carolina hospitals and health care providers were affected by a ransomware attack that hit software used by a communications vendor. Law enforcement believed the attack came from a criminal group based in Russia. Personal data may have been stolen through the attack.

More severe local events are possible. The City of Atlanta was hit by a major ransomware attack in 2018, recovery from which wound up costing a reported $2.6M, significantly more than the $52,000 ransom demand. A similar attack against the city of Baltimore in 2019 affected the city government's email, voicemail, property tax portal, water bill and parking ticket payment systems, and delayed more than 1,000 pending home sales.

The Privacy Rights Clearinghouse, a nonprofit organization focused on data privacy, maintains a timeline of 35,167 data breaches in the United States from 2002-2023. The database lists 359 data breaches in North Carolina, totaling over 16 million records breached. Of these breaches, 191 were the result of hacking, and multiple incidents targeted organizations located in Wake County. However, none of the reported breaches were specifically targeted at local government systems in Wake County, although some of them almost certainly included information on individuals who live in the county. Similarly, some county residents were almost certainly affected by national and international data breaches.

EXTENT

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed.

Impact: 1 – Minor

Spatial Extent: 2 – Small

PROBABILITY OF FUTURE OCCURRENCE

Cyber-attacks occur daily, but most have negligible impacts at the county level. The possibility of a larger disruption affecting the county exists at all times, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become commonplace occurrences, but are usually stopped with minimal impact. Similarly data breaches impacting the information of Wake County residents are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems in the county are less likely but cannot be ruled out.

Probability: 2 – Possible

CLIMATE CHANGE

Climate change is not expected to affect incidence of cyber-attacks.

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Vulnerability to cyber-attacks was assessed based on past occurrences nationally and internationally as well as publicly available information on these vulnerabilities.

PEOPLE

Cyber-attacks can have a significant cumulative economic impact. Symantec reports that in the last three years, businesses have lost $3 billion due to spear-phishing email scams alone. A major cyber-attack has the potential to undermine public confidence and build doubt in their government's ability to protect them from harm.

Injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

PROPERTY

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks are typically limited to computer systems.

ENVIRONMENT

The vast majority of cyber incidents have little to no environmental impact. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

CONSEQUENCE ANALYSIS

Table 4.131 summarizes the potential consequences of a cyber-attack.

Table 4.131 – Consequence Analysis – Cyber Threat

Category	Consequences
Public	Cyber-attacks can impact personal data and accounts. Injuries or fatalities could potentially result from a major cyber terrorist attack against critical infrastructure.

Category	Consequences
Responders	Cyber-attacks can impact personal data and accounts. Injuries or fatalities could potentially result from a major cyber terrorist attack against critical infrastructure.
Continuity of Operations (including Continued Delivery of Services)	Agencies that rely on electronic backup of critical files are vulnerable. The delivery of services can be impacted since governments rely, to a great extent, upon electronic delivery of services.
Property, Facilities and Infrastructure	Rare. Most attacks affect only data and computer systems. Sabotage of utilities and infrastructure from a major cyber terrorist attack could potentially result in system failures that damage property on a scale equal with natural disasters. Facilities and infrastructure may become unusable as a result of a cyber-attack.
Environment	Rare. A major attack could theoretically result in a hazardous materials release.
Economic Condition of the Jurisdiction	Could greatly affect the economy. In an electronic-based commerce society, any disruption to daily activities can have disastrous impacts to the economy. It is difficult to measure the true extent of the impact.
Public Confidence in the Jurisdiction's Governance	The government's inability to protect critical systems or confidential personal data could impact public confidence. An attack could raise questions regarding the security of using electronic systems for government services.

HAZARD SUMMARY BY JURISDICTION

The table below summarizes cyber threat risk by jurisdiction. Risk does not vary across the planning area.

Jurisdiction	Probability	Impact	Spatial Extent	Warning Time	Duration	Score	Priority
Wake County	2	1	2	4	4	2.5	M
Apex	2	1	2	4	4	2.5	M
Cary	2	1	2	4	4	2.5	M
Fuquay-Varina	2	1	2	4	4	2.5	M
Garner	2	1	2	4	4	2.5	M
Holly Springs	2	1	2	4	4	2.5	M
Knightdale	2	1	2	4	4	2.5	M
Morrisville	2	1	2	4	4	2.5	M
Raleigh	2	1	2	4	4	2.5	M
Rolesville	2	1	2	4	4	2.5	M
Wake Forest	2	1	2	4	4	2.5	M
Wendell	2	1	2	4	4	2.5	M
Zebulon	2	1	2	4	4	2.5	M

4.5.14 HAZARDOUS MATERIALS INCIDENT

HAZARD BACKGROUND

A hazardous substance is any substance that may cause harm to persons, property, or the environment when released to soil, water, or air. Chemicals are manufactured and used in increasing types and quantities. Each year over 1,000 new synthetic chemicals are introduced and as many as 500,000 products pose physical or health hazards and can be defined as "hazardous chemicals". Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. Hazardous material incidents generally affect a localized area.

FIXED HAZARDOUS MATERIALS INCIDENT

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

TRANSPORTATION HAZARDOUS MATERIALS INCIDENT

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during transport. In Wake County, these incidents can occur during highway or air transport. Highway accidents involving hazardous materials pose a great potential for public exposures, particularly for nearby populations and motorists. If airplanes carrying hazardous cargo crash, or otherwise leak contaminated cargo, populations and the environment in the impacted area can become exposed.

PIPELINE INCIDENT

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Warning Time Score: 4 – Less than six hours

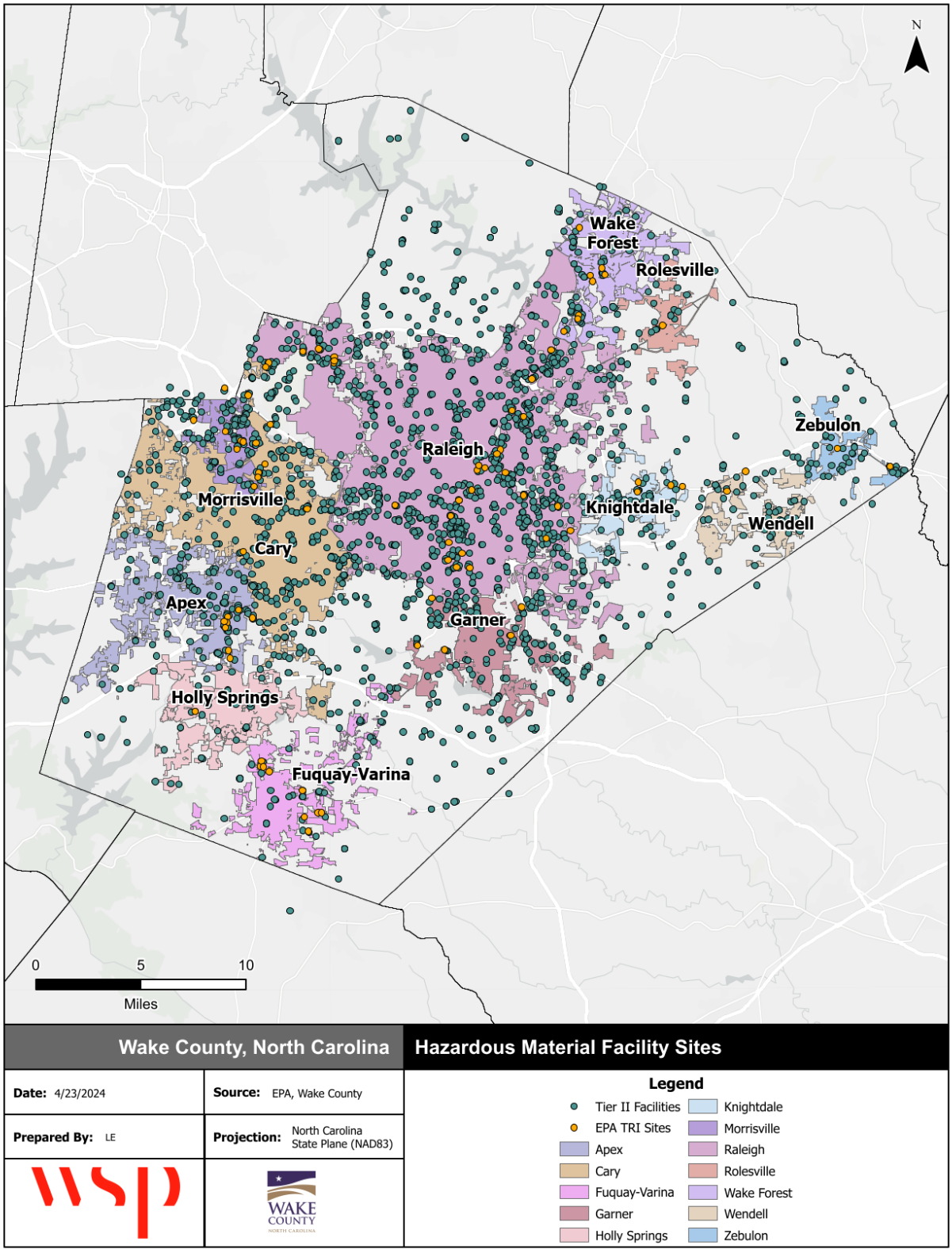
Duration Score: 2 – Less than 24 hours

LOCATION

The Toxics Release Inventory (TRI) Program run by the U.S. Environmental Protection Agency (EPA) maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The EPA reports 35 TRI sites in Wake County. Wake County Emergency Management also tracks Tier II facility data, which covers facilities that are required to report to the EPA under the Emergency Planning and Community Right-to-Know Act (EPCRA) because they have hazardous materials present in quantities equal to or greater than 500 lbs, 55 gallons, or the Threshold Planning Quantity. Wake County has approximately one fourth of the Tier II reporting facilities in the state of North Carolina, with over 2,300 facilities in 2023. TRI and Tier II sites are shown in Figure 4.33.

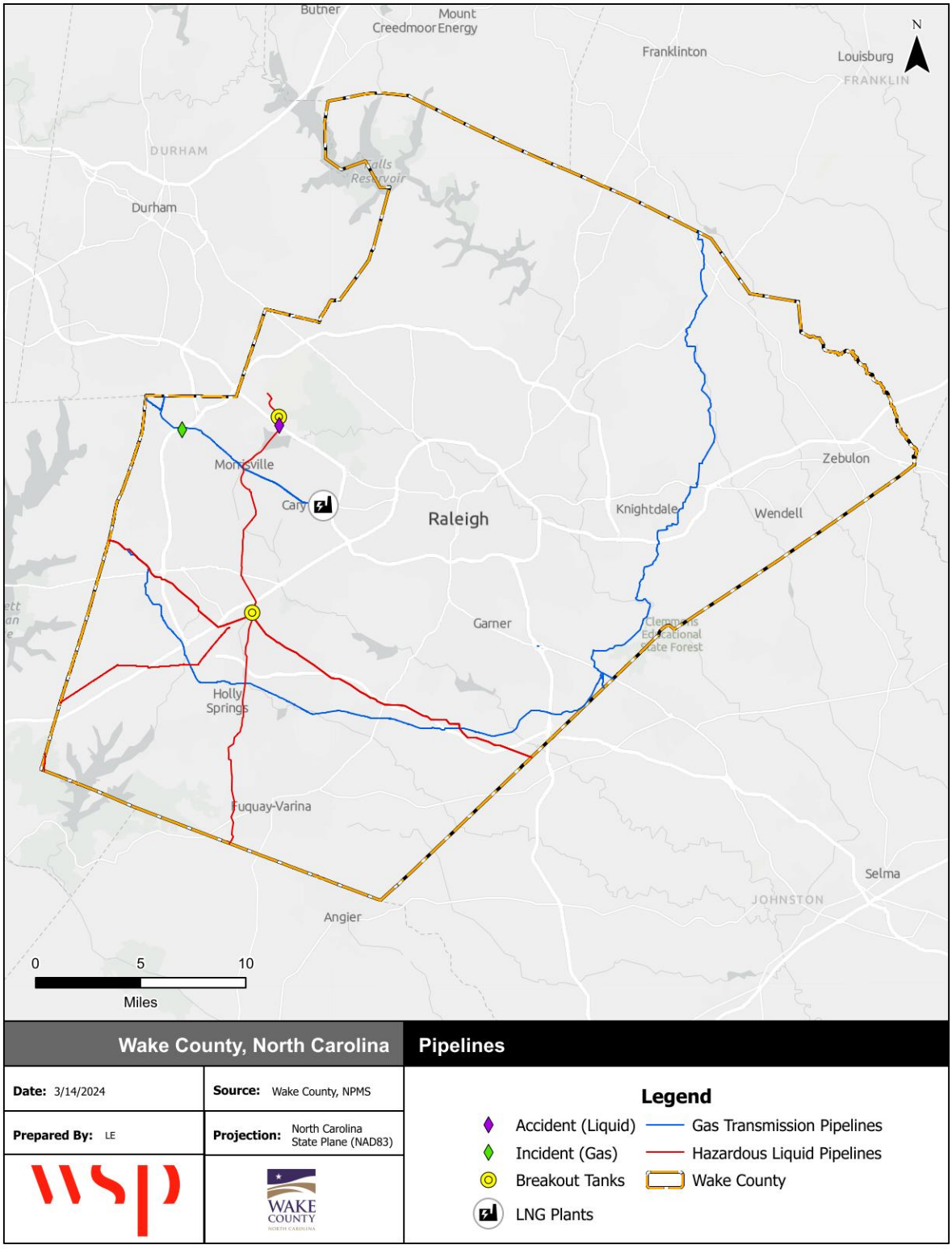
The U.S. Department of Transportation (USDOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains an inventory of all gas transmission and hazardous liquid pipelines, liquid natural gas plants, and hazardous liquid breakout tanks. The location of pipelines and pipeline infrastructure in Wake County are shown in Figure 4.34, per the National Pipeline Mapping System.

Figure 4.33 – Hazardous Materials Facility Sites in Wake County



Source: EPA Toxic Release Inventory, Wake County

Figure 4.34 – Pipelines and Pipeline Infrastructure in Wake County



Source: US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, National Pipeline Mapping System

Table 4.132 shows the estimated exposure by occupancy that would occur within 0.5 miles of the TRI sites located in Wake County. Residential occupancy represents the majority of exposure at 95 percent. Additionally, Table 4.133 shows the total exposure and estimated structure and content values by jurisdiction within 0.5 miles of the TRI sites located in Wake County.

Table 4.132 - Total Exposure to HAZMAT by Occupancy within 0.5 Miles in Wake County

Occupancy	Estimated Parcel Count	Structure Value	Estimated Content Value	Total Value
Agriculture	578	$202,361,744	$202,361,744	$404,723,488
Commercial	6352	$22,873,407,312	$22,873,407,312	$45,746,814,624
Education	352	$5,836,287,982	$5,836,287,982	$11,672,575,964
Government	1076	$8,673,014,682	$8,673,014,682	$17,346,029,364
Industrial	2071	$7,122,677,973	$10,684,016,960	$17,806,694,933
Religious	779	$2,455,280,875	$2,455,280,875	$4,910,561,750
Residential	258877	$115,611,444,640	$57,805,722,320	$173,417,166,960
Total	**270,085**	**$162,774,475,208**	**$108,530,091,875**	**$271,304,567,083**

Source: EPA, GIS Analysis

Table 4.133 – Total Exposure to HAZMAT by Jurisdiction within 0.5 Miles in Wake County

Jurisdiction	Estimated Parcel Count	Structure Value	Estimated Content Value	Total Value
Apex	18,957	$10,106,992,575	$6,273,327,367	$16,380,319,942
Cary	44,924	$30,101,760,659	$18,800,158,720	$48,901,919,379
Fuquay-Varina	10,499	$4,764,728,865	$3,019,130,233	$7,783,859,098
Garner	11,442	$5,965,425,186	$4,588,019,286	$10,553,444,472
Holly Springs	7,941	$5,524,974,346	$3,924,305,674	$9,449,280,020
Knightdale	6,707	$3,169,303,614	$2,198,808,422	$5,368,112,036
Morrisville	6,801	$6,206,358,382	$4,617,526,222	$10,823,884,604
Raleigh	116,636	$73,198,579,694	$50,137,784,703	$123,336,364,397
Rolesville	2,991	$1,455,441,787	$832,910,928	$2,288,352,715
Wendell	4,048	$1,420,726,324	$963,697,587	$2,384,423,911
Wake Forest	11,035	$6,013,467,284	$3,809,550,878	$9,823,018,162
Zebulon	3,013	$1,211,897,515	$1,027,395,615	$2,239,293,130
Unincorporated Wake County	25,091	$13,634,818,977	$8,337,476,242	$21,972,295,219
Total	**270,085**	**$162,774,475,208**	**$108,530,091,875**	**$271,304,567,083**

Source: EPA, GIS Analysis

EXTENT

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The USDOT's PHMSA, which records hazardous material incidents across the country, defines a "serious incident" as a hazardous materials incident that involves:

- A fatality or major injury caused by the release of a hazardous material,

- The evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- A release or exposure to fire which results in the closure of a major transportation artery,
- The alteration of an aircraft flight plan or operation,
- The release of radioactive materials from Type B packaging,
- The release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- The release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

Impact: 2 – Limited

Spatial Extent: 1 – Negligible

HISTORICAL OCCURRENCES

The USDOT PHMSA's National Pipeline Mapping System records two events within Wake County:

April 6, 2005 – Excavation damage recorded on a PSNC Energy pipeline. No fatalities or injuries occurred.

September 16, 2009 – Damage occurred on to a Colonial Pipeline Co. pipeline causing 0.90 barrels of aviation kerosene to be released. The cause of the accident was reported as "Material/Weld/Equipment Failure".

PHMSA also maintains a database of other reported hazardous materials incidents, which are summarized in Table 4.134 by hazard class and mode of transport. According to PHMSA records, there were 719 recorded releases in Wake County from 1998 through 2023. Eighteen events were considered serious incidents, of which 14 were serious bulk releases; 5 events were flagged for serious evacuation.

Table 4.134 – Hazardous Materials Releases in Wake County, 1998 – 2023

Location & Mode of Release	Hazard Class	Incident Count
Wake County		**5**
Air (RDU Airport)	Flammable - Combustible Liquid	1
Air (RDU Airport)	Miscellaneous Hazardous Material	1
Highway (Clayton)	Corrosive Material	1
Highway (Eagle Rock)	Miscellaneous Hazardous Material	1
Highway (Willow Spring)	Flammable - Combustible Liquid	1
Apex		**2**
Highway	Corrosive Material	1
Highway	Flammable - Combustible Liquid	1
Cary		**6**
Highway	Corrosive Material	2
Highway	Flammable - Combustible	3
Highway	Non-Flammable Gas	1
Fuquay Varina		**3**
Highway	Flammable – Combustible Liquid	2
Highway	Oxidizer	1
Garner		**5**
Highway	Corrosive Material	5
Knightdale		**2**
Highway	Flammable - Combustible Liquid	1

Location & Mode of Release	Hazard Class	Incident Count
Highway	Oxidizer	1
Morrisville		**209**
Air	Corrosive Material	3
Air	Flammable - Combustible Liquid	13
Air	Flammable Gas	4
Air	Poisonous Materials	2
Air	Miscellaneous Hazardous Material	11
Air	Nonflammable Compressed Gas	9
Air	(Not Defined)	1
Air Subtotal		43
Highway	Corrosive Material	70
Highway	Flammable - Combustible Liquid	67
Highway	Flammable Gas	1
Highway	Flammable Solid	2
Highway	Nonflammable Compressed Gas	*8*
Highway	Organic Peroxide	3
Highway	Oxidizer	3
Highway	Hazardous Gas	1
Highway	Poisonous Materials	11
Highway Subtotal		*166*
Raleigh		**471**
Air	Corrosive Material	12
Air	Flammable - Combustible Liquid	13
Air	Flammable Gas	1
Air	Flammable Solid	1
Air	Miscellaneous Hazardous Material	5
Air	Nonflammable Compressed Gas	1
Air	Organic Peroxide	1
Air	Poisonous Materials	5
Air	(Not Defined)	1
Air Subtotal		40
Highway	Hazardous Gas	3
Highway	Corrosive Material	164
Highway	Flammable - Combustible Liquid	189
Highway	Flammable Gas	5
Highway	Flammable Solid	2
Highway	Miscellaneous Hazardous Material	5
Highway	Nonflammable Compressed Gas	18
Highway	Organic Peroxide	4
Highway	Oxidizer	24
Highway	Poisonous Materials	6
Highway	(Not Defined)	1
Highway Subtotal		*421*
Rail	Corrosive Material	3
Rail	Flammable - Combustible Liquid	3
Rail	Miscellaneous Hazardous Material	2

Location & Mode of Release	Hazard Class	Incident Count
Rail	Nonflammable Compressed Gas	1
Rail	Oxidizer	1
Rail Subtotal		*10*
Rolesville		**2**
Highway	Hazardous Gas	1
Highway	Flammable - Combustible Liquid	1
Wake Forest		**5**
Highway	Corrosive Material	2
Highway	Flammable - Combustible Liquid	3
Wendell		**2**
Highway	Corrosive Material	1
Highway	Very Insensitive Explosive	1
Zebulon		**7**
Highway	Corrosive Material	2
Highway	Flammable - Combustible Liquid	2
Highway	Flammable Gas	2
Highway	Poisonous Materials	1
Total		**719**

Source: PHMSA Incident Reports, Office of Hazardous Materials Safety, Incident Reports Database Search, data as of Feb 27, 2024.
Note: Unincorporated Wake County incidents include reports for Willow Spring, Clayton, Eagle Rock, and RDU Airport.

The following narratives, recorded in the PHMSA database, are for a selection of past releases deemed serious incidents, and illustrate the types of spills and damages that may occur:

Zebulon, March 24, 2003 – A transport truck was involved in a single vehicle accident which caused the load to shift and the bulk tank to rollover. The tank ruptured, which caused the loss of approx. 3000 gallons of gasoline. The spill was contained by Wendell Fire Department Hazmat Unit. Reclamation and renovation of the site was performed by eastern environmental. The driver was the only injury. He was hospitalized but recovered fully.

Zebulon, July 14, 2004 – delivery driver had finished his delivery to this customer. Driver was doing his normal vehicle walk around check, he heard a noise, looked under the unit and noticed a leak out of the belly valve area. He tried the emergency shut-off but the leak was past this area. Driver was able to manually shut this leak down. Driver had noted that after his delivery unit was @ 35% after he shut off the leak it was at 30% this is how we determined the gallon of release. Driver called the local fire department and hazmat team they evacuated approximately 10 people from about 300 yds away. They had a small two-lane road closed for about 3 hours. No property damages. No injuries.

Cary, July 10, 2013 – While entering parking lot at Ace Hardware in Cary North Carolina it appears the freight shifted and punctured one 300-gallon tote of caustic soda 50% being shipped as sodium hydroxide solution. Approximately 250 gallons of free product released to the trailer floor and asphalt parking lot. Cary Fire Department responded to assess the site and proceeded to wash the parking lot with excessive amounts of water. As a result, free product and water affected the asphalt parking lot entrance around to back of store and impacted outside pallets and debris being held outside the hardware store. Environmental Restoration and Hepaco were dispatched to perform the cleanup. Upon arrival on site absorbent material was applied to the affected area in an effort to contain. Due to the large area of impact as a result of the fire department water placement a vacuum truck was dispatched to recover free liquids from the lot. Environmental Restoration and Hepaco personnel proceeded to recover free product and wash waters from the parking lot while neutralizing the caustic material. Once the parking lot was secure

Hepaco Inc. proceeded to offload trailer clean impacted trailer floor and surrounding areas and containerize remaining free product. Freight was loaded onto a recovery trailer provided by Wilson Trucking Corporation to be sent on to its destination. Following a rain event in the area Hepaco returned to the site collected residual product and site was deemed for closure. Disposal was coordinated in accordance with local state and federal regulations. There were no injuries or exposures reported.

Raleigh, April 27, 2020 – Package driver opened the rear door of his package car at the customer location. Product had leaked onto the rubber strip at the bottom of the door and splashed into driver's face and dripped down onto his legs below both knees. On road responder arrived on the scene with mobile spill cart and PPE. He identified the contents, and contained and cleaned the spill, and arranged for driver to receive medical attention. Driver experienced burning on his face and legs and was transported to the burn center.

Raleigh, June 9, 2021 - PVS Transportation driver was scheduled to deliver a shipment of Hypochlorite 12.5% to MVP Services Inc. in Raleigh, NC. Once the driver arrived on site, he noticed there were three tanks and proceeded to fill the back tanks firsFt. After the driver proceeded to hook up to the customer tank and product flowing the driver proceeded back to his truck. Two MVP Service employees noticed product was overfilling the tank and notified the driver. The driver proceeded to shut down the delivery and approximately 300 gallons was released into customer's containment.

Cary, January 18, 2022 - While transporting a 1,000 gallon portable site tank, tank fell from trailer, which resulted in the release of approximately 150 gallons of fuel oil. Free product released to the asphalt roadway and adjacent soil. North Carolina DOT and Local FD responded to assess the site. North Carolina DOT applied sand to the affected roadway, to contain free product, which was swept to the shoulder. Miller Environmental was dispatched to perform additional cleanup. Miler Environmental coordinated removal of contaminated sand, and excavation of impacted soil to ensure all contamination was recovered. Disposal was coordinated in accordance with local, state, and federal regulations. There were no injuries or exposures reported.

PROBABILITY OF FUTURE OCCURRENCE

Based on historical occurrences recorded by PHMSA, there have been 18 serious incidents of hazardous materials release in the 25-year period from 1998 through 2023. Using historical occurrences as an indication of future probability, there is a 72 percent annual probability of a serious incident occurring.

Probability: 3 – Likely

VULNERABILITY ASSESSMENT

PEOPLE

People near facilities storing or transporting hazardous materials are at higher risk of exposure to a release incident. Additionally, any individuals working with or transporting hazardous materials are also at heightened risk. Depending on the materials, they may pose certain health hazards. If hazardous materials contaminate soils or water supply, people may be at risk of exposure through food or water.

PROPERTY

A radiological incident could cause severe damage to the power station itself but would not cause direct property damage outside the station. However, property values could drop substantially if a radiological incident resulted in contamination of nearby areas.

ENVIRONMENT

A radiological incident could result in the spread of radioactive material into the environment, which could contaminate water and food sources and harm animal and plant life.

CONSEQUENCE ANALYSIS

Table 4.135 summarizes the potential detrimental consequences of hazardous materials incident.

Table 4.135 – Consequence Analysis – Hazardous Materials Incident

Category	Consequences
Public	Contact with hazardous materials could cause serious illness or death. Those living and working closest to hazardous materials sites face the greatest risk of exposure. Exposure may also occur through contamination of food or water supplies.
Responders	Responders face similar risks as the general public but a heightened potential for exposure to hazardous materials.
Continuity of Operations (including Continued Delivery of Services)	A hazardous materials incident may cause temporary road closures or other localized impacts but is unlikely to affect continuity of operations.
Property, Facilities and Infrastructure	Some hazardous materials are flammable, explosive, and/or corrosive, which could result in structural damages to property. Impacts would be highly localized.
Environment	Consequences depend on the type of material released. Possible ecological impacts include loss of wildlife, loss of habitat, and degradation of air and/or water quality.
Economic Condition of the Jurisdiction	Clean up, remediation, and/or litigation costs may apply. Long-term economic damage is unlikely.
Public Confidence in the Jurisdiction's Governance	A hazardous materials incident may affect public confidence if the environmental or health impacts are enduring.

4.5.15 RADIOLOGICAL INCIDENT

HAZARD BACKGROUND

A radiological incident is an occurrence resulting in the release of radiological material at a fixed facility (such as power plants, hospitals, laboratories, etc.) or in transit.

Radiological incidents related to transportation are described as an incident resulting in a release of radioactive material during transportation. Transportation of radioactive materials through North Carolina over the interstate highway system is considered a radiological hazard. The transportation of radioactive material by any means of transport is licensed and regulated by the federal government. As a rule, there are two categories of radioactive materials that are shipped over the interstate highways:

- Low level waste consists of primarily of materials that have been contaminated by low level radioactive substances but pose no serious threat except through long-term exposure. These materials are shipped in sealed drums within placarded trailers. The danger to the public is no more than a wide array of other hazardous materials.
- High level waste, usually in the form of spent fuel from nuclear power plants, is transported in specially constructed casks that are built to withstand a direct hit from a locomotive.

Radiological emergencies at nuclear power plants are divided into classifications. Table 4.136 shows these classifications, as well as descriptions of each.

Table 4.136 – Radiological Emergency Classifications

Emergency Classification	Description
Notification of Unusual Event (NOUE)	Events are in progress or have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.
Alert	Events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life-threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the Environmental Protection Agency (EPA) Protective Action Guides (PAGs)
Site Area Emergency (SAE)	Events are in progress or have occurred which involve actual or likely major failures of plant functions needed for protection of the public or hostile action that results in intentional damage or malicious acts; 1) toward site personnel or equipment that could lead to the likely failure of or; 2) that prevent effective access to, equipment needed for the protection of the public. Any releases are not expected to result in exposure levels which exceed EPA PAG exposure levels beyond the site boundary.
General Emergency	Events are in progress or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity or hostile action that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA PAG exposure levels offsite for more than the immediate site area.

Warning Time: 4 – Less than 6 hours

Duration: 4 – More than one week

LOCATION

Harris Nuclear Plant, which is located in southwest Wake County, is a single-unit 964-megawatt power plant. The plant began commercial operation in 1987 and now employs over 500 people. Its reactor is a pressurized water reactor and the plant operates with a very high level of security. This is the location from which the most catastrophic nuclear accident might occur in Wake County and will be the focal point of the nuclear analysis in this plan. However, it should also be noted that there is a 1-megawatt PULSTAR research reactor located on North Carolina State University's campus in downtown Raleigh. Although its impacts would potentially be less far-reaching than Harris Nuclear Plant's in the event of an accident, it should still be noted that the effects could be extremely detrimental, especially to citizens and property within Raleigh.

The Nuclear Regulatory Commission defines two emergency planning zones around nuclear plants:

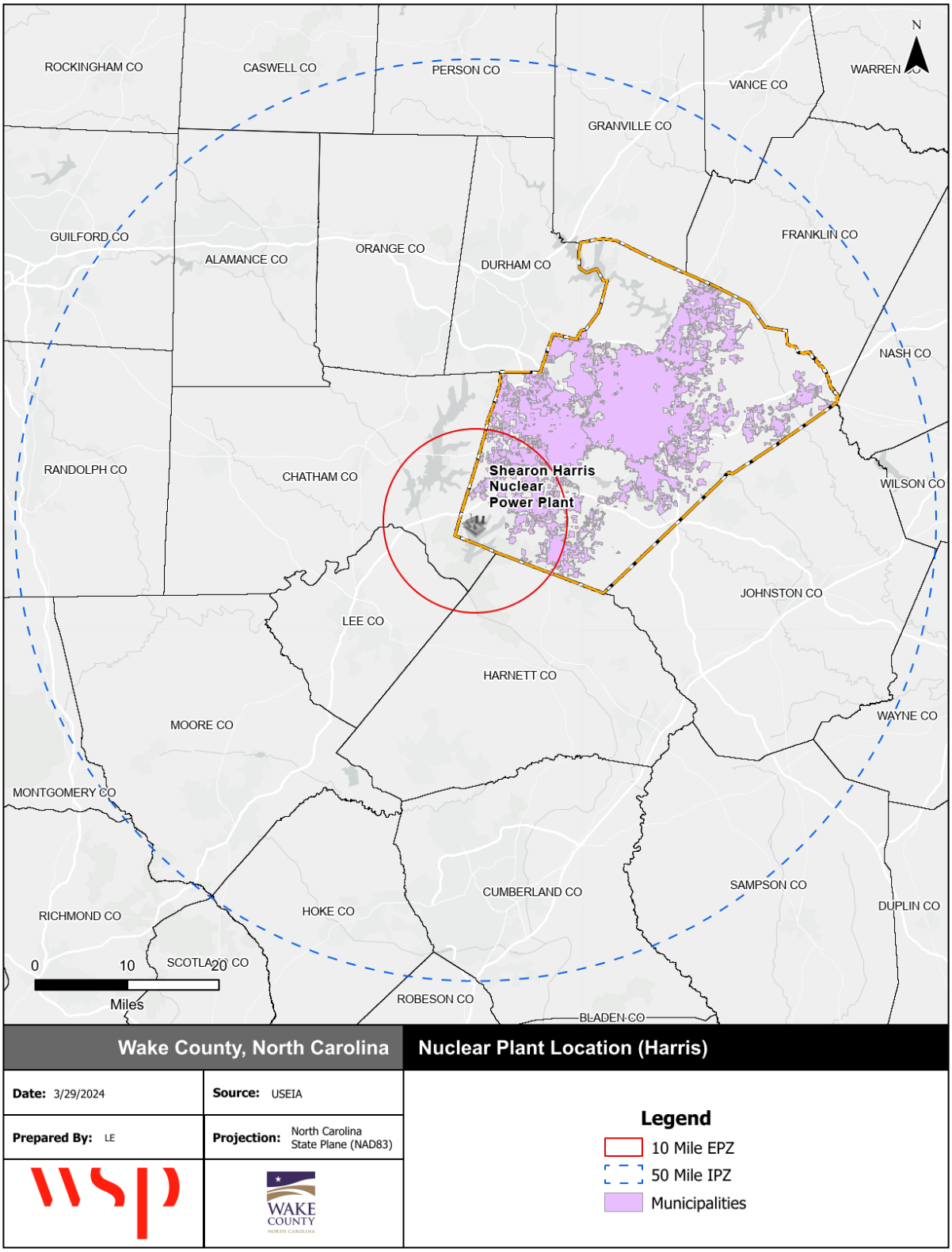
- **Emergency Planning Zone (EPZ)** – The EPZ is a 10-mile radius around nuclear facilities. It is also known as the Plume Exposure Pathway. Areas located within this zone are considered to be at highest risk of exposure to radioactive materials. Within this zone, the primary concern is exposure to and inhalation of radioactive contamination. Predetermined action plans within the EPZ are designed to avoid or reduce dose from such exposure. Residents within this zone would be expected to evacuate in the event of an emergency. Other actions such as sheltering, evacuation, and the use of potassium-iodide must be taken to avoid or reduce exposure in the event of a nuclear incident.
- **Ingestion Pathway Zone (IPZ)** – The IPZ is delineated by a 50-mile radius around nuclear facilities as defined by the federal government. Also known as the Ingestion Exposure Pathway, the IPZ has been designated to mitigate contamination in the human food change resulting from a radiological accident at a nuclear power facility. Contamination to fresh produce, water supplies, and other food produce may occur when radionuclides are deposited on surfaces.

Figure 4.35 shows the location of Harris Nuclear Plant and the approximate 10-mile Emergency Planning Zone (EPZ) buffer and 50-mile Ingestion Pathway Zone (IPZ) around the plant. Nearly all of Apex and Holly Springs, and much of western Fuquay-Varina fall within the EPZ for Harris Nuclear Plant. All of Wake County falls within the IPZ for Harris Nuclear Plant.

The entire county is at risk to a nuclear incident. However, areas in the southwest part of the region are more susceptible due to their proximity to the Harris Nuclear Plant and its 10-mile EPZ.

The Nuclear Regulatory Commission defines two emergency planning zones around nuclear plants. Areas located within 10 miles of the station are considered to be within the zone of highest risk to a nuclear incident and this radius is the designated evacuation radius recommended by the Nuclear Regulatory Commission. Within the 10-mile zone, the primary concern is exposure to and inhalation of radioactive contamination. The most concerning effects in the secondary 50-mile zone are related to ingestion of food and liquids that may have been contaminated. All areas of the county that are not located within the 10-mile radius are located within this 50-mile radius that is still considered to be at risk from a nuclear incident.

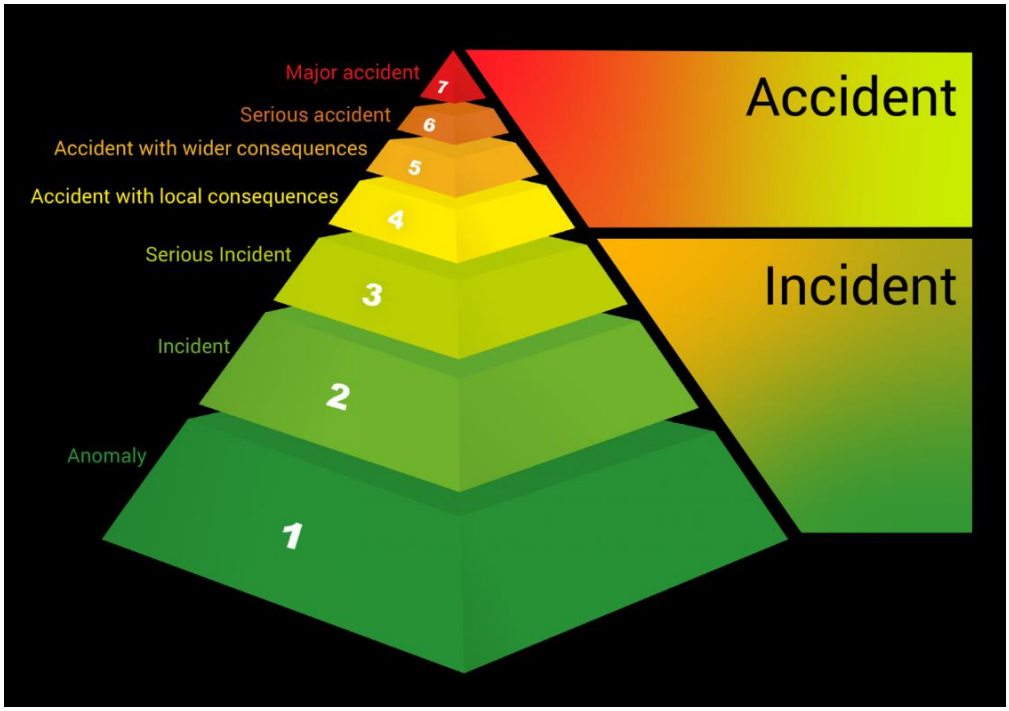
Figure 4.35 – Harris Nuclear Plant Location



EXTENT

The International Atomic Energy Association (IAEA) developed the International Nuclear and Radiological Event Scale to quantify the magnitude of radiological events. This scale is logarithmic, meaning each increasing level represents a 10-fold increase in severity compared to the previous level.

Figure 4.36 – International Nuclear and Radiological Event Scale



Source: International Atomic Energy Association

Impact: 4 – Catastrophic

Spatial Extent: 2 – Small

HISTORICAL OCCURRENCES

As reported in the 2023 State Hazard Mitigation Plan, Harris Nuclear Plant is one of only three plants in the country to have had no Nuclear Regulatory Commission findings as of February 2024. Therefore, there are no recent historical occurrences of any serious incidents at the Harris Plant. However, there have been events that warranted emergency declarations at both the Harris Nuclear Plant and the PULSTAR research reactor at North Carolina State University. Table 4.137 lists emergency declarations reported at the Harris Nuclear Plant between 1986 and 2023.

Table 4.137 – Emergency Declarations at Harris Nuclear Plant, 1986 – 2023

Emergency Declaration	Date	Description
Alert	08/12/1988	Loss of greater than 50% of main control board (MCB) alarms due to electrical problems; normal power supply to annunciator panel failed and did not transfer to its backup inverter.
Alert	10/09/1988	Fire on "B" Main Electrical Transformer; release of flammable gas in the Protected Area.
Unusual Event	11/28/1986	Loss of ERFIS computer system to display Safety Parameter Display System (SPDS) (55 lapsed minutes).

Emergency Declaration	Date	Description
Unusual Event	11/29/1986	Loss of ERFIS computer system to display SPDS (58 lapsed minutes).
Unusual Event	11/30/1986	Loss of ERFIS computer system to display SPDS (48 lapsed minutes).
Unusual Event	12/03/1986	Loss of ERFIS computer system to display SPDS (27 lapsed minutes).
Unusual Event	12/11/1986	Safety Injection (an Emergency Core Cooling System) actuated while testing electronic circuitry.
Unusual Event	01/27/1987	Loss of ERFIS computer system to display SPDS (23 lapsed minutes).
Unusual Event	07/11/1987	Loss of ERFIS computer system to display SPDS (22 lapsed minutes).
Unusual Event	07/24/1987	Loss of ERFIS computer system to display SPDS (32 lapsed minutes).
Unusual Event	07/25/1987	Loss of ERFIS computer system to display SPDS (28 lapsed minute).
Unusual Event	02/04/1988	Fire within the Protected Area greater than 10 minutes; smoke observed coming from the motor for the reactor auxiliary building supply fan.
Unusual Event	10/06/1988	RCS leakage in excess of Tech Specs (unidentified leakage > 1.0 gpm).
Unusual Event	10/20/1988	RCS leakage in excess of Tech Specs; pressure operated relief valve opened and admitted RCS inventory to the pressurized relief tank (PRT).
Unusual Event	11/17/1988	Loss of ERFIS computer system to display SPDS for > 60 minutes.
Unusual Event	12/01/1988	Reactor coolant system (RCS) leakage in excess of Tech Specs (unidentified leakage > 1.0 gpm).
Unusual Event	12/16/1988	High level alarm on radiological effluent release monitor the (Treated Laundry and Hot Shower high level alarm was set just above background).
Unusual Event	03/13/1989	Loss of ERFIS computer system to display SPDS for > 60 minutes.
Unusual Event	01/24/1991	Plant shutdown required by Technical Specifications. Excessive leakage of a containment penetration; leakage discovered during surveillance testing.
Unusual Event	02/15/1991	Loss of ERFIS computer system to display SPDS for > 4 hours.
Unusual Event	03/05/1991	Plant shutdown required by Technical Specifications (testing of “A” Reactor Coolant Pump (RCP) electrical protection function).
Unusual Event	04/14/1992	Loss of ERFIS computer system to display SPDS for > 4 hours.
Unusual Event	02/06/1993	Loss of ERFIS computer system to display SPDS for > 4 hours.
Unusual Event	02/17/1994	Loss of ERFIS computer system to display SPDS for > 4 hours.
Unusual Event	07/22/1994	Loss of both emergency diesel generators - “B” diesel generator was being worked on; in accordance with test procedures, “A” diesel generator is required to be tested within 24 hours following having redundant diesel out-of-service; did not pass test.
Unusual Event	11/05/1995	Unplanned emergency core cooling system (ECCS) discharge to the reactor vessel; reactor trip and safety injection (SI) occurred during the performance of testing.
Unusual Event	12/14/1995	Train derailment on site - while removing empty cask car from the Protected Area, the rail cars were moved onto the Engine Spur to allow passage of the CSX engine on adjacent Plant Spur; cask car shifted; 4 wheels of the car left the rails.
Unusual Event	01/22/1997	Security Event - while working Work Request and Authorization (WR&A), I&C Tech investigation found cut wire in a Turbine Building radiation monitor. Later determined to not be vandalism (i.e., not a security threat).

Emergency Declaration	Date	Description
Unusual Event	04/02/2000	Loss of Emergency Response Facility Information System (ERFIS) computer system to display Safety Parameter Display System (SPDS) for more than 4 hours.
Unusual Event	08/23/2011	Seismic activity at the site due to a magnitude 5.8 earthquake near Mineral, VA.

Source: 2019 Wake County Multi-Jurisdictional Hazard Mitigation Plan

Table 4.138 – Emergency Declarations at the PULSTAR Research Reactor, 1986 – 2023

Emergency Declaration	Date	Description
None	12/13/2010	A radiography technician walked in front of a 30 REM per hour beam of radiation for 60 seconds due to a shutter being left open. This incident was reported to the Nuclear Regulatory Commission (NRC), but no assistance was required from the City of Raleigh or Wake County.
None	07/02/2011	PULSTAR shut down due to a 10 gallon per hour leak. No emergency was declared (less than 350 gallons per hour reporting threshold), and no action was required from the City of Raleigh or Wake County.
Unusual Event	08/23/2011	Seismic activity at the site due to a magnitude 5.8 earthquake near Mineral, VA.

Source: 2019 Wake County Multi-Jurisdictional Hazard Mitigation Plan

PROBABILITY OF FUTURE OCCURRENCE

Radiological hazards are highly unpredictable. Nuclear reactors present the possibility of catastrophic damages, yet the industry is highly regulated and historical precedence suggests an incident is unlikely.

Probability: 1 – Unlikely

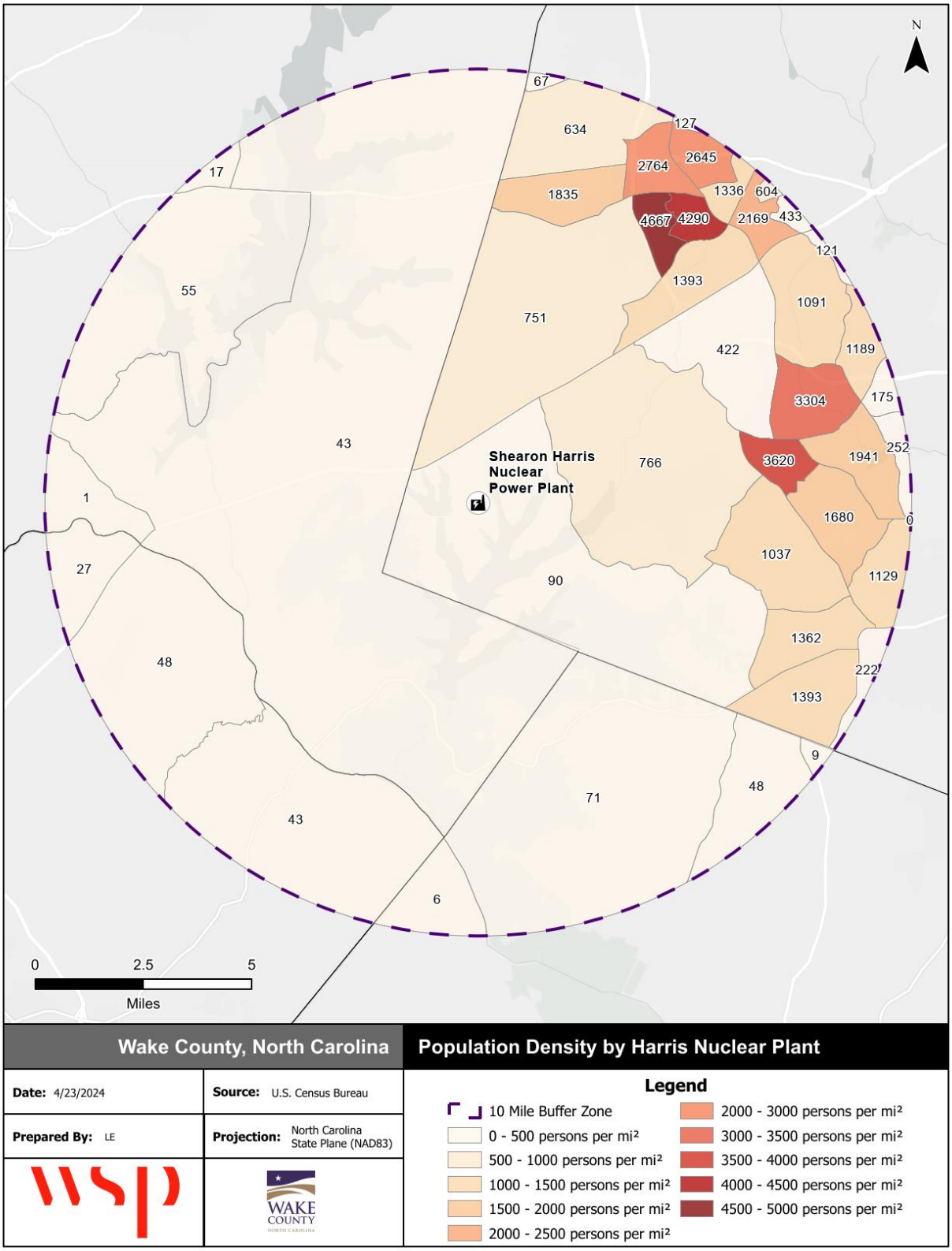
VULNERABILITY ASSESSMENT

PEOPLE

People within the 10-mile EPZ are at risk of direct exposure to radioactive material. People within the 50-mile EPZ are at risk of exposure through ingestion of contaminated food and water. Low levels of radiation are not considered harmful, but a high exposure to radiation can cause serious illness or death.

Figure 4.37 reflects the population density of census block groups within the 10-mile EPZ of Harris Nuclear Plant and indicates the potential vulnerability of people to a radiological incident.

Figure 4.37 – Population Density by Census Block Group within the Harris Nuclear Plant 10-Mile EPZ



Source: U.S. Census Bureau, GIS Analysis

PROPERTY

A radiological incident could cause severe damage to the power station itself but would not cause direct property damage outside the station. However, property values could drop substantially if a radiological incident resulted in contamination of nearby areas.

A GIS analysis was completed to determine the vulnerability of critical facilities to radiological incident by overlaying the Emergency Planning Zone area with the critical facilities inventory. The resulting vulnerability of critical facilities found within a 10-mile radius of the Harris Nuclear Plant EPZ is summarized in Table 4.139.

Table 4.139 – Critical Facilities within the Harris Nuclear Plant 10-Mile EPZ

Type	Critical Facility Count	Structure Value
Communications	21	$30,513,999
Energy	60	$75,160,261
Food, Hydration, Shelter	32	$517,187,525
Hazardous Materials	123	$889,145,639
Health and Medical	57	$183,500,329
Safety and Security	67	$269,941,810
Transportation	6	$19,976,201
Water Systems	47	$98,839,141
Total	**413**	**$2,084,264,905**

Source: NCEM IRISK Database; Wake County HMPC GIS analysis

ENVIRONMENT

A radiological incident could result in the spread of radioactive material into the environment, which could contaminate water and food sources and harm animal and plant life.

CONSEQUENCE ANALYSIS

Table 4.140 summarizes the potential detrimental consequences of radiological incident.

Table 4.140 – Consequence Analysis – Radiological Incident

Category	Consequences
Public	High levels of radiation could cause serious illness or death. Those living and working closest to the nuclear plant would face the greatest risk.
Responders	Responders face potential for heightened exposure to radiation, which could cause severe chronic illness and death.
Continuity of Operations (including Continued Delivery of Services)	An incident at the nuclear plant could interrupt power generation and cause power shortages. Regular operations would likely be affected by the response effort an event would require.
Property, Facilities and Infrastructure	The plant itself could be damaged by a radiological incident. Nearby property and facilities could be affected by contamination.
Environment	Water supplies, food crops, and livestock within 50 miles of the plant could be contaminated by radioactive material in the event of a major incident.
Economic Condition of the Jurisdiction	The local economy could be affected by a radiological incident. Property values and economic activity could decline as a result.
Public Confidence in the Jurisdiction's Governance	A radiological incident would likely cause severe loss of public confidence given that the hazard is human-caused and highly regulated. Public confidence can also be affected by false alarms.

4.5.16 TERRORISM

HAZARD BACKGROUND

There is no universal globally agreed-upon definition of terrorism. In a broad sense, terrorism is the use of violence and threats to intimidate or coerce, especially against civilians, in the pursuit of political aims. Terrorism is defined in the United States by the Code of Federal Regulations as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance of political or social objectives."

For this analysis, this hazard encompasses the following sub-hazards: enemy attack, biological terrorism, chemical terrorism, conventional terrorism, cyber-attack, radiological terrorism, and public disorder. These hazards can occur anywhere and demonstrate unlawful force, violence, and/or threat against persons or property causing intentional harm for purposes of intimidation, coercion or ransom in violation of the criminal laws of the United States. These actions may cause massive destruction and/or extensive casualties. The threat of terrorism, both international and domestic, is ever present, and an attack can occur when least expected.

Enemy attack is an incident that could cause massive destruction and extensive casualties throughout the world. Some areas could experience direct weapons' effects: blast and heat; others could experience indirect weapons' effect. International political and military activities of other nations are closely monitored by the federal government and the State of North Carolina would be notified of any escalating military threats.

The use of biological agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom can be described as biological terrorism. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents vary in the amount of time they pose a threat. They can be a threat for hours to years depending upon the agent and the conditions in which it exists.

Chemical terrorism involves the use or threat of chemical agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Effects of chemical contaminants are similar to biological agents.

Use of conventional weapons and explosives against persons or property in violation of the criminal laws of the United States for purposes of intimidations, coercion, or ransom is conventional terrorism. Hazard effects are instantaneous; additional secondary devices may be used, lengthening the time duration of the hazard until the attack site is determined to be clear. The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Conventional terrorism can also include tactical assault or sniping from remote locations.

Electronic attack using one computer system against another in order to intimidate people or disrupt other systems is a cyber-attack. All governments, businesses and citizens that conduct business utilizing computers face these threats. Cyber-security and critical infrastructure protection are among the most important national security issues facing our country today. The North Carolina State Bureau of investigation' Computer Crime Unit helps law enforcement across North Carolina solve sophisticated crimes involving digital evidence.

Radiological terrorism is the use of radiological materials against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at

the surface, in the air or at high altitude.

Mass demonstrations, or direct conflict by large groups of citizens, as in riots and non-peaceful strikes, are examples of public disorder. These are assembling of people together in a manner to substantially interfere with public peace to constitute a threat, and with use of unlawful force or violence against another person, or causing property damage or attempting to interfere with, disrupting, or destroying the government, political subdivision, or group of people. Labor strikes and work stoppages are not considered in this hazard unless they escalate into a threat to the community. Vandalism is usually initiated by a small number of individuals and limited to a small target or institution. Most events are within the capacity of local law enforcement.

The Southern Poverty Law Center defines a hate group as any group with "beliefs or practices that attack or malign an entire class of people – particularly when the characteristics being maligned are immutable." It is important to note that inclusion on the SPLC list is not meant to imply that a group advocates or engages in violence or other criminal activity. The SPLC reports 43 active hate groups in North Carolina. Five hate groups identified by the SPLC have a footprint in Wake County, with three identified in Raleigh, one in Apex, and one in the county.

Warning Time: 4 – Less than 6 hours

Duration: 4 – More than one week

Generally, no warning is given for specific acts of terrorism. Duration is dependent on the vehicle used during the terrorist attack. This score takes into account a prolonged scenario with continuous impacts.

LOCATION

A terror threat could occur at any location in the County, but are more likely to target highly populated areas, critical infrastructure, or symbolic locations.

In terms of cyber-attack, our society is highly networked and interconnected. An attack could be launched from anywhere on earth and could range in impacts from small and localized to a far-reaching global scale. Depending on the attack vector and parameters, a cyber-attack could impact all of Wake County and its associated municipal jurisdictions.

EXTENT

The extent of a terrorist incident is tied to many factors, including the attack vector, location, time of day, and other circumstances; for this reason, it is difficult to put assess a single definition or conclusion of the extent of "terrorism." As a general rule, terrorism incidents are targeted to where they can do the most damage and have the maximum impact possible, though this impact is tempered by the weapon used in the attack itself.

Impact: 4 – Catastrophic

Spatial Extent: 1 – Negligible

HISTORICAL OCCURRENCES

There has never been a major terror attack in North Carolina, but several terror related incidents have been prevented through the arrest of terrorism suspects, the disruption of terrorism planning and training activities, and the response to lone suspect attacks. North Carolina has for decades dealt with homegrown extremists with a propensity for terror and violence. Examples of these extremists include militia groups, white supremacy groups, sovereign citizens, and left wing/right wing extremist groups.

In 2009, seven longtime residents were arrested in the rural Wake County subdivision of Shadow Oaks on suspicion of plotting terrorism and for providing money, training, transportation, and men to help terrorists. All seven conspirators were found guilty and sentenced for terrorist activities documented

between 2006 and 2009.

PROBABILITY OF FUTURE OCCURRENCE

While difficult to estimate when a deliberate act like terrorism may occur, it can be inferred that the probability of a terrorist attack in any one area in the County is very low at any given time. When identified, credible threats may increase the probability of an incident; these threats are generally tracked by law enforcement.

Probability: 1 – Unlikely

VULNERABILITY ASSESSMENT

METHODOLOGIES AND ASSUMPTIONS

Vulnerability to terrorism was assessed through hypothetical scenarios. These scenarios were modeled using the Electronic Mass Casualty Assessment and Planning Scenarios (EMCAPS) tool developed by the Johns Hopkins Office of Critical Event Preparedness and Response, Johns Hopkins Applied Physics Laboratory, the U.S. Department of Homeland Security, and the National Center for the Study of Preparedness and Catastrophic Event Response.

PEOPLE

People can suffer death or illness as a result of a terrorist attack. Symptoms of illness from a biological or chemical attack may go undetected for days or even weeks. Local healthcare workers may observe a pattern of unusual illness or early warning monitoring systems may detect airborne pathogens. People will face increased risk if a biological or chemical agent is released indoors, as this may result in exposure to a higher concentration of pathogens, whereas agents that are released outdoors would disperse in the direction of the wind. Physical harm from a weapons attack or explosive device is not dependent on location, but risk is greater in areas where higher numbers of people may gather. People could also be affected by an attack on food and water supply. In addition to impacts on physical health, any terrorist attack could cause significant stress and anxiety.

The following hypothetical scenarios illustrate the potential impacts of a chlorine gas release and an improvised explosive device (IED) attack on a location in the City of Raleigh, chosen due to its relatively high population density as well as the presence of multiple government buildings, culturally significant sites, and critical facilities and infrastructure. These scenarios were modeled using the Electronic Mass Casualty Assessment and Planning Scenarios (EMCAPS) tool developed by the Johns Hopkins Office of Critical Event Preparedness and Response, Johns Hopkins Applied Physics Laboratory, the U.S. Department of Homeland Security, and the National Center for the Study of Preparedness and Catastrophic Event Response.

Scenario #1 – Chemical Attack: Toxic Gas – Chlorine Release

Scenario Overview: A bomb is attached to a tractor trailer tanker carrying compressed chlorine. The entire contents of the tank escape to the atmosphere and the plume spreads to the surrounding area. The plume spreading and the effect on the population are calculated according to the following input variables: outdoor temperature is 60°F, wind speed is 9 mph, the setting is urban, and the population density is 2,826 persons per square mile. The following assumptions apply:

- 4,850-gallon tank, all contents released through 3-ft hole
- Partly cloudy, no precipitation
- 50% of people in plume area are indoors

- Effects of chlorine on population determined through evaluation of chlorine gas concentration zones, which were determined using ALOHA plume modeling software (see References)
- First effects on humans at concentration = 10 ppm
- Minimum lethal dose = 430 ppm for 30 min
- Median lethal dose (short-term exposure) = 1,000 ppm

Table 4.141 outlines the expected losses based on the above parameters.

Table 4.141 – Estimated Casualties from Chlorine Attack

Injury Description	Population Affected
Fatality	59 persons
Eye pain & swelling, headache, restricted airflow – difficulty breathing, coughing, chest pain, lung inflammation and edema, bloody sputum, vomiting, skin irritation, possible chemical burns	89 persons
Eye pain & swelling, headache, throat irritation, rapid breathing, coughing, chest pain, lung inflammation and edema, bloody sputum, vomiting, skin irritation	205 persons
Eye pain & swelling, headache, throat irritation, rapid breathing, coughing, chest pain, skin irritation	426 persons
Eye irritation, headache, throat irritation, coughing, skin irritation	521 persons
Eye irritation, headache, coughing, skin irritation	481 persons

Source: EMCAPS tool

Scenario #2 – IED: Truck Bomb

Scenario Overview: An Improvised Explosive Device (IED) utilizing an ammonium nitrate/fuel oil (ANFO) mixture is carried in a cargo truck to a populated area and detonated. The bomb size is assumed to be 1000 lbs ANFO and the average space between persons is 3 feet, equivalent to a moderately crowded pedestrian area as might be found in an average large city or outside a stadium. It is assumed that the explosion takes place in a relatively open area (e.g. stadium parking lot, park, etc). The following assumptions apply:

- ANFO - TNT equivalence = 0.82
- Blast pressure damage impact taken from National Fire Protection Association (NFPA) 921 Guide for Fire and Explosion Investigations - 2001 Edition, Table 18.13.3.1[b]
- Quantity of Cs-137 in bomb = 2,700 Curies
- Buildings and other physical structures are not considered in these calculations

Table 4.142 outlines the expected losses based on the above parameters.

Table 4.142 – Estimated Casualties from IED Attack

Blast Injuries	Population Affected
Total Dead	275 persons
Total Traumatic Injuries	482 persons
Total Urgent Care Injuries	2,367 persons
Injuries not Requiring Hospitalization	885 persons

Source: EMCAPS tool

Radiological Poisoning Injuries	Population Affected
Need Aggressive Treatment	2

Radiological Poisoning Injuries	Population Affected
Need Non-Critical Treatment	87
Self-Medicate with Public Info	12376

Source: EMCAPS tool

Expected symptoms and injuries from the blast would include impact injuries (pulmonary blast), pulmonary contusion, barotrauma, fractures (internal, compound, spinal), smoke inhalation, GI blast injury (edema, hemorrhage, rupture), auditory blast injury (partial or total loss of hearing), lacerations, shrapnel, debris penetrations (glass, metal, etc.) and burns. Radiological exposure effects would include headaches, increased risk of infection, fatigue, nausea, and vomiting. Transportation would be limited or inaccessible near the blast, and services and utilities could be unavailable.

PROPERTY

The potential for damage to property is highly dependent on the type of attack. Buildings and infrastructure may be damaged by an explosive device or by contamination from a biological or chemical attack. Impacts are generally highly localized to the target of the attack.

ENVIRONMENT

Environmental impacts are also dependent on the type of attack. Impacts could be negligible or could require major clean-up and remediation.

CONSEQUENCE ANALYSIS

Table 4.143 summarizes the potential detrimental consequences of a terror threat.

Table 4.143 – Consequence Analysis – Terrorism

Category	Consequences
Public	Illness, injury, or fatality are possible; these impacts would be highly localized to the attack. Widespread stress and psychological suffering may occur.
Responders	Responders face increased risks during an effort to stop an attack or rescue others while an attack is underway.
Continuity of Operations (including Continued Delivery of Services)	Critical infrastructure may be targeted by an attack; therefore, continuity of operations may be affected. Long-term issues may arise if transportation or utility infrastructure is severely damaged.
Property, Facilities and Infrastructure	Impacts depend of the type of attack. Buildings and infrastructure could be unaffected or completely destroyed.
Environment	Water and food supply could be contaminated by a biological or chemical attack. Remediation could be required.
Economic Condition of the Jurisdiction	The local economy could be disrupted, depending on the location and scale of an attack.
Public Confidence in the Jurisdiction's Governance	Loss of public confidence likely should an attack be carried out; additional loss of confidence and trust may result if response and recovery are not swift and effective

4.6 CONCLUSIONS ON HAZARD RISK

PRIORITY RISK INDEX

As discussed in Section 4.3 Risk Assessment Methodology and Assumptions, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table 4.144 summarizes the degree of risk assigned to each identified hazard using the PRI method.

Table 4.144 – Summary of PRI Results

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Dam Failure	Possible	Critical	Negligible	< 6 hours	< 1 week	2.4
Drought	Likely	Minor	Large	> 24 hours	> 1 week	2.5
Earthquake	Unlikely	Minor	Large	< 6 hours	< 6 hours	1.9
Extreme Heat	Highly Likely	Critical	Large	> 24 hours	< 1 week	3.3
Flood	Likely	Critical	Small	6 to 12 hours	< 1 week	2.8
Hurricane & Tropical Storm	Likely	Critical	Large	> 24 hours	< 24 hours	2.9
Infectious Disease	Possible	Critical	Large	> 24 hours	> 1 week	2.8
Landslide	Unlikely	Minor	Negligible	6 to 12 hours	< 6 hours	1.2
Severe Weather: Hail[1]	Highly Likely	Minor	Small	6 to 12 hours	< 6 hours	2.3
Severe Weather: Lightning[1]	Highly Likely	Minor	Negligible	6 to 12 hours	< 6 hours	2.1
Severe Weather: Thunderstorm Winds[1]	Highly Likely	Limited	Large	6 to 12 hours	< 6 hours	3.0
Severe Winter Storm	Highly Likely	Limited	Large	> 24 hours	> 1 week	3.0
Tornado	Likely	Critical	Small	< 6 hours	< 6 hours	2.7
Wildfire	Possible	Limited	Moderate	< 6 hours	< 1 week	2.5
Hazardous Materials Incident	Highly Likely	Limited	Negligible	< 6 hours	< 24 hours	2.6
Cyber Threat	Possible	Minor	Small	< 6 hours	> 1 week	2.5
Radiological Emergency	Unlikely	Catastrophic	Small	< 6 hours	> 1 week	2.7
Terrorism	Unlikely	Catastrophic	Negligible	< 6 hours	< 6 hours	2.2

[1]Note: Severe Weather hazards average to a score of 2.5 and are therefore considered together as a medium risk hazard.

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table 4.145:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Medium Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is negligible or nonexistent.

Table 4.145 – Summary of Hazard Risk Classification

High Risk (≥ 3.0)	Extreme Heat Severe Winter Storm
Moderate Risk (2.0 – 2.9)	Hurricane & Tropical Storm Flood Infectious Disease Tornado Radiological Emergency Hazardous Materials Incident Drought Severe Weather Wildfire Cyber Threat Dam Failure Terrorism
Low Risk (< 2.0)	Earthquake Landslide

Note: Low risk hazards are not prioritized for mitigation.

5 CAPABILITY ASSESSMENT

This section discusses the capability of the Wake County planning area to implement hazard mitigation activities. It consists of the following four subsections:

- 5.1 Overview
- 5.2 Methodology
- 5.3 Capability Assessment Findings
- 5.4 Conclusions on Local Capability

5.1 OVERVIEW

The purpose of conducting a capability assessment is to determine the ability of a local jurisdiction to implement a comprehensive mitigation strategy, and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, or projects. As in any planning process, it is important to try to establish which goals, objectives, and actions are feasible, based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical and likely to be implemented over time given a local government's planning and regulatory framework, level of administrative and technical support, number of fiscal resources, and current political climate.

A capability assessment has two primary components: 1) an inventory of a local jurisdiction's relevant plans, ordinances, and programs already in place; and 2) an analysis of its capacity to carry them out. Careful examination of local capabilities will detect any existing gaps, shortfalls, or weaknesses with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. The capability assessment also highlights the positive mitigation measures already in place or being implemented at the local government level, which should continue to be supported and enhanced through future mitigation efforts.

The capability assessment completed for the Wake County planning area serves as a critical planning step toward developing an effective mitigation strategy. Coupled with the risk assessment, the capability assessment helps identify and target effective goals, objectives, and mitigation actions that are realistically achievable under given local conditions.

5.2 METHODOLOGY

To facilitate the inventory and analysis of local government capabilities within the planning area, the project team started with the information collected in the Local Capability Self-Assessment during the last plan update. During the last plan update, the Local Capability Self-Assessment worksheet was distributed to members of the HMPC after the first planning committee meeting. The survey questionnaire requested information on a variety of "capability indicators" such as existing local plans, policies, programs, or ordinances that contribute to and/or hinder the region's ability to implement hazard mitigation actions. Other indicators included information related to the region's fiscal, administrative, and technical capabilities, such as access to local budgetary and personnel resources for mitigation purposes, and existing education and outreach programs that can be used to promote mitigation. Communities were also asked to comment on the current political climate with respect to hazard mitigation, an important consideration for any local planning or decision-making process.

At a minimum, the survey results provide an extensive and consolidated inventory of existing local plans, ordinances, programs, and resources in place or under development. With this information, inferences can be made about the overall effect on hazard loss reduction in each community. In completing the survey, local officials were also asked to rate their jurisdiction's specific capabilities. The survey instrument thereby not only helps accurately assess the degree of local capability, but it also serves as a good source of introspection for counties and local jurisdictions that want to improve their capabilities. Identified gaps, weaknesses, or conflicts can be recast as opportunities for specific actions to be proposed as part of the mitigation strategy.

Expanding on the information that was collected during the last plan update's Local Capability Self-Assessment, the project team reviewed municipal websites to determine if additional capacity or capacity changes had occurred in the last few years. The responses provided from the survey questionnaire and information collected from the municipal websites were incorporated into a database for further analysis.[1] A general scoring methodology was then applied to quantify each jurisdiction's overall capability. According to the scoring system, each capability indicator was assigned a point value based on its relevance to hazard mitigation. Additional points were added based on the jurisdiction's self-assessment of their own planning and regulatory capability, administrative and technical capability, fiscal capability, education and outreach capability, and political capability.

Using this scoring methodology, a total score and an overall capability rating of "High," "Moderate," or "Limited" could be determined according to the total number of points received. These classifications are designed to provide nothing more than a general assessment of local government capability. In combination with the narrative responses provided by local officials, the results of this capability assessment provide critical information for developing an effective and meaningful mitigation strategy.

5.3 CAPABILITY ASSESSMENT FINDINGS

The findings of the capability assessment are summarized to provide insight into the relevant capacity of the Wake County planning area to implement hazard mitigation activities. All information is based upon the input provided by local government officials through the Local Capability Self-Assessment.

5.3.1 PLANNING AND REGULATORY CAPABILITY

Planning and regulatory capability is based on the implementation of plans, ordinances, and programs that demonstrate a local jurisdiction's commitment to guiding and managing growth, development, and redevelopment in a responsible manner, while maintaining the general welfare of the community. It includes emergency response and mitigation planning, comprehensive land use planning, and transportation planning. Regulatory capability also includes the enforcement of zoning or subdivision ordinances and building codes that regulate how land is developed and structures are built, as well as protecting environmental, historic, and cultural resources in the community. Although some conflicts can arise, these planning initiatives generally present significant opportunities to integrate hazard mitigation principles and practices into the local decision-making process.

This assessment is designed to provide a general overview of the key planning and regulatory tools or programs in place or under development for the Wake County planning area, along with their potential effect on loss reduction. This information will help identify opportunities to address gaps, weaknesses, or

[1] North Carolina Emergency Management Risk Management Tool was used to score the capabilities

conflicts with other initiatives and integrate the implementation of this plan with existing planning mechanisms where appropriate.

Table 5.1 provides a summary of the relevant local plans, ordinances, and programs already in place or under development for the Wake County planning area. A checkmark (√) indicates that the given item is currently in place and being implemented. An asterisk (*) indicates that the given item is currently being developed for future implementation. A plus sign (+) indicates that a jurisdiction is covered for that item under a county-implemented version. Each of these local plans, ordinances, and programs should be considered available mechanisms for incorporating the requirements of the Hazard Mitigation Plan.

Table 5.1 – Relevant Plans, Ordinances, and Programs

Jurisdiction	Hazard Mitigation Plan	Comprehensive Land Use Plan	Floodplain Management Plan	Open Space Management Plan	Stormwater Management Plan	Emergency Operations Plan	SARA Title III Plan	Radiological Emergency Plan	Continuity of Operations Plan	Evacuation Plan	Disaster Recovery Plan	Capital Improvements Plan	Economic Development Plan	Historic Preservation Plan	Transportation Plan	Flood Damage Prevention Ordinance	Zoning Ordinance	Subdivision Ordinance	Site Plan Review Requirements	Unified Development Ordinance	Post-Disaster Redevelopment Ordinance	Building Code	Fire Code	Community Wildfire Protection Plan	National Flood Insurance Program	Community Rating System
Wake County	✓	✓	✓	✓	✓	✓	✓	✓	*	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	
Apex	✓	✓	✓	✓	✓	✓	+	+	✓	+		✓	*	+	✓	✓	✓	✓	✓	✓		✓	✓		✓	
Cary	✓	✓		✓	✓	✓	+	+	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Fuquay-Varina	✓	✓	✓	✓	✓	✓	+	+	✓	+		✓	✓	+	✓	✓	✓	✓	✓	✓		✓	✓		✓	
Garner	✓	✓	✓	✓	✓	✓	+	+	✓	+		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	
Holly Springs	✓	✓	✓	✓	✓	✓	+	+	✓	✓		✓	✓	+	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Knightdale	✓	✓	✓	✓	*	✓	+	+				✓	✓	+	✓	✓	✓	✓	✓	✓		+	✓		✓	
Morrisville	✓	✓	✓	✓	✓	✓	+	+	✓			✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Raleigh	✓	✓			✓	✓	+	+	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
Rolesville	✓	✓	✓	✓	✓	✓	+	+	✓			✓	✓	+	✓	✓	✓	✓	✓	✓		✓	✓		✓	
Wake Forest	✓	✓	✓	✓	✓	✓	+	+	*		*	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	
Wendell	✓	✓	✓	✓	✓	+	+	+				✓	✓	+	✓	✓	✓	✓	✓	✓		+	+		✓	
Zebulon	✓	✓	✓	✓	✓	✓	+	+				✓	*	+	✓	✓	✓	✓	✓	✓		✓	✓		✓	

A more detailed discussion on the region's planning and regulatory capability follows, along with the incorporation of additional information based on the narrative comments provided by local officials in response to the survey questionnaire.

EMERGENCY MANAGEMENT

Hazard mitigation is widely recognized as one of the four primary phases of emergency management, as is shown in Figure 5.1. Mitigation is interconnected with all other phases and is an essential component of effective preparedness, response, and recovery. Opportunities to reduce potential losses through mitigation practices are most often implemented before a disaster event, such as through the elevation of flood-prone structures or by regular enforcement of policies that regulate development. However, mitigation opportunities can also be identified during immediate preparedness or response activities, such as installing storm shutters in advance of a hurricane. Furthermore, incorporating mitigation during the long-term recovery and redevelopment process following a disaster event is what enables a community to become more resilient.

Figure 5.1 – The Four Phases of Emergency Management

Planning for each phase is a critical part of a comprehensive emergency management program and a key to the successful implementation of hazard mitigation actions. As such, the Local Capability Self-Assessment asked several questions across a range of emergency management plans to assess the region's willingness to plan and their level of technical planning proficiency.

HAZARD MITIGATION PLAN

A hazard mitigation plan is a community's blueprint for how it intends to reduce the impact of natural, and in some cases human-caused, hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment, and mitigation strategy.

- 13 of the 13 participating jurisdictions in this regional planning effort have previously been covered by the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

DISASTER RECOVERY PLAN

A disaster recovery plan serves to guide the physical, social, environmental, and economic recovery and reconstruction process following a disaster event. In many instances, hazard mitigation principles and practices are incorporated into local disaster recovery plans with the intent of capitalizing on opportunities

to break the cycle of repetitive disaster losses. Disaster recovery plans can also lead to the preparation of disaster redevelopment policies and ordinances to be enacted following a hazard event.

- 3 of the 13 participating jurisdictions have a disaster recovery plan either in place or under development. (2 jurisdictions have one in place; 1 has one under development)

EMERGENCY OPERATIONS PLAN

An emergency operations plan outlines responsibilities and how resources will be deployed during and following an emergency or disaster.

- 13 of the 13 participating jurisdictions have an emergency operations plan either in place or are covered under a county plan. (12 jurisdictions have one in place; 1 is covered under the county plan)

CONTINUITY OF OPERATIONS PLAN

A continuity of operations plan establishes a chain of command, line of succession, and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster event.

- 10 of the 13 participating jurisdictions have a continuity of operations plan in place. (8 jurisdictions have one in place; 2 have one under development)

GENERAL PLANNING

The implementation of hazard mitigation activities often involves agencies and individuals beyond the emergency management profession. Stakeholders may include local planners, public works officials, economic development specialists, and others. In many instances, concurrent local planning efforts will help to achieve or complement hazard mitigation goals, even though they may not be designed as such. The Local Capability Self-Assessment asked questions regarding general planning capabilities and the degree to which hazard mitigation is integrated into other ongoing planning efforts in the region.

COMPREHENSIVE/GENERAL PLAN

A comprehensive land use plan, or general plan, establishes the overall vision for what a community wants to be and serves as a guide for future governmental decision making. Typically, a comprehensive plan contains sections on demographic conditions, land use, transportation elements, and community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can enhance the likelihood of achieving risk reduction goals, objectives, and actions.

- 13 of the 13 participating jurisdictions have a comprehensive land use plan in place.

CAPITAL IMPROVEMENTS PLAN

A capital improvements plan guides the scheduling of spending on public improvements. A capital improvements plan can serve as an important mechanism for guiding future development away from identified hazard areas. Limiting public spending in hazardous areas is one of the most effective long-term mitigation actions available to local governments.

- 13 of the 13 participating jurisdictions have a capital improvements plan in place.

HISTORIC PRESERVATION PLAN

A historic preservation plan is intended to preserve historic structures or districts within a community. An often-overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards, and the identification of ways to reduce future damages. This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet

current building standards or are within a historic district that cannot easily be relocated out of harm's way.

- 11 of the 13 participating jurisdictions have an historic preservation plan in place or are covered by a county plan.

ZONING ORDINANCE

Zoning represents the primary means by which land use is controlled by local governments. As part of a community's police power, zoning is used to protect the public health, safety, and welfare of those in a given jurisdiction that maintains zoning authority. A zoning ordinance is the mechanism through which zoning is typically implemented. Since zoning regulations enable municipal governments to limit the type and density of development, a zoning ordinance can serve as a powerful tool when applied in identified hazard areas.

- 13 of the 13 participating jurisdictions have a zoning ordinance in place.

SUBDIVISION ORDINANCE

A subdivision ordinance is intended to regulate the development of residential, commercial, industrial, or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development.

- 13 of the 13 participating jurisdictions have a subdivision ordinance in place.

BUILDING CODES, PERMITTING, AND INSPECTIONS

Building codes regulate construction standards. In many communities, permits and inspections are required for new construction. Decisions regarding the adoption of building codes (that account for hazard risk), the type of permitting process required both before and after a disaster, and the enforcement of inspection protocols all affect the level of hazard risk faced by a community.

- 13 of the 13 participating jurisdictions have building codes in place.

The adoption and enforcement of building codes by local jurisdictions is routinely assessed through the Building Code Effectiveness Grading Schedule (BCEGS) program, developed by the Insurance Services Office, Inc. (ISO). In North Carolina, the North Carolina Department of Insurance assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. The results of BCEGS assessments are routinely provided to ISO's member private insurance companies, which in turn may offer ratings credits for new buildings constructed in communities with strong BCEGS classifications. The expectation is that communities with well-enforced, up-to-date codes should experience fewer disaster-related losses, and as a result should have lower insurance rates.

In conducting the assessment, ISO collects information related to personnel qualification and continuing education, as well as number of inspections performed per day. This type of information combined with local building codes is used to determine a grade for that jurisdiction. The grades range from 1 to 10, with a BCEGS grade of 1 representing exemplary commitment to building code enforcement, and a grade of 10 indicating less than minimum recognized protection.

FLOODPLAIN MANAGEMENT

Flooding represents the greatest natural hazard facing the nation, yet the tools available to reduce the impacts associated with flooding are among the most developed when compared to other hazard-specific mitigation techniques. In addition to approaches that cut across hazards such as education, outreach, and

the training of local officials, the National Flood Insurance Program (NFIP) contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary for local governments; however, program participation is strongly encouraged by FEMA as a first step for implementing and sustaining an effective hazard mitigation program. It is therefore used as part of this *Capability Assessment* as a key indicator for measuring local capability.

In order for a county or municipality to participate in the NFIP, they must adopt a local flood damage prevention ordinance that requires jurisdictions to follow established minimum building standards in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings be protected from damage by a 100-year flood event, and that new development in the floodplain not exacerbate existing flood problems or increase damage to other properties.

A key service provided by the NFIP is the mapping of identified flood hazard areas. Once completed, the Flood Insurance Rate Maps (FIRMs) are used to assess flood hazard risk, regulate construction practices, and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials, and the private sector about the likelihood of flooding in their community.

Table 5.2 provides NFIP policy and claim information for each participating jurisdiction in the Wake County planning area.

All jurisdictions in the region participate in the NFIP and will continue to comply with all required provisions of the program. Floodplain management is managed through zoning ordinances, building code restrictions, and the county building inspection program. The jurisdictions will coordinate with NCEM and FEMA to develop maps and regulations related to Special Flood Hazard Areas within their jurisdictional boundaries and, through a consistent monitoring process, will design and improve their floodplain management program in a way that reduces the risk of flooding to people and property.

COMMUNITY RATING SYSTEM

An additional indicator of floodplain management capability is active participation in the Community Rating System (CRS). The CRS is an incentive-based program that encourages communities to undertake defined flood mitigation activities that go beyond the minimum requirements of the NFIP. Each of the CRS mitigation activities is assigned a point value. As a community earns points and reaches identified thresholds, they can apply for an improved CRS class. Class ratings, which range from 10 to 1 and increase on 500-point increments, are tied to flood insurance premium reductions. Every class improvement earns an additional 5 percent discount for NFIP policyholders, with a starting discount of 5 percent for Class 9 communities and a maximum possible discount of 45 percent for Class 1 communities.

Community participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10. The CRS application process has been greatly simplified over the past several years, based on community comments intended to make the CRS more user friendly, and extensive technical assistance available for communities who request it.

- The City of Raleigh joined the CRS program in 2024 and is awaiting an official Class rating. The Town of Cary was previously a CRS participant but has since been rescinded and is now a Class 10 community.

Table 5.2 – NFIP Policy and Claim Information

Jurisdiction	Date Joined NFIP	Current Effective Map Date	NFIP Policies in Force	Insurance in Force	Written Premium in Force	Closed Losses	Total Payments
City of Raleigh	06/28/74	07/19/22	1,774	$494,165,600	$1,821,219	840	$23,269,081
Town of Apex	03/03/92	07/19/22	96	$28,479,400	$43,304	1	$1,299
Town of Cary	06/28/74	07/19/22	695	$205,652,100	$376,232	137	$2,424,510
Town of Fuquay-Varina	04/11/75	07/19/22	88	$23,759,100	$42,592	3	$107,051
Town of Garner	07/19/74	07/19/22	116	$29,600,400	$81,284	21	$167,744
Town of Holly Springs	03/03/92	07/19/22	70	$21,438,300	$31,255	11	$186,744
Town of Knightdale	04/12/74	07/19/22	35	$10,167,000	$17,907	3	$31,363
Town of Morrisville	10/29/78	07/19/22	78	$23,604,000	$35,687	4	$92,752
Town of Rolesville	03/03/92	07/19/22	11	$3,227,000	$4,009	0	$0
Town of Wake Forest	03/15/74	07/19/22	120	$35,040,700	$48,537	0	$0
Town of Wendell	03/08/74	07/19/22	19	$4,928,000	$8,754	8	$144,907
Town of Zebulon	03/08/74	07/19/22	21	$3,668,000	$9,158	10	$187,065
Wake County (Unincorporated Area)	11/15/78	07/19/22	370	$100,313,300	$143,940	70	$996,074
Total	-	-	**3,493**	**$984,042,900**	**$2,663,878**	**1,108**	**$27,608,590**

Source: FEMA NFIP Policy Statistics, NCEM Risk Management Tool

FLOODPLAIN MANAGEMENT PLAN

A floodplain management plan (or a flood mitigation plan) provides a framework for action regarding corrective and preventative measures to reduce flood-related impacts.

- 11 of the 13 participating jurisdictions have a floodplain management plan in place.

SUBSTANTIAL DAMAGE ESTIMATING PROCEDURES

Immediately after a natural disaster, the **Wake County** Building Inspections Team is deployed to the impacted area to commence structural damage assessments.

Wake County Building Inspections uses ARCGIS Survey 123, which is a map-based tool to electronically track, collect, and survey the damage. This information can be easily shared among various work groups and agencies. Each inspector uses an app on their iPad to interface with the database.

Subsequent to the damage assessment, homeowners are provided guidance on necessary permits for repair work so that the structure is brought into compliance with all building codes. Structures that are deemed "unsafe" will be posted accordingly and require the owner to mitigate any safety issues. These procedures apply for **Knightdale, Rolesville, Wendell, and Zebulon**.

The **Town of Apex**'s Unified Development Ordinance (UDO) prohibits the location of any new buildings, in whole or in part, within the floodplain. It also prohibits the creation of residential lots within the floodplain. This robust ordinance was adopted in 2000 and has essentially eliminated substantial damages/claims in Apex.

The Town's UDO includes language about Substantial Damage, but it has never been used. As of November 2020, the Town had a cumulative total of 3 closed paid losses valued at $1,300 total for all the years the data has been collected. In the past, the Town of Apex has not incurred flood losses that qualify as "substantial damage."

With the adoption of the new FIRM maps in 2022, some floodplains have expanded to cover properties that were not previously considered at risk. The Town is evaluating steps to track future damage to these properties.

Immediately after a flood event in the **Town of Cary**, employees across multiple departments that consist of Town planners, stormwater and transportation engineers, inspectors, building officials, and certified floodplain managers deploy to the affected areas. The town is broken into three areas and each area has a dedicated number of teams to conduct windshield surveys and assess damage.

This is tracked digitally and on paper forms and then logged into Town databases. Once homeowners come in for permits for repair work, this data is referenced and if a substantial damage is triggered then the building must come into compliance with all Town ordinances, including the floodplain ordinance.

If a homeowner or applicant comes in to improve the property voluntarily without damage, then substantial improvement protocols are activated. This entails a lengthy review during plan review of the project scope, evaluating the building's depreciated value either by tax assessor value or through an appraisal, and the work is adjusted accordingly depending on the determination. All work is also field verified by inspectors to make sure construction is up to code and in compliance with Town ordinances.

These procedures also apply for the **Town of Morrisville**. In Morrisville, five areas where substantial damage may occur have been identified by Town staff; these areas are evaluated post-event through windshield surveys and damage assessments.

Following a flood event in the **Town of Garner**, employees from the Engineering, Planning, and Inspections departments convene and divide into teams. Teams include engineers, building inspectors, infrastructure inspectors, and other staff. The number of teams deployed is dependent on the extent of the

affected area. Teams gather damage data electronically and submit to the Town's Floodplain Administrator, who maintains an electronic database of the information.

When homeowners submit for permits for repair work, the substantial damage determination procedures, as outlined in the Floodplain Ordinance in the Town's Unified Development Ordinance, are followed. These procedures are performed by the Floodplain Administrator (Engineering Director) and the Inspections Director and are:

- Estimate the market value, or require the applicant to obtain an appraisal of the market value prepared by a qualified independent appraiser, of the building or structure before the start of construction of the proposed work; in the case of repair, the market value of the building or structure shall be the market value before the damage occurred and before any repairs are made;
- Compare the cost to perform the improvement, the cost to repair a damaged building to its pre-damaged condition, or the combined costs of improvements and repairs, if applicable, to the market value of the building or structure;
- Determine and document whether the proposed work constitutes substantial improvement or repair of substantial damage; and
- Notify the applicant if it is determined that the work constitutes substantial improvement or repair of substantial damage and that compliance with the flood resistant construction requirements of the NC Building Code and this ordinance is required.

All construction within the floodplain requires a Floodplain Development Permit to be issued by the Floodplain Administrator. Pre-construction and post-construction inspections are performed to ensure compliance with the Floodplain Ordinance.

The **Town of Fuquay-Varina**'s Public Works Department maintains catch basins, storm lines, culverts and ditches to ensure they are free of debris, sediment etc. Per the Town's Operation and Maintenance Plan for Municipal Facilities, this maintenance will occur weekly and before and after rainfall events. Additionally, street sweeping is performed weekly. These activities are logged into City Works and are utilized when determining substantial damage cases.

Substantial improvement and substantial damage protocols are integrated into the Town's Land Development Ordinance and are implemented by the Town's Departments responsible for development. If a homeowner or applicant comes in to improve the property voluntarily without damage, then substantial improvement protocols are activated. Protocols entail: 1) An estimate or appraisal of the market value (prior to damage) of the structure before start of repair or improvement; 2) Cost comparisons of the improvement or repair to the market value; 3) Determination of whether the proposed work constitutes improvement or repair of substantial damage; and 4) Notification to the applicant if it is determined that work constitutes substantial improvement or repair of substantial damage. Notification also includes compliance requirements per NC Building Code and the Town's Flood Damage Prevention Regulations.

All work is also field verified by inspectors to make sure construction is up to code and in compliance with Town ordinances.

In the **Town of Holly Springs**, immediately after a flood event, employees across multiple departments that consist of Stormwater Staff, Town Engineers, Infrastructure Inspectors and Building Code Officials will deploy to the affected areas, as needed. The Town has a limited amount of areas that are likely to be affected by a large rainfall event and these areas have been previously identified in the Town's floodplain mapping efforts.

Any specific damage will be noted in the Town's development software. Any affected parcels will receive a parcel message in the software, denoting that additional permit review for substantial damage is necessary. When a property owner applies for a permit for repair work, this parcel message will appear

and the reviewer will take the appropriate steps to review the application to see if it triggers substantial damage requirements. If a substantial damage requirement is triggered, then the building must come into compliance with all Building Code requirements and Town ordinances, including the Flood Damage Prevention Ordinance.

If a property owner applies for a permit in order to voluntarily improve a property that has not been damaged, then the above referenced substantial improvement protocols will be activated. This will include a full review during plan review of the project scope, evaluating the building's depreciated value either by tax assessor value or through an appraisal and ensuring that the work is adjusted accordingly depending on the determination. All work will be field verified during the building process to make sure construction is up to code and in compliance with Town ordinances.

Following an impact event in the **City of Raleigh**, a comprehensive approach to substantial damage assessment is undertaken. A fifteen-member inspection team comprising Stormwater Division employees, many of whom are Certified Floodplain Managers (CFM), is mobilized to assess damage across the city. This effort involves collaboration among various divisions within the Engineering Services Department.

The city is divided into four quadrants, each assigned dedicated teams for conducting windshield surveys and damage assessments. Data collected during these assessments is meticulously recorded using FEMA's Substantial Damage Estimator Tool or on paper forms if cellphone service is temporarily down. All data recorded on paper forms will be uploaded to the estimator tool as soon as possible.

The database is immediately incorporated into the City of Raleigh's emergency permitting process so that all new permit applications can be cross-referenced with this data. In all instances of property improvements, the City of Raleigh upholds its commitment to safety and compliance by continuing with existing cumulative substantial improvement protocols.

It is important to note that these procedures may vary depending on the specific requirements of the situation and the entities involved in the survey process. However, the City of Raleigh ensures adherence to standardized protocols and best practices to guarantee consistency, accuracy, and effectiveness in assessing substantial damage.

After a significant disaster event or flood in the **Town of Wake Forest**, the initial response of the Town involves mobilizing emergency services and first responders to the affected area, including fire, police, EMS, Engineering, and Wake Forest Public Works crews. Activities in primary impact areas include:

- Securing the area.
- Evacuating people.
- Conducting search and rescue.
- Providing emergency medical care.
- Sheltering evacuees.
- Identifying hazardous materials.
- Suppressing fires.
- Surveying the affected area.

The response aims to help mitigate any substantial damage and restore the community's quality of life to its pre-event level. Short-term measures include:

- Clearing debris from the stormwater system in flood-prone areas.
- Renewing economic activities.
- Restoring government services.
- Providing essentials to victims.
- Establishing disaster assistance centers.
- Conducting damage surveys.
- Providing health and human services.

Additionally, the engineering and public works department focuses on erosion control to ensure the functionality of streams, ponds, and dams. Long-term measures involve:

- Rebuilding structures.
- Revitalizing the economic system.
- Ensuring infrastructure resilience.

After a disastrous event, such as flooding, it is important to engage with various key organizations for damage assessments. These organizations may include prominent entities like the American Red Cross, insurance providers, private engineering consultant firms, and utility companies. This coordinated effort is aimed at facilitating independent assessments to comprehensively evaluate the extent of the damage. Upon the occurrence of a disaster, the Town will undertake a thorough and systematic analysis of the damage to ascertain its magnitude and impact. The primary objective of this assessment process is to effectively determine the necessary interventions required, allocate financial resources, and identify potential external support and aid.

In instances where the town encounters challenges in the assessment process, it will seek assistance from Wake County, enhancing the collaborative approach in addressing the aftermath of the disaster. To streamline disaster-related information and communications, a central coordinating hub will be established within the Emergency Operations Center (EOC). This will serve as the focal point for receiving and disseminating vital information related to the disaster, thus ensuring efficient coordination and response efforts.

In the event of a significant disaster causing substantial damage to both private and public properties, comprehensive assessment reports will be meticulously prepared, submitted, and documented in the town's centralized database. This comprehensive documentation process is vital for record-keeping and informing future decision-making processes.

Furthermore, the adherence to the town's well-defined permitting processes and the alignment with its building standards as outlined in the Unified Development Ordinance (UDO) is mandatory for all buildings and private homes. These guidelines ensure that reconstruction and rehabilitation efforts comply with established safety and quality standards, thereby promoting resilience and sustainable recovery in the community.

OPEN SPACE MANAGEMENT PLAN

An open space management plan is designed to preserve, protect, and restore largely undeveloped lands in their natural state, and to expand or connect areas in the public domain such as parks, greenways, and other outdoor recreation areas. In many instances open space management practices are consistent with the goals of reducing hazard losses, such as the preservation of wetlands or other flood-prone areas in their natural state in perpetuity.

- 12 of the 13 participating jurisdictions have an open space management plan in place or under development.

STORMWATER MANAGEMENT PLAN

A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding.

- 13 of the 13 participating jurisdictions have a stormwater management plan in place. (12 jurisdictions have one in place; 1 has one in development)

5.3.2 ADMINISTRATIVE AND TECHNICAL CAPABILITY

The ability of a local government to develop and implement mitigation projects, policies, and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability can be evaluated by determining how mitigation-related activities are assigned to local departments and if there are adequate personnel resources to complete these activities. The degree of intergovernmental coordination among departments will also affect administrative capability for the implementation and success of proposed mitigation activities.

Technical capability can generally be evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in using geographic information systems (GIS) to analyze and assess community hazard vulnerability. The Local Capability Self-Assessment was used to capture information on administrative and technical capability through the identification of available staff and personnel resources.

Table 5.3 provides a summary of the Local Capability Self-Assessment results for the region with regard to relevant staff and personnel resources. A checkmark indicates the presence of a staff member(s) in that jurisdiction with the specified knowledge or skill.

Table 5.3 – Relevant Staff/Personnel Resources

Jurisdiction	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused hazards	Building Official	Emergency manager	Floodplain manager	Land surveyors	Scientist familiar with the hazards of the community	Staff with education or expertise to assess the community vulnerability to hazards	Personnel skilled in Geographic Information Systems (GIS) and/or HAZUS	Resource development staff or grant writers	Maintenance programs to reduce risk	Warning systems/services	Mutual Aid Agreements
Wake County	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓	✓
Town of Apex	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓
Town of Cary	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Town of Fuquay-Varina	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Town of Garner	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Town of Holly Springs	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Town of Knightdale	✓	✓	✓	✓	✓	✓				✓			✓	✓
Town of Morrisville	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
City of Raleigh	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Town of Rolesville	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓
Town of Wake Forest	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Town of Wendell	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
Town of Zebulon	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓

Source: Local Capability Assessment Survey

5.3.3 FISCAL CAPABILITY

The ability of a local government to implement mitigation actions is often dependent on the amount of money available. This may take the form of outside grant funding awards or locally based revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied primarily to staff time or administrative costs associated with the creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project such as the acquisition of flood-prone houses, which can require a substantial commitment from local, state, and federal funding sources.

The Local Capability Self-Assessment was used to capture information on the region's fiscal capability through the identification of locally available financial resources.

Table 5.4 provides a summary of the results for the region with regard to relevant fiscal resources. A checkmark indicates that the given fiscal resource is locally available for hazard mitigation purposes (including match funds for state and federal mitigation grant funds).

Table 5.4 – Relevant Fiscal Resources

Jurisdiction	Capital Improvement Programming	Community Development Block Grants (CDBG)	Special Purpose Taxes	Gas/Electric Utility Fees	Water/Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation Bonds	Revenue Bonds	Special Tax Bonds	Other
Wake County	✓	✓	✓					✓	✓	✓	
Town of Apex	✓	✓		✓	✓	✓	✓	✓	✓		✓
Town of Cary	✓	✓			✓		✓	✓	✓		✓
Town of Fuquay-Varina	✓	✓	✓		✓			✓	✓		
Town of Garner	✓	✓			✓	✓	✓				
Town of Holly Springs	✓	✓			✓	✓		✓	✓		
Town of Knightdale	✓	✓		✓	✓	✓	✓	✓			
Town of Morrisville	✓	✓	✓	✓		✓		✓	✓	✓	✓
City of Raleigh	✓	✓			✓	✓	✓	✓	✓	✓	
Town of Rolesville	✓	✓			✓		✓	✓			
Town of Wake Forest	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Town of Wendell	✓	✓			✓	✓		✓			
Town of Zebulon	✓	✓	✓			✓	✓				

Source: Local Capability Assessment Survey

5.3.4 EDUCATION AND OUTREACH CAPABILITY

This type of local capability refers to education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information. Examples include natural disaster or safety related school programs; participation in community programs such as Firewise or StormReady; and activities conducted as part of hazard awareness campaigns such as a Tornado Awareness Month.

Table 5.5 provides a summary of the results for the region with regard to relevant education and outreach resources. A checkmark indicates that the given resource is locally available for hazard mitigation purposes.

Table 5.5 – Education and Outreach Resources

Jurisdiction	Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Natural disaster or safety related school programs	StormReady certification	Firewise Communities certification	Public-private partnership initiatives addressing disaster-related issues	Other
Wake County	✓	✓	✓	✓		✓	
Town of Apex	✓	✓	✓				
Town of Cary	✓	✓					
Town of Fuquay-Varina	✓	✓	✓				
Town of Garner		✓				✓	
Town of Holly Springs	✓	✓	✓				✓
Town of Knightdale	✓	✓	✓				✓
Town of Morrisville	✓	✓	✓				✓
City of Raleigh	✓	✓	✓			✓	
Town of Rolesville		✓					
Town of Wake Forest		✓	✓			✓	
Town of Wendell	✓	✓					
Town of Zebulon		✓					✓

Source: Local Capability Assessment Survey

5.3.5 MITIGATION CAPABILITY

This type of local capability refers to the mitigation strategies and actions that are developed by the communities in this plan.

Table 5.6 provides a summary of the results for the planning area regarding relevant mitigation resources. A checkmark (√) indicates that the given resource is locally available for hazard mitigation purposes.

Table 5.6 – Mitigation Resources

Jurisdiction	Do you apply for mitigation grant funding?	Do you perform reconstruction projects?	Do you perform building elevations?	Do you perform acquisitions?
Wake County				
Town of Apex		✓		✓
Town of Cary	✓			✓
Town of Fuquay-Varina	✓	✓		
Town of Garner			✓	
Town of Holly Springs		✓		
Town of Knightdale			✓	
Town of Morrisville				
City of Raleigh	✓	✓	✓	✓
Town of Rolesville				
Town of Wake Forest	✓			✓
Town of Wendell				✓
Town of Zebulon	✓			

5.3.6 POLITICAL CAPABILITY

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to reduce the impact of future hazard events. Hazard mitigation may not be a local priority, or it may conflict with or be seen as an impediment to other goals of the community, such as growth and economic development. Therefore, the local political climate must be considered in designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing their adoption and implementation.

The Local Capability Self-Assessment was used to capture information on political capability of the region. Survey respondents were asked to rate political support as they perceive it and identify general examples of local political capability, such as guiding development away from identified hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (e.g., building codes, floodplain management, etc.).

Most participating jurisdictions indicated that political leaders are willing to implement mitigation measures. However, fiscal limitations were noted as a limitation for garnering political support. Additionally, some jurisdictions noted that although their local leaders are willing to implement mitigation measures, current state legislation is not supportive of that effort, particularly in terms of environmental regulations.

Several jurisdictions have local standards in support of hazard mitigation that exceed state requirements. For example, in Garner and Wendell, not development is allowed in the 100-year floodplain. In Wake Forest, no development is allowed within the 500-year floodplain. Both Wake Forest and Morrisville have higher freeboard requirements for construction in the floodplain. Additionally, Morrisville requires stormwater detention for the 1-, 2-, and 10-year storm events despite the state only requiring detention for the 1-year event. These regulations are indicative of local political capability to implement mitigation measures.

Four jurisdictions responded in the Local Capability Self-Assessment that they do not have local standards for mitigation exceeding state requirements, which may suggest increased barriers to implementation of mitigation regulations in this jurisdictions.

5.3.7 LOCAL SELF-ASSESSMENT RATING

In addition to the inventory and analysis of specific local capabilities, the Local Capability Self-Assessment asked counties and local jurisdictions within the Wake County planning area to assign a rating of their perceived capability across each of the capability categories and overall as either "limited," "moderate," or "high."

Table 5.7 summarizes the results of the self-assessment ratings for each community in the Wake County planning area.

Table 5.7 – Self-Assessment of Capability

Jurisdiction	Plans, Ordinances, Codes and Programs	Administrative and Technical Capability	Fiscal Capability	Education and Outreach Capability	Mitigation Capability	Political Capability	Overall Capability
Wake County	High	Moderate	Moderate	Limited	Unrated	Unrated	Moderate
Town of Apex	Moderate	High	High	Limited	High	High	High
Town of Cary	High	High	High	High	High	High	High
Town of Fuquay-Varina	High	High	High	High	High	High	High
Town of Garner	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate
Town of Holly Springs	High	High	High	Moderate	Moderate	High	High
Town of Knightdale	High	Moderate	Limited	Limited	Limited	Moderate	Moderate
Town of Morrisville	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
City of Raleigh	High	High	High	High	High	High	High
Town of Rolesville	High	High	Moderate	Moderate	Moderate	Moderate	Moderate
Town of Wake Forest	High	High	High	Moderate	Limited	High	High
Town of Wendell	High	Moderate	Limited	Limited	Limited	Limited	Limited
Town of Zebulon	Moderate	Moderate	Moderate	Moderate	Limited	Moderate	Moderate

Source: Local Capability Assessment Survey

5.4 CONCLUSIONS ON LOCAL CAPABILITY

In order to form meaningful conclusions on the assessment of local capability, a quantitative scoring methodology was designed and applied to results of the Local Capability Self-Assessment. This methodology attempts to assess the overall level of capability of the Wake County planning area to implement hazard mitigation actions.

Table 5.8 shows the results of the capability assessment using the designed scoring methodology. The capability score is based on responses provided by local officials for the Local Capability Self-Assessment and information collected from municipal websites. According to the assessment, the average local capability score for all responding jurisdictions is 98, which falls into the Moderate capability ranking.

Table 5.8 – Capability Assessment Results

Jurisdiction	Overall Capability Score	Overall Capability Rating
Wake County	96	Moderate
Town of Apex	103	High
Town of Cary	113	High
Town of Fuquay-Varina	107	High
Town of Garner	95	Moderate
Town of Holly Springs	108	High
Town of Knightdale	87	Moderate
Town of Morrisville	98	Moderate
City of Raleigh	105	High
Town of Rolesville	93	Moderate
Town of Wake Forest	103	High
Town of Wendell	79	Moderate
Town of Zebulon	88	Moderate

Source: Local Capability Assessment Survey, NCEM Risk Management Tool

As previously discussed, one of the reasons for conducting a capability assessment is to examine local capabilities to detect any existing gaps or weaknesses within ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. These gaps or weaknesses have been identified, for each jurisdiction, in the tables found throughout this section. The participating jurisdictions used the capability assessment as part of the basis for the mitigation actions that are identified in Section 7; therefore, each jurisdiction addresses their ability to expand on and improve their existing capabilities through the identification of their mitigation actions.

6 MITIGATION STRATEGY

Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the process for developing the mitigation strategy for the Wake County Multi-Jurisdictional Hazard Mitigation Plan. It describes how the plan participants met the requirements for Planning Step 6 (Set Goals), Planning Step 7 (Review Possible Activities), and Planning Step 8 (Draft an Action Plan). This section includes the following sub-sections:

- 6.1 Goals and Objectives
- 6.2 Identification & Analysis of Mitigation Activities

6.1 GOALS AND OBJECTIVES

Requirement §201.6(c)(3)(i): [The mitigation strategy section shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Goal setting builds upon the findings of Section 4, which documents the hazards and associated risks that threaten the Wake County planning area, and Section 5, which evaluates the capacity of the county and incorporated communities to reduce the impact of those hazards. The intent of goal setting is to identify areas where feasible actions can be taken or improvements to existing capabilities can be made so that community vulnerability to hazards is reduced. Goals and objectives encompass mitigation for all hazards. Goals are also necessary to guide the review of possible mitigation measures. This plan needs to make sure that recommended actions are consistent with what is appropriate for the county and incorporated municipalities. Mitigation goals need to reflect community priorities and should be consistent with other local plans.

- **Goals** are general guidelines that explain what is to be achieved. They are usually broad-based policy type statements, long term and represent global visions. Goals help define the benefits that the plan is trying to achieve.
- **Objectives** are short term aims that, when combined, form a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

6.1.1 COORDINATION WITH OTHER PLANNING EFFORTS

The goals of this plan need to be consistent with and complement the goals of other local planning efforts. The primary planning documents that the goals of this plan should complement and be consistent with are the county and participating jurisdictions' comprehensive plans. Comprehensive plans are important because they are developed and designed to guide future growth within their communities so they encompass long-term strategies and can be critical to reducing long term vulnerabilities. Keeping the Hazard Mitigation Plan and Comprehensive Plans consistent ensures that land development is done with awareness and understanding of hazard risk and that mitigation projects complement rather than contradict community development objectives.

6.1.2 GOAL SETTING

At the third planning meeting, held on May 30, 2024, the HMPC reviewed and discussed the goals from the 2019 hazard mitigation plan. The HMPC did not propose any changes to the existing goals or objectives and instead reaffirmed the importance of continuing to achieve these goals and objectives. The Wake County planning area mitigation goals and objectives are detailed below in Section 6.1.3.

6.1.3 RESULTING GOALS AND OBJECTIVES

The HMPC agreed upon four general goals for this planning effort and included specific objectives in support of each goal. The refined goals and objectives are as follows:

Goal 1 – Protect public health, life, safety, and welfare by increasing public awareness and education of hazards and by encouraging collective and individual responsibility for mitigating hazard risks.

Objective 1.1: Develop outreach materials and expand outreach platforms to identify hazard areas and explain risks.

Objective 1.2: Seek opportunities to improve warning and notification of hazard events.

Goal 2 – Improve technical capability (including administrative resources, tools, data, and equipment) to implement hazard mitigation and respond to hazard events.

Objective 2.1: Ensure that disaster response and recovery personnel have the necessary equipment and supplies available in order to serve the public in the event of a disaster.

Objective 2.2: Seek to fill gaps in local capabilities that will enable improved implementation of mitigation projects.

Goal 3 – Minimize threats to life and property by protecting the most vulnerable populations, buildings, and critical facilities through the implementation of cost-effective and technically feasible mitigation actions.

Objective 3.1: Retrofit, harden, or otherwise protect critical facilities and infrastructure to protect against damages and ensure continuity of operations during hazard events.

Objective 3.2: Implement policies and projects that reduce vulnerabilities of key populations and property at risk.

Goal 4 – Incorporate resiliency into future growth by ensuring that hazard mitigation is considered for both new development and post-disaster redevelopment and recovery.

Objective 4.1: Enhance existing or create new policies and ordinances that will help reduce the damaging effects of natural hazards.

Objective 4.2: Integrate hazard mitigation into existing and new planning efforts.

6.2 IDENTIFICATION AND ANALYSIS OF MITIGATION ACTIVITIES

Requirement §201.6(c)(3)(ii): [The mitigation strategy section shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.

To identify and select mitigation projects that support achieving the mitigation goals and objectives, the risks and vulnerabilities associated with all hazards identified and evaluated in Section 4 Risk Assessment were evaluated for mitigation opportunities. The HMPC analyzed viable mitigation options that supported the identified goals and objectives, addressed key problems, risks, or vulnerabilities, and aligned with other local plans and efforts. The HMPC was provided with the following list of mitigation categories which are utilized as part of the CRS planning process but are also applicable to multi-hazard mitigation.

- Prevention
- Property Protection
- Natural Resource Protection
- Emergency Services
- Structural Projects
- Public Information and Outreach

The HMPC was also provided with examples of potential mitigation actions for each of the above categories. The HMPC was instructed to consider both future and existing buildings in evaluating possible mitigation actions. Facilitated discussions took place to examine and analyze the options. The HMPC also considered which actions from the previous plan that were not already completed should be continued in this action plan.

More details on mitigation alternatives considered by the HMPC are provided in Appendix C.

6.2.1 PRIORITIZATION PROCESS

In the process of identifying continuing and new mitigation actions, the HMPC was provided with a set of prioritization criteria to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. HMPC members were asked to rate each action on a set of criteria, which were grouped into three categories: Suitability, Risk Reduction, and Cost. The criteria for the prioritization process included the following:

- **Suitability**
  - Appropriateness of Action
  - Community Acceptance
  - Technical and Administrative Feasibility
  - Environmental Impact
  - Legal Conformance
  - Consistency with Existing Plans and Other Community Goals

- **Risk Reduction**
  - Scope of Benefits

  - Potential to Save Lives
  - Importance of Benefits
  - Level of Inconvenience or Unintended Consequence
  - Losses Avoided
  - Number of People to Benefit

- **Cost**
  - Estimate of Upfront Cost
  - Estimate of Ongoing Cost
  - Benefit to Cost Ratio
  - Financing Availability
  - Affordability
  - Elimination of Repetitive Damages

In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority, as reflected in the prioritization criteria above. For each action, the HMPC considered the benefit-cost analysis in terms of:

- Ability of the action to address the problem
- Contribution of the action to save life or property
- Available technical and administrative resources for implementation
- Availability of funding and perceived cost-effectiveness

The consideration of these criteria helped to prioritize and refine mitigation actions but did not constitute a full benefit-cost analysis. The cost-effectiveness of any mitigation alternative will be considered in greater detail through performing benefit-cost project analyses when seeking FEMA mitigation grant funding for eligible actions associated with this plan.

Using these prioritization criteria, the HMPC the assigned a subjective priority rating of High, Medium, or Low priority to each action. The prioritization ranking for each mitigation action considered by the HMPC is provided in Section 7 Mitigation Action Plans.

7 MITIGATION ACTION PLANS

Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include an] action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This section provides the mitigation action plans for each participating jurisdiction. The plans are organized as follows:

- Wake County
- City of Raleigh
- Town of Apex
- Town of Cary
- Town of Fuquay-Varina
- Town of Garner
- Town of Holly Springs
- Town of Knightdale
- Town of Morrisville
- Town of Rolesville
- Town of Wake Forest
- Town of Wendell
- Town of Zebulon

Mitigation action plans are also provided in each jurisdiction's annex of this plan.

Table 7.1 – Mitigation Action Plan, Wake County

Wake County											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Conduct a groundwater assessment using a network of wells and leading to a groundwater model that can enhance the understanding of groundwater capacity, threats and vulnerabilities in response to growth and weather.	1	1	Drought	High	Wake Environmental Services, Wake Water Partnership, USGS	$1,565,000	Non-departmental operating expense and USGS	3-5 years	In-Progress – Carry Forward	Contract renewed with USGS to continue groundwater gauge monitoring. Groundwater flow model set to be complete June 2025.
P-2	Continue to coordinate with City of Raleigh on Flood Early Warning System Future: Reference modeling data and municipal gauge networks to Identify gaps in coverage and install gauges to support flood projections and emergency response.	1	2	Flood	Moderate	Wake County Community Services	To be determined	Local, Federal	Ongoing – Next 5 years	New	N/A
P-3	Establish and implement a proactive review process for dam emergency action plans and condition with property owners.	2	2	Flood, Dam Failure	Moderate	Wake County Community Services	To be determined	Local, Federal	Ongoing – Next 5 years	New	N/A
Property Protection											
PP-1	Provide support and advocacy for long term solutions to address orphan roads in Wake County, including legislative solutions and incentives for developers to turn roads over to NCDOT for state maintenance.	3	1	All	Moderate	Wake County Community Services	$50,000,000	State and Federal Funds	Ongoing - Next 5 years	In Progress – Carry Forward	Wake County Orphan Road Program finances road repair, paid back by property owners. Outside funding is needed.
PP-2	Ponderosa Sanitary Sewer Improvements	3	3	Flood Hurricane & Tropical Storm, Severe Weather	High	County Administration	To be determined	FEMA HHDPR, BRIC, Local Funding	5 years	Carry Forward	To apply for FEMA BRIC implementation funding, Wake County adopted this mitigation action as part of an amendment to the 2019 Wake County HMP. Applied for funding in 2023.
PP-3	Assist in reinstating water and sewer services post disaster	1	1	All	Low	Wake County Community Services	$50,000,000	Local and Federal Grant	Ongoing - Next 5 years	In-Progress – Carry Forward	Wake County Water, Sewer Financial policy allows county to repair and restore water and sanitation.
Natural Resource Protection											
NRP-1	Partner with other governmental units and other interested parties to jointly identify and acquire 30,000 acres of open space lands.	3	2	Flood, Drought, Landslide, Extreme Heat	High	Wake County Community Services	$335,000,000	Open Space Bonds	3-5 years	In-Progress – Carry Forward	Continuing to purchase and protect via partnerships. Protected just under 10k (total-2400 since 2019) acres county wide through partnerships with municipalities. Nearing the end of bond allocation funding. Spending down mitigation money form the DOT. County goal is still 30k acres to be protected open space. Additional bonds 2026 but unconfirmed.

Wake County											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
NRP-2	Reference modeling data associated with Wake County One Water Plan (in development, est. completion date Dec. 2025) and existing flood data to identify locations to implement nature-based solutions such as green stormwater infrastructure projects, stormwater wetlands and floodplain restoration.	2	2	Flood	Moderate	Wake County Community Services	To be determined	Local, Federal	Ongoing – Next 5 years	New	N/A
Structural Projects											
SP-1	Replace emergency generators located at facilities that serve as emergency shelter locations based on their scheduled end of life cycle.	3	1	All	Moderate	Wake County Facilities Design & Construction	$1,400,000	Local and Federal Grant	More than 5 years	In Progress – Carry Forward	Sanderson remains unreplaced. Due to some additional funding coming available it will be replaced by end of 2025. Garner, Middle Creek, and Heritage by end of 2024. Completed schools are SE Raleigh and Knightdale are complete. JC will edit the dates for purposes. Supply chain - award contract and wait.
Emergency Services											
ES-1	Recovery Plan. Develop a comprehensive disaster recovery plan for Wake County consistent with the vision and goals described in PPD-8 and the National Disaster Recovery Framework.	4	2	All	Moderate	Wake County Emergency Management	$150,000	Local	3-5 years	In-Progress – Carry Forward	County wishes to pursue this effort. Covid and staff time committed to "routine" efforts have postponed this project. The County desires to keep it on the project list in hopes of seeking grant funding to accomplish.
ES-2	Upload dam failure inundation maps to Everbridge system for notification and evacuation.	1	2	Dam Failure	High	Wake County Emergency Management	Staff time	Local	1 year	In-Progress – Carry Forward	Staff time and resources are insufficient. County wishes to pursue this effort and to keep it on the project list in hopes of seeking gran funding to accomplish.
ES-3	Create a critical infrastructure inventory and expand situational awareness capabilities. This project will focus on identifying, cataloguing and monitoring essential assets to enhance resiliency and response capabilities.	2	2	All	Moderate	Wake County Emergency Management	$2,000,000	Local, State, and Federal Funds	Ongoing – 5 Years	New	N/A
Public Education and Awareness											
PEA-1	Increase public awareness and participation in the Ready Wake program and resources.	1	1	All	Moderate	Wake County Fire Services, Emergency Management	$10,000	Federal Grants and Local	2-3 years	In-Progress – Carry Forward	Since the last plan update, the County has hired a full-time staffer for this purpose, developed paper and electronic media, conducted scores of public events; and, signed up thousands to the ReadyWake notification system. Even with all these efforts, we have only touched a portion of our population, and this is an on-going effort.

Table 7.2 – Mitigation Action Plan, City of Raleigh

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Develop ongoing multi-year program of detailed basin studies for each watershed in City's jurisdiction. Fifteen basin studies are complete with 10 additional studies budgeted in the capital program. (CRS 410).	2	2	Flood	Moderate	Raleigh Engineering Services	$100,000 - $1m	Local	1 year	In-Progress – Carry Forward	The detailed basin study program has been established but the studies themselves will be ongoing. The City is conducting approximately 3 basin studies per year.
P-2	Update and maintain GIS data of building footprints, parcels, and critical facilities, and use it to regularly identify buildings in need of mitigation.	2	2	All	Moderate	Raleigh Information Technology, GIS staff	Staff time	Local	Ongoing - Next 5 years	In-Progress – Carry Forward	Currently, critical facilities aren't maintained and/or integrated with the Enterprise GIS System, taken as an action item to further develop layers/datasets.
P-3	Develop a local floodplain mapping program to produce regular mapping updates to flood hazard maps.	2	2	Flood	Moderate	Raleigh Engineering Services	$100,000- $1m	Local, Federal	Ongoing - Next 5 years	New	The City is continuing to gather information on how data produced through ongoing detailed basin studies can be used for mapping updates, outlining criteria for where and how often mapping updates will be conducted, and evaluating potential budgetary and resource needs.
P-4	Continue active lake level management activities at Lake Johnson to reduce flood risk to downstream Walnut Creek properties during storm events.	3	2	Flood, Hurricane	Moderate	Raleigh Engineering Services	Less than $100,000	Local	Ongoing - Next 5 years	New	Staff uses a web-based software to remotely control the actuators, valves and gates at Lake Johnson. This allows us to remotely lower the lake prior to large storm events which gives us more storage in the lake to capture runoff during storm events and help reduce flooding downstream. We will be looking at adding this type of system to other Lakes and SCMs in the area over the next few year.
P-5	Proactively review dam emergency action plans and condition with property owners as part of the City's dam public education and outreach program.	1	2	Flood, Hurricane	Moderate	Raleigh Engineering Services	$100,000 and staff time	Local	Ongoing - Next 5 years	New	N/A
Property Protection											
PP-1	Develop ongoing program designed to utilize grant resources to assist private property owners in acquiring, relocating, elevating, or floodproofing existing structures located in flood hazard zones	3	2	Flood	Moderate	Raleigh Engineering Services	$100,000 - $1m	Local, Federal	3-5 years	In-Progress – Carry Forward	The City has established a Floodplain Management team to manage mitigation projects going forward. A prioritization model has also been developed to score and evaluate potential mitigation properties.

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PP-2	Program to install emergency electrical generators at all public utility facilities. Current focus on redundant generators at critical facilities, second fuel truck and completion of 100% generator coverage in Garner area.	3	1	All	High	Raleigh Public Utilities	$100,000 - $1m	Local	2-3 years	In-Progress – Carry Forward	Received supplemental funding for FY25, working to obtain quotes but looking at supporting sustainability by using natural gas.
Structural Projects											
SP-1	Install cameras in flood prone areas throughout the City of Raleigh to allow us to view these locations and make informed decisions as it relates to flooding	2	2	Flood, Hurricane	Moderate	City of Raleigh Transportation	$100,000 to $1m	Unknown	3-5 years	In-Progress – Carry Forward	Addition of cameras is ongoing. We currently have 18 cameras installed and have 6 more in-house to be installed. Over the next few years we are looking to have a total of 31 cameras in flood prone areas.
SP-2	Implement stormwater improvement projects that improve conveyance, retention, and/or detention capabilities, particularly in areas that frequently experience flooding.	3	2	Flood	High	Raleigh Engineering Services	$100,000 - $1m, >$1m	Local	Ongoing - Next 5 years	In-Progress – Carry Forward	Continue the study and design of major improvement projects (Rose Lane, Smoky Hollow, etc.). Continue with drainage assistance projects/GSI installs. Approximately 4 residential properties benefited from drainage assistance projects/GSI installs over the last year.
Emergency Services											
ES-1	Provide and enhance technical rescue capabilities more equitably throughout the city.	2	1	Dam Failure, Flood, Hurricane, Severe Weather, Severe Winter Storm, Tornado, Wildfire	High	Raleigh Fire	$100,000 - $1m	Local	2-3 years	In-Progress – Carry Forward	As the square mileage of the city continues to grow, the ability for a single rescue unit and two squads to respond in a timely manner is becoming challenging. A second dedicated rescue unit will be needed in the near future to address reasonable response times to all areas of the city. We continue to successfully train all members of the technical rescue team in various aspects of rescue. Training our team is a continuous goal due to attrition of team members through separation and promotion.
ES-2	Provide after-action report of emergency response to severe weather events in order to improve planning for future disasters.	2	2	Hurricane, Severe Weather, Severe Winter Storm, Tornado	High	Raleigh Fire and Emergency Management	$100,000 - $1m	Local	Ongoing- Post Event	In-Progress – Carry Forward	AAR's are an on-going and adaptive concern. Information derived from AAR's should be used to drive change in emergency response.
ES-3	Maintain a standard operating guideline to direct operational planning prior to anticipated weather emergencies.	2	1	All	High	Raleigh Fire and Emergency Management	$100,000 - $1m	Local	Ongoing – next 5 years	In-Progress – Carry Forward	EOPs and SOGs are an ever-changing condition.

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-4	Continue to conduct disaster tabletop exercise program.	2	1	All	Low	Raleigh Public Utilities, Fire, Police, City Manager, Emergency Management, and Engineering Services	$100,000 - $1m	Local	Ongoing – next 5 years	In-Progress – Carry Forward	Continuing effort with new Emergency Management staff, broaden exercise topics from natural/tropical hazards to all-hazards along with routine/quarterly Working Group meetings on various topics/trainings/exercises
ES-5	Establish cross-functional team to develop Debris Management Plan. Team should work to identify and prepare additional debris management sites.	2	1	Flood, Tornado, Earthquake, Severe Winter Storm, Severe Weather, Hurricane	Moderate	City of Raleigh Transportation	$100,000	FEMA, City of Raleigh general fund support	1 year	In-Progress – Carry Forward	Group between three partner departments formed in 2019 to investigate our debris management and plan for how the City manages debris long term. City Real Estate assisted with identification of sites at that time and resulted in 4 proposed sites, Thornton Rd, Old Battle Bridge Rd, Patriot Dr (rear of current Yard Waste Facility) and Tarheel Club Rd (Parks Site). Also, Hertz Dr site was discussed as an intermediate drop site and/or use for grinding debris. At this time sites have not been studied for impact to flood plain or for proper permitting by Solid Waste Services.
ES-6	Develop a Substantial Damage Management Plan	2	2	Flood, Hurricane	High	Raleigh Engineering Services	Less than $100,000	Local	Ongoing – 1 Year	New	Communities that participate in the Community Rating System (CRS) can receive credit points for going beyond those basic standards by developing a detailed, written plan for managing the susceptibility of buildings within their jurisdictions to substantial damage from floods and other hazardous events. Such a plan helps increase awareness of flood risk areas, identifies vulnerable structures and neighborhoods, and ensures that there is a strategy in place for making damage determinations and enforcing the substantial damage requirements if a flood occurs. In addition, the plan, and the process of producing it, fosters communication with residents and elected officials and helps develop long-term actions to mitigate properties and reduce future losses.

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Public Education and Awareness											
PEA-1	Enhance flood monitoring and warning capabilities by expanding the City's Flood Early Warning System and through the continued use and addition of gages, sensors, signs, and cameras.	1	2	Flood	Moderate	Raleigh Engineering Services	$3m - $4m	Local, Federal	Ongoing – Next 5 years	New	The Flood Early Warning System (FEWS) is being developed to predict, monitor, report, and notify on flooding events. The system has Gauge Adjusted Radar Rainfall that updates every 5-minutes, predictive current rainfall gauge data, Watchpoints at stream gauge locations that shows current observations and predictions of the stream level over the next several hours that updates every 5-minutes, alerts and notifications that can be programed and received via text, email or phone call, post event reports that can be ran to get the 5-minute data from all the system throughout the storm event, forecasts from national models are built into the system, and a "What if" scenario app that can be used to pull in the current forecast or a made up scenario to see how a rainfall event might affect the creek level during that event. In the program we also have flood sensors that active flashing signs along the roadway for motorist to be aware of flooded road conditions. We currently have 9 locations with this system and should soon have another system in place. We also use low-cost cellular and solar powered cameras to deploy in locations that the Traffic cameras can't be installed. We currently have 21 of these cameras and look to have 62 in place over the next few years.
PEA-2	Educate residents on emergency preparedness, clearing storm drains, and reporting illicit discharges.	1	1	Flood, Hurricane	High	Raleigh Engineering Services, Emergency Management, Public Utilities	Less than $100,000	Local	Ongoing - Next 5 years	New	Informed residents are better able to protect themselves, their property, and natural floodplain functions when they are prepared. Outreach is done through various Community Rating System (CRS) projects (e.g., in our water bill mailer, on our website, etc,).
PEA-3	Promote flood insurance.	1	1	Flood, Hurricane	High	Raleigh Engineering Services	Less than $100,000	Local	Ongoing - Next 5 years	New	With an NFIP flood insurance policy, residents and business owners can recover faster and more fully after a disaster. Promotional outreach is done through various Community Rating System (CRS) projects (e.g., in our water bill mailer, on our website, etc.).

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PEA-4	Community Climate Education for a Resilient Raleigh: grant from NOAA Office of Education's Environmental Literacy Program for a three-year project to improve the climate resilience of Raleigh's vulnerable communities	1	1	Flood, Heat	Moderate	Raleigh Sustainability and Stormwater	~$440,000	Federal	Ongoing - Next 3 years	New	This is a flagship program and three-year $440,000 Federal grant through the National Oceanic and Atmospheric Administration (NOAA). Partners include: the City of Raleigh, Partners for Environmental Justice (PEJ), the State of North Carolina's Climate Office and many more stakeholders representing local neighborhoods, government, non-profit, business and more. There are 3 main activities for this grant, which include education and outreach through the expansion of the Watershed Learning Network in partnership with PEJ to develop cohorts of residents that are empowered on climate resilience; community capacity building for resilience action in local communities including the Ready Raleigh Emergency Preparedness Guide; and climate resilience planning efforts.

Table 7.3 – Mitigation Action Plan, Town of Apex

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Sanitary Sewer Condition Assessment	3	1	Flood, Hazardous Materials, Severe Weather	High	Water Resources	$400,000	Federal Grant	2-3 Years	New	Funding for a flow and visual infrastructure analysis.
P-2	Stormwater System Condition Assessment	3	1	Flood, Hurricane, Tornado, Severe Weather	High	Water Resources	$461,300	Town Funds; Federal Grant	2-3 Years	New	N/A
P-3	Assess equipment capacity for adverse weather response and disaster debris management.	2	1	Hurricane, Tornado, Severe Weather, Winter Storm	Moderate	Public Works	Staff Time	Town Funds	1-3 Years	New	N/A
Property Protection											
PP-1	Restore streams to slow the speed of water and reduce erosion to prevent both private property loss and public infrastructure damage.	3	2	Flood	Moderate	Water Resources (Director)	Over $500,000	Local & Federal	Ongoing - Next 5 years	In-Progress – Carry Forward	Evaluating Funding Opportunities
Natural Resource Protection											
NRP-1	Middle Creek Greenway (Miramonte to Holly Springs).	3	2	Flood; Evacuation	Moderate	Apex Parks and Recreation	$6.1 million	Town Funds	3-5 years	In-Progress – Carry Forward	Under construction
NRP-2	White Oak Creek Corridor Preservation & Maintenance study – including purchase of additional property near Wimberly Road Par	3	2	Flood; Evacuation	Moderate	Apex Parks & Recreation; Cary Parks & Recreation; Triangle Land Conservancy	Unknown	Apex Town Funds; Cary Town Funds; TLC Funds	3-5 years	In-Progress – Carry Forward	Purchased 1 parcel; negotiating the purchase of 2nd parcel; and final draft plan to be presented to the public in mid-2024
NRP-3	Beaver Creek Greenway (PHI, PHIA, & PHII)	3	2	Flood; Evacuation	Moderate	Apex Parks and Recreation	$14.5 million	Bond, Federal and Town	1-2 Years	In-Progress – Carry Forward	NCDOT releasing for bid and construction
NRP-4	Apex West Greenway	3	2	Flood; Evacuation	Moderate	Apex Parks and Recreation	$712,000	County and Town	1-2 Years	In-Progress – Carry Forward	USACOE permitting then Bid and Construction
NRP-5	Big Branch Greenway	3	2	Flood; Evacuation	Low	Apex Parks and Recreation	$8.45 million	Town Funds	5 Years	New	N/A
NRP-6	Reedy Branch Greenway (Abbington-Kelly Road West to Goliath Lane	3	2	Flood; Evacuation	Low	Apex Parks and Recreation	$3.3 million	Town Funds	5 years	New	N/A
NRP-7	Middle Creek Greenway (Gladstone North to Center Street)	3	2	Flood; Evacuation	Low	Apex Parks and Recreation	$4.6 million	Town Funds	5+ years	New	N/A

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Structural Projects											
SP-1	Improve communications abilities for emergency response by building new fiber optic internet infrastructure and replacing current radio systems. Set up dedicated fiber connections to Cary for their radios. 3-5 years from replacing radios for PD, Fire & PW.	2	1	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Police Dept; Fire Dept; Public Works; Information Technology	$915,000	Town Funds	3-5 years	Carry Forward – In Progress	Partway done.
SP-2	GPS Emergency Vehicle Preemption - allow emergency vehicles to interrupt normal traffic signal timing during an emergency	2	1	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$660,000	Town Funds	3-5 years	New	N/A
SP-3	Jessie Drive Phase 1 - Build Jessie Drive to connect Ten Ten Rd future Production Dr.	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$11.5 million	Town Funds	3-5 years	Carry Forward – Not Started	Separated phases into 2 items; Preparing to conduct property appraisals in advance of land acquisition; Public Open House held on May 20, 2024.
SP-4	Jessie Drive phase 2 - Build Jessie Drive to connect future Production Dr. and NC-55	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$11.5 million	Town Funds	More than 5 Years	Carry Forward – Not Started	Feasibility study completed, no final design.
SP-5	Finish the SW Peakway loop connector road	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	High	Transportation & Infrastructure Development	$30 million	Town Funds	3-5 years	Carry Forward – In Progress	Awaiting NCDOT approval of signal plans; Under Construction as of Dec. 2024
SP-6	Finish SE Peakway Loop connector road	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	High	Transportation & Infrastructure Development	$27.3 million	Town Funds	More than 5 years	Carry Forward – In Progress	Feasibility study complete; final design not yet funded

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
SP-7	Justice Heights St. Extension	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	High	Transportation & Infrastructure Development	$750,000 - 1 million	Town Funds	1-2 years	New	Design in review. Environmental permitting in progress. Public open house anticipated in June/July
SP-8	Apex Peakway North Widening (Center St to Old Raleigh Rd)- widen from a 2- to 4-lane road to handle congestion.	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$5.75 million	Town Funds	2 years	New	N/A
SP-9	Pristine Water Drive Connector (Pristine Water Dr. to Lufkin Rd)	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$3.5 million	Town Funds	2-3 years	New	N/A
SP-10	Construct Electric Substation #4 for North West Side of town (Jenks Rd/Hwy 64). This will allow systems redundancy in the event of major damages.	3	2	All Hazards	Moderate	Electric Department (Electric Utilities Director)	$5 million	Town Funds	Ongoing – Next 5 years	Carry Forward – In Progress	Working on land acquisition
SP-11	Upgrade the East Williams St. Substation - Add two 40 MVA Power Transformers	3	1	All Hazards	Moderate	Electric Department (Electric Utilities Director)	$1.8 million	Town Funds	5+ years	New	N/A
SP-12	Construct new feeder lines in strategic locations to tie electric substations together & move power around town during emergencies.	3	1	All Hazards	Moderate	Electric Department (Electric Utilities Director)	$200,000	Town Funds	1-2 years	New	Beginning design
SP-13	Determine temporary storage site during for debris removal during disaster or storm cleanup	3	2	Hurricane, Tornado, Severe Weather	Moderate	Public Works	$500,000	Town Funds	2-5 year	Carry Forward – In Progress	Beginning negotiations
SP-14	Change location of the backup data disaster recovery site.	2	1	All: reduces risk of data loss during a disaster	Moderate	Information Technology	$250,000	Town Funds	1-2 year	Carry Forward – In Progress	Completed once; reviewing a new move
SP-15	Stream relocation in Nature Park to prevent impact on sewer line.	3	2	Flood	Moderate	Water Resources (Stormwater)	$690,000	Town Funds & NCLWF Grant	More than 5 years	Carry Forward – In Progress	Currently in design
SP-16	New 1.5 MG Water Tower (Pleasant Park)	3	1	Drought, All Hazards	High	Water Resources	$8.6 million	Town Funds & ARPA Funds	1-2 years	New	Currently in the surveying & design process

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Emergency Services											
ES-1	Construct Public Safety Station #7 (Olive Chapel Road and Richardson Road Area)	3	2	All Hazards	Moderate	Apex Fire Dept.	$10.7 million	Town Funds	5+ years	Carry Forward – In Progress	Location being evaluated.
ES-2	Relocate Fire Department Administration from its existing location to Station 1 because of the impacts of widening NC-55.	3	1	All Hazards	Moderate	Apex Fire Dept.	$6.5 million	Town Funds	2-5 years	Carry Forward – In Progress	No progress to report
ES-3	Fire Station 3 Renovation	3	2	All Hazards	Moderate	Apex Fire Dept.	$3.5 million	Town Funds	2-5 years	New	N/A
ES-4	Police Department Addition & Renovation – add office space	3	2	All Hazards	Moderate	Apex Police Dept.	$6.6 million	Town Funds	5+ years	New	N/A
ES-5	Public Safety Station 8	3	1	All Hazards	Moderate	Apex Fire Dept.	$11 million	Town Funds	5+ years	New	N/A
ES-6	Create a town wide plan for staging and distribution of resources and emergency services – location would need to be near a large park or similar	2	2	All Hazards	Moderate	Apex Fire Dept. & Apex Parks & Recreation	$500,000	Town Funds	2-5 years	Carry Forward – In Progress	No progress to report
ES-7	Camera Project in downtown & Town Campus	2	2	All Hazards	Moderate	Apex Fire Dept, Apex Police Dept & IT	$950,000	Town Funds	2-5 years	New	N/A
Public Education and Awareness											
PEA-1	Include Environment Education Station and classroom at Nature Park.	1	1	All	Moderate	Apex Parks and Recreation	$5.2 million	Town Funds	3-5 years	In-Progress – Carry Forward	Looking for funding options.
PEA-2	Post warning signage at local parks for lightning.	1	1	Severe Weather	Low	Apex Parks and Recreation	$15,000	Town Funds	3-5 years	In-Progress – Carry Forward	No progress to report

Table 7.4 – Mitigation Action Plan, Town of Cary

Town of Cary											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Town's Comprehensive Plan- The Town has an existing comprehensive plan which includes land use, parks and recreation, open space, transportation, utilities, and environment.	4	2	All	High	Cary Planning	$1M for plan development; implementation ongoing	General Fund	2-3 years	In-Progress – Carry Forward	This is Cary's 2040 Comprehensive Plan. The plan will continue to be updated as new master plans and specialized plans are complete.
P-2	Adaptive Approach to Stormwater	4	1	Flood	High	Cary Stormwater	$900,000	General Fund and $300K Grant	Ongoing	In-Progress – Carry Forward	Multi-pronged approach including 5 key components: 1) Working Group of residents and local experts to learn and advise 2) Maintenance, including Condition Assessment (a separately listed "action") 3) Open Space, examining how open space and tree canopy provide stormwater benefits 4) Model, hiring a firm to build a dynamic rainfall-runoff model to establish a baseline and test solutions and scenarios 5) Ordinance, looking at the stormwater ordinance as a way to achieve our risk mitigation goals.
P-3	Stormwater Condition Assessment Program	4	2	Flood	High	Cary Stormwater	$750,000	General Fund	2-3 years	In-Progress – Carry Forward	In phase 4, (1-GIS Assessment Tool, 2-GIS Mapping Data and assessment, 3-Modeling, 4-Maintenance) Assessment Tool completed. GIS Mapping 99% completed.
P-4	Develop flood model for upper Swift Creek watershed	2	2	Flood, Hurricane	High	Cary Stormwater	$1.2 Million	Town Funds and Grants	2 years	In-Progress – Carry Forward	1st phase complete, but additional phases added, and grant funding acquired. Additional phases are underway.
P-5	Conduct study and develop improvement plan for Twin Lakes dam	2	2	Dam Failure	High	Cary Stormwater	$5 Million	Town Funds	2 years	In-Progress – Carry Forward	In progress; permitting with Dam Safety
P-6	Participant & collaborator for Neuse Basin Flood Resiliency Blueprint	4	2	Flood	High	NC DEQ	No Cost	N/A	2 years	New	Working with local stakeholders, interagency partners, academics, and technical experts, DEQ's Division of Mitigation Services plans a comprehensive approach to identify problems, address barriers, and prioritize solutions to increase community resilience to flooding throughout North Carolina's River basins.
P-7	CRS membership	2	2	Flood	High	Cary Stormwater	Unknown	Town Funds	1 year	New	Seeking membership in CRS
Property Protection											
PP-1	Lake Pine and Brookgreen culvert replacements	3	1	Flood	High	Cary Stormwater	$4 million	General Fund	2 years	New	Culvert replacement project that will reduce flooding upstream of Kildaire Farm Lake within the Swift Creek Watershed
PP-2	Cedar Street Drainage Improvements	3	1	Flood	High	Cary Stormwater	$600,000	General Fund	1 year	New	Retrofits to aging stormwater network to reduce both structural flooding and flooding of Cedar St.

Town of Cary											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PP-3	Meridian Regional Wetland SCM	3	1	Flood	High	Cary Stormwater and Private Developer	$750,000	General Fund/Private Funds	2 years	New	Public-Private partnership to construct regional wetland device within swift creek watershed and retrofit outfalls to mitigate historical flooding of downstream structures
PP-4	Walnut Creek Floodplain Buyout	3	2	Flood	High	Cary Stormwater	$10 million	General Fund	3 years	New	Town initiative to purchase flood prone properties within the Walnut Creek corridor for demolition and open space restoration
Natural Resource Protection											
NRP-1	Buffer and UTB Protection	3	2	Flood	High	Cary Stormwater and Cary Planning	Over $10,000,000	Private (Developer) Funds	Ongoing - Next 5 Years	In-Progress – Carry Forward	Extra 50-foot buffer (UTB) on USGS streams; no buffers platted in lots.
NRP-2	Urban Park Bioretention Filtration Conveyance (BFC)	3	1	Flood	Moderate	Cary Stormwater	$300,000	General Funds	2-3 Funds	New	GSI installation and retrofit to improve water quality and reduce peak flows into Walnut Creek.
NRP-3	Lions Park BFC	3	1	Flood	Moderate	Cary Stormwater	$300,000	General Funds	2-3 Funds	New	GSI installation and retrofit to improve water quality and reduce peak flows into Swift Creek.
Structural Projects											
SP-1	Update Water Shortage Response Plan	2	4	Drought	High	Town of Cary	Staff Time	N/A	1 year	In-Progress – Carry Forward	No progress to report
SP-2	Water System Risk Analysis	3	1	All	High	Town of Cary	$89,000	General Fund	Ongoing - 1 Year	In-Progress – Carry Forward	The Water System Risk Analysis is a comprehensive look at the risks to our water system. It is being done to comply with the American Water Infrastructure Act of 2018. It will result in a new emergency response plan for our water system.
SP-3	Woodland Drive Culvert Replacement	3	2	Flood	Moderate	Cary Stormwater	$225,000	General Fund	2 years	New	Culvert replacement to replace undersized/old culvert and mitigate upstream flooding within Crabtree Watershed
Emergency Services											
ES-1	Provide and enhance technical rescue capabilities throughout the Town.	2	1	All	High	Cary Fire	Unknown	Local	Ongoing – initiative for preparation	In-Progress – Carry Forward	Cary's Fire Department has a technical rescue training program that we coordinate with Morrisville and Apex, NC. We train on all disciplines of technical rescue.
ES-2	Provide after-action report of emergency response to severe weather events in order to improve planning for future disasters.	2	2	All	High	Cary Fire, Water Resources, and Facilities Design & Transportation Services	Unknown	General Fund	Ongoing – initiative for preparation	In-Progress – Carry Forward	Cary's key emergency response departments have formal after-action meetings to learn from what went well and seek opportunities to improve. This occurs after each event, so is ongoing in nature.

Town of Cary											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-3	Establish a relationship/partnership with the Renaissance Computing Institute (RENCI) to create a web-based tool capable of providing real-time flood data to emergency managers and historic data for future emergency response planning.	2	2	All	Low	Cary Fire and Technology Services	Unknown	General Fund	Ongoing – Next 5 Years	In-Progress – Carry Forward	Efforts for developing a dedicated Public Safety IT division are ongoing.
ES-4	Partnership with FBI Terrorism Task Force	2	2	Terrorism	Moderate	Town of Cary, Town of Cary Police	$100,000	General Fund	Ongoing – Next 5 Years	In-Progress – Carry Forward	Since 2011 the Town of Cary Police have an officer assigned full time to the FBI Terrorism Task Force to maintain a relationship with the FBI. FBI Terrorism Task Force located in the FBI Raleigh Office located in the Town of Cary off Cary Parkway near US 1. Wake County Emergency Management has a plan for large scale events that impact Wake County. Those plans include guidance for law enforcement as part of a multi-agency response to all sorts of issues that could include the unlikely event of a terrorist attack.
ES-5	Inclement Weather Response Plan	2	1	Severe Winter Storm, Thunderstorm, Hurricane	Moderate	Town of Cary, Town of Cary Public Works	$100,000 - $1 Million (depending on number and type)	General Fund	Ongoing – Next 5 Years	In-Progress – Carry Forward	Cary commits significant Town-wide resource allocations and operational commitment to ensure all aspects of Adverse Weather events are planned, executed, and reviewed to maximize positive recovery outcomes for its citizens. The Town has similar structure and programs in place to address thunderstorm or wind events.
Public Education and Awareness											
PEA-1	Environmental Education "green infrastructure" signage on Dry Avenue Properties that were bought out due to flooding. Signs to be installed early 2019	1	1	Flood	Low	Cary Stormwater and Sustainability	$11,000	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Updated/expanded from 2019
PEA-2	Citizen volunteers make up the Community Emergency Response Team (CERT). CERT training is a Citizens Corps program designed to enable citizens to care for themselves and their neighbors during the first three days following a disaster event. Participants are educated about disaster preparedness, CERT organization, light search and rescue, medical care, fire extinguisher use and disaster psychology.	1	2	All	Moderate	Cary Police Department and Fire Department	$1,000/year	Donations	Ongoing - Next 5 Years	In-Progress – Carry Forward	Fire and Police have staff that perform education for citizens and businesses in Town.

Table 7.5 – Mitigation Action Plan, Town of Fuquay-Varina

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Require pre and post construction certification for residential lot development within 10 feet of Wake County Flood Hazard Soils.	4	1	Flood	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of permit review process
P-2	Annually calculate acreage of flood prone property preserved as open space.	2	2	Flood, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of an annual report
P-3	Map storm water drainage system as part of Phase II Stormwater Management Plan.	2	2	Flood	High	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of infrastructure acceptance / ongoing project to work on historical data inclusion. More staff time needed to complete.
P-4	Provide for public dissemination building inspections brochures regarding high winds, water damage prevention, and tie downs for accessory structures.	1	1	Flood, Tornado, Hurricane, Severe Weather	Moderate	Fuquay-Varina Inspections	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Brochures continuously made available to public at Town Hall
P-5	Review and update of drought policy for water conservation	2	2	Drought	High	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	3-5 years	In-Progress – Carry Forward	Plan is updated every five years, originally adopted Feb 2024
P-6	Neuse River Buffer Rules Implementation	3	1	Flooding	High	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
Property Protection											
PP-1	Continue to enforce the Flood Damage Prevention Ordinance for all new construction or substantial building rehabilitations.	4	1	Flood, Hurricane	High	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
PP-2	Require minimum finished floor elevation in known FEMA flood hazard zones be minimum 2' above base flood elevation.	4	1	Flood, Hurricane	High	Fuquay-Varina Planning and Inspections	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
PP-3	Identify and inventory buildings that are located in FEMA flood zones to determine which structures may be prone to flooding (possible relocation and/or elevation).	3	1	Flood, Hurricane	High	Fuquay-Varina Planning and Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	We reference the Dept of Public Safety's report. More staff time needed, change in FEMA mapping added more structures.
PP-4	Decommissioning Brighton Forest Wastewater Treatment Plant	3	2	Flood, Hurricane & Tropical Storm, Severe Weather	High	Municipal Administration	To be Determined	FEMA HHDPR, BRIC, Local Funding	5 Years	In-Progress - Carry Forward	To apply for FEMA BRIC implementation funding, the Town of Fuquay-Varina adopted this mitigation action as part of an amendment to the 2019 Wake County HMP. Applied for funding in 2023.

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Natural Resource Protection											
NRP-1	Work with the U.S. Army Corps of Engineers on wetland protection.	4	1	Flood, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
NRP-2	Use Open Space Ordinance to protect wildlife habitat.	4	1	All	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
NRP-3	Notify Wake County of any illegal stream dumping instances	3	1	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Planning and Public Utilities	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
NRP-4	Enforce standards for tree protection and control of clear cutting (Town has received legislative authority to enact tree protection and control of clearcutting standards.)	4	1	Flood, Wildfire, Landslide	High	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
NRP-5	Town Spill Response Plan			Hazardous Materials	High	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
NRP-6	Brighton Forest Wastewater Treatment Plant Decommissioning			Hazardous Materials	High	Fuquay-Varina Public Utilities	Budgeted Staff Time	BRIC	Ongoing - Next 5 Years	New	N/A
Structural Projects											
S-1	Geotechnical investigation to establish data for risk analysis and development of engineering designs/solutions	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-2	Implementing engineered design solutions to improve performance/safety of existing dam	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-3	Property Acquisition in inundation area(s) below dam	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-4	Raise crest of dam to increase storage capacity	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-5	Add additional spillways, widen or lower existing spillways to increase discharge capacity	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-6	Warning systems to alert downstream areas of potential dam failure	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-7	Improve flow path below dam to increase conveyance capacity	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-8	Encourage conservation or re-forestation of upstream land to reduce runoff	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-9	Development of community Stormwater Management Plans for upstream communities	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-10	Complete an Emergency Action Plan in conjunction with NCDEQ for all High Hazard Dams in the county	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-11	Permanently breach hazardous dams, or modify risers such that dam can no longer impound water, but may still provide attenuation of peak flooding by acting as a stormwater retention feature	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-12	New Fire Station cameras & generator	2	1	All	High	All Departments	To Be Determined	Annual Budget	1 year	New	N/A
S-13	New Waterline from Sanford	3	1	Flood, Wildfire, Terrorism, Drought	High	Fuquay-Varina Public Utilities	To Be Determined	Annual Budget	Ongoing - Next 5 Years	New	N/A
Emergency Services											
ES-1	Maintain current warning system with local sirens on elevated platforms and use of the Emergency Broadcast System.	1	2	All	High	Fuquay-Varina Planning, Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-2	Coordinate an incident command course for all Town employees, related to Emergency Operations Plan and Disaster Operations Plan for the Town.	2	1	All	Moderate	Fuquay-Varina Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Lack of staffing has prevented implementation
ES-3	Conduct a scenario-based training exercise, related to Emergency Operations Plan and Disaster Operations Plan for the Town.	2	1	All	Moderate	Fuquay-Varina Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Lack of staffing has prevented implementation
ES-4	Assist Wake County Emergency Management with updating list of local hazardous materials sites.	2	1	Hazardous Materials Incident, Radiological Emergency	Moderate	Fuquay-Varina Fire and Wake County Emergency Management	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-5	Continue Pre-Fire Incident Plan program for all commercial facilities within the Town limits.	3	2	All	High	Fuquay-Varina Fire	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-6	Address securing and cleaning up affected hazardous areas when revising Disaster Operations Plan.	4	2	All	High	Fuquay-Varina Planning, Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-7	Continue to evaluate and improve response and recovery methods following each hazard event.	2	2	All	High	Fuquay-Varina Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-9	Wake County Everbridge Text Alert Implementation	1	2	All	Moderate	Fuquay-Varina Fire	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
Public Education and Awareness											
PEA-1	Maintain floodplain maps for public use and produce other maps as needed.	1	1	Flood, Hurricane	Moderate	Fuquay-Varina Planning and Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-2	Develop and maintain a hazard mitigation section on the Town website that is updated every 5 years as the plan is updated.	1	1	All	High	Fuquay-Varina Public Information and Information Technology	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-3	Collect educational materials on disaster preparedness and display at public library and local government offices.	1	1	All	High	Fuquay-Varina Planning, Inspections, Police, and Fire	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Lack of staffing has prevented implementation
PEA-4	Educate public on importance of channel maintenance as part of Phase II Stormwater Management Plan.	1	1	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-5	Work with local real estate agents to ensure that potential buyers are aware of properties that are exposed to potential flood damage.	1	1	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PEA-6	Require delineation of Wake County Flood Hazard Soils, FEMA flood zones, and wetlands on final plats.	3	2	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
PEA-7	Annual participation in Severe Weather Preparedness Week (March 3-9) via Weather Channel (social media campaign, newsletter, published materials)	1	1	All	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-8	Annual participation in National Preparedness Month (September) Ready.gov (social media campaign, newsletter, published materials)	1	1	All	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-9	Annual participation in Hurricane Prep Week (May 13-19) ReadyNC.gov (social media campaign, newsletter, published materials)	1	1	Flood, Landslide, Hurricane	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-10	Annual participation in Earthquake Awareness Month and National Earthquake Drill (February & October) Ready.gov (social media campaign, newsletter, published materials)	1	1	Earthquake	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-11	Annual participation in National Dam Safety Awareness Day (May 31) Ready.gov (social media campaign, newsletter, published materials)	1	1	Dam Failure	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-12	Structured public education through social media, brochures, and flyers in critical facilities	1	1	All	High	Fuquay Varina Planning, Fire & Police, and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A

Table 7.6 – Mitigation Action Plan, Town of Garner

Town of Garner											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Evaluate the need for regulations to encourage use of low impact development site planning principles to help control stormwater volume impacts.	4	1	Flood, Dam Failure, Hurricane	Moderate	Garner Engineering and Planning	Staff time	Local	2-3 years (2026)	In-Progress – Carry Forward	The current UDO does not contain specific language to require or encourage low impact development; therefore, it is encouraged in practice rather than by regulation. With the expected addition of stormwater staff in the coming years, this will be incorporated into our overall stormwater program.
P-2	Provide adequate water supply through storage and interconnection with other public water systems.	3	2	Drought	Moderate	City of Raleigh and Garner Engineering	TBD	Local	2-3 years (2026)	In-Progress – Carry Forward	Ongoing collaboration with the City of Raleigh and support of efforts to better the water supply system and search for regional supply solutions. The Town also participates in the Wake County One Water effort to address regional water supply.
P-3	Garner Transportation Plan – Continue to address disaster preparedness (evacuation) through road interconnectivity, paved roads, and widening of roads.	4	2	Flood, Dam Failure, Earthquake, Hurricane, Severe Weather, Severe Winter Weather, Tornado, Hazardous Materials Incident, Radiological Emergency, Terrorism	Moderate	Garner Planning and Public Works	Improvement costs TBD on case-by-case basis	Local, State, Federal	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town's emergency preparedness plan follows the Wake County for routes. The Town's 2018 Transportation Plan does encourage and promote interconnectivity.
P-4	The Town will inventory all its structures located within or immediately adjacent to known flood hazard areas.	2	2	Flood	Moderate	Garner Planning and Engineering	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Town has inventory of all structures in regulatory floodplains per the newest flood maps. Will continue expand inventory to contain structures in non-regulatory flood prone areas.
Property Protection											
PP-1	The Town has a service to respond to requests and questions from citizens regarding actions they may take to improve drainage, halt erosion, and to relocate, renovate or retrofit structures being flooded.	1	1	Flood	Moderate	Garner Engineering	Staff time	Local, Private	Ongoing - Next 5 Years	In-Progress – Carry Forward	Staff time should continue to be allocated to maintain this activity as part of normal Town operations.

Town of Garner											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Structural Projects											
SP-1	Pursue stream restoration projects	3	2	Flood	High	Garner Engineering	TBD	Local, Regional, State, Federal	2-3 Years (2027)	Not Started – Carry Forward	The Town expects to seek new funding mechanisms for stormwater capital and an expanded stormwater program in the next 1-2 years. With this effort, stream restoration projects can become a capital project category under "stormwater" as problem areas are identified.
Emergency Services											
ES-1	Develop a Business Continuity Plan that is the primary document housing all disaster related plans and procedures including Hazard Mitigation Plan, Debris Management Plan, Multi-Hazard Plan as well as disaster response plans for all Town departments.	2	2	All Hazards	High	Garner Police, Public Works, and Administration	$25,000-$50,000	Local	2-3 Years	In-Progress – Carry Forward	Target 2028
Public Education and Awareness											
PEA-1	Town website will be updated with public access to information pertaining to evacuation routes, emergency contact numbers, and detailed weather reports in case of emergency.	1	2	Flood, Hurricane, Earthquake, Severe Weather, Tornado, Severe Winter Storm, Wildfire, Hazardous Materials Incident, Radiological Emergency	Moderate	Police & Fire Departments, Garner Communications	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Target 2028
PEA-2	Develop and maintain a hazard mitigation section on the Town website.	1	1	All Hazards	Moderate	Garner Communications, and Garner IT	Staff time	Local	2-3 Years	Not Started – Carry Forward	Target 2028

Table 7.7 – Mitigation Action Plan, Town of Holly Springs

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Vision Holly Springs Comprehensive Plan - The Town has an existing Comprehensive Plan which includes Land Use, Parks and Recreation, Public Safety, Economic Development, Transportation, Public Utilities and Environment. This plan includes past and current conditions and sets goals for future needs of the Town. The Hazard Mitigation Plan will be incorporated as an additional component of the CGP at plan update.	4	2	All	Moderate	Holly Springs Planning & Zoning	To be determined	Local	1 year	In-Progress – Carry Forward	Last update occurred in 2021. The Holly Springs Comprehensive Plan is a fluid plan that will be updated and changed continually.
P-2	Implement Floodplain Development Regulations related to participating in the National Flood Insurance Program	4	1	Flood	High	Holly Springs Engineering	Staff time	Local	2-3 years	Not Started – Carry Forward	On-going process that will need to be changed as circumstances and regulations change.
P-3	Water Emergency Response Plan - Develop Water Emergency Response Plan in accordance with EPA mandate with wastewater emergency plan developed voluntarily.	3	2	All	High	Holly Springs Public Utilities, Engineering	To be determined	Local	3-5 years	In-Progress – Carry Forward	With the development of the wastewater filtration facility expansion, current plans need reviews and revisions to include Sanford facility. Will be deleted on next update.
Property Protection											
PP-1	Building Acquisition and Clearance - The Town is willing to develop a plan designed to utilize Federal grant resources to assist private property owners in purchasing properties located in flood hazard zones.	3	2	Flood	Low	Holly Springs Code Enforcement	Staff time; acquisition costs TBD on case by case basis	Local, State, Federal	2-3 years	Not Started – Carry Forward	Target for development of plan to enable this activity is now 5-10 year implementation. Carry forward until funding needs are met.
PP-2	Building Relocation - The Town is willing to develop a plan designed to utilize Federal grant resources to assist private property owners in relocating existing structures out of flood hazard zones.	3	2	Flood	Low	Holly Springs Code Enforcement	Staff time; relocation costs TBD on case by case basis	Local, State, Federal	2-3 years	Not Started – Carry Forward	Target for development of plan to enable this activity is now 5-10 year implementation. Carry forward until funding needs are met.
PP-3	Building Retrofit - The Town is willing to develop a plan to utilize Federal grant resources to assist private property owners in renovating and retrofitting existing structures in flood hazard zones to reduce vulnerability to flooding damage.	3	2	Flood	Low	Holly Springs Code Enforcement	Staff time; retrofitting costs TBD on case by case basis	Local, State, Federal	2-3 years	Not Started – Carry Forward	Target for development of plan to enable this activity is now 5-10 year implementation. Carry forward until funding needs are met.

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PP-4	Purchase of Open Space, Parks and Greenways – As part of new residential development, the Town collects dedicated open space and parkland, or fees-in-lieu of dedication to then purchase land in accordance with Town of Ordinance requirements and Comprehensive Planning documents. The Town also works with Wake County and other agencies to find other funding for open space acquisition. Once funds are obtained the Town will acquire land consistent with Land Use and Master Open Space Plans.	4	2	Flood	Moderate	Holly Springs Parks and Recreation	Land Cost	County & State Agencies	More than 5 years	In-Progress – Carry Forward	This is an ongoing goal to create open space, parks, and greenways in pace with the growth of the community
PP-5	Backup Power to Fire and Police Stations – The Town provides backup power to all fire and police stations. Fire Station 1 – backup power provided by a grant; backup power to Fire Station 2 and Fire Station 3 and Police Station provided by local funds.	3	1	All	High	Holly Springs Public Safety	Requires new facility. Cost unknown at this time.	Local, Federal	3-5 Years	In-Progress – Carry Forward	The new station is under construction, and we are finalizing contract with generator specifications. Will be completed by next update.
PP-6	Emergency Generator for Public Works Building	3	1	All	Moderate	Holly Springs Public Works	To be determined	Local	3-5 Years	In-Progress – Carry Forward	The Town currently has an emergency generator to provide power to the Front Office of the Public Works Building during emergencies. The building personnel are getting relocated to a new facility. That facility is slated to be built in the next few years. Still in the planning phase and this new facility will include a generator.
PP-7	Install additional Generators	3	1	All	High	Holly Springs Public Utilities	To be determined	Local	1 year	In-Progress – Carry Forward	We have 3 new lift stations with 1 at a new fire station that are not built yet and do not have generators. Carry forward until stations are complete with generators. Will be deleted on next update.
PP-8	Build a Regional Pump Station to alleviate capacity concerns, reduce flood damages, and avoid infrastructure investments in older existing pump stations that are located in moderate and high flood risk areas.	3	2	All	High	Holly Springs Utilities and Infrastructure	$8 million	Local, Federal	5 years	New	One existing pump station located in the SFHA is incompatible with newer lines and repeatedly failing, causing the release of wastewater into the floodplain and requiring costly response and cleanup. Construction of this Regional Pump Station will reduce wastewater flowing to this station and two others that flow to it, alleviating capacity concerns, reducing future flood damages, and reducing infrastructure upgrades in flood prone areas.
Natural Resource Protection											
NRP-1	Restore bank stability and floodplain on Middle Creek.	3	2	Flood	High	Holly Springs Utilities and Infrastructure	$250,000	Grant, Local	2-3 years	New	The Town is pursuing a Water Resources Development (WRD) grant to implement this project.
Structural Projects											
S-1	The Town is in the process of pursuing options to improve the existing spillway or create a secondary spillway. Per an agreement with NC Dam Safety, this will be completed within the next 5 years.	3	2	Flood, Dam Failure	High	Holly Springs Engineering, Parks & Recreation	Over $100,000	Local	3-5 years	In-Progress – Carry Forward	This project is in design, it was delayed due to dispute between FEMA/Dam safety

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-2	Reservoirs/Retention/Detention Basins - The Town does not currently maintain any retention or detention basins. The Town does maintain Bass Lake Dam. The Town regularly provides maintenance of vegetation and minor erosion while providing visual inspections of the dam. If larger repairs are required, the Town will find appropriate means to resolve the problem. The Town also has a few small ponds located on existing parks. The Town maintains these ponds consistent with measures taken to maintain the Bass Lake Dam.	3	1	Flood	Moderate	Holly Springs Parks & Recreation	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Consistently and correctly maintains all ponds and dams. Ongoing project.
S-3	Geotechnical investigation to establish data for risk analysis and development of engineering designs/solutions	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-4	Build upstream dam to reduce load on existing dam	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-5	Property Acquisition in inundation area(s) below dam	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-6	Raise crest of dam to increase storage capacity	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-7	Add additional spillways, widen or lower existing spillways to increase discharge capacity	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-8	Warning systems to alert downstream areas of potential dam failure	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-9	Improve flow path below dam to increase conveyance capacity	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-10	Encourage conservation or re-forestation of upstream land to reduce runoff	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-11	Development of community Stormwater Management Plans for upstream communities	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-12	Complete an Emergency Action Plan in conjunction with NCDEQ for all High Hazard Dams in the county	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-13	Permanently breach hazardous dams, or modify risers such that dam can no longer impound water, but may still provide attenuation of peak flooding by acting as a stormwater retention feature	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-14	New water filtration facility expansion project to provide clean stable water supply for residents and neighboring jurisdictions. This will project encompasses multiple phases and components.	1	1	Drought	High	Holly Springs Utilities & Infrastructure	Over $65 Million	Local, Grants, Bonds	2-5 Years	New	To provide for current and future clean water capacity protection and delivery, Holly Springs has partnered with Pittsboro and Fuquay-Varina to expand the Sanford water treatment facility along a 14 mile conveyance line.
Emergency Services											
ES-1	Technical Rescue Capabilities - Provide and enhance technical rescue capabilities more equitably throughout the Town.	2	2	All	High	Holly Springs Public Safety	No cost	Local, Federal	3-5 Years	In-Progress – Carry Forward	We have done training for confined spaces but do not have any training capabilities for swift water rescue.
ES-2	Tabletop Exercise Program - Continue to conduct disaster tabletop exercise program with Wake County	2	2	All	High	Holly Springs Public Safety	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	As the county went through a reorganization and population growth, the needs for training/exercises have increased throughout all jurisdictions. Carry forward until staffing is adequate with county resources.

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-3	Counseling – Police psychologist and Critical Incident Stress Debriefing Team training to provide debriefing sessions for personnel.	2	1	All	High	Holly Springs Police Department	Staff time	Local	5 years	In-Progress – Carry Forward	Currently the Town police department has a contract for services. The need will be continuous as mental health services and peer support expand with various sensitive incidents. Will be deleted on next update.
ES-4	Development of Town Emergency Operations Plan and Continuity of Operations Plan	2	2	All	High	Holly Springs Public Safety	Staff Time	Local	1-2 Years	New	Currently under the Wake County EOP. Partially completed draft of the Town's own Emergency Operations Plan. Open for departments revisions. On-going process still awaiting implementation. COOP to follow.
Public Education and Awareness											
PEA-1	Environmental Education	1	1	Flood, Drought	High	Holly Springs Engineering	Staff time and O&M costs	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town currently has a program which includes environmental education for the public through Town festivals (Holly Fest), public meetings, brochures and preconstruction meetings. The Town operates the Bass Lake Retreat Center which will allow for space to hold additional environmental education activities. The Town will also expand its current education activities to meet NPDES Phase II requirements. The Town's Environmental Education focuses on flooding, drainage, the National Flood Insurance Program, NPDES Phase II, Erosion & Sedimentation Control, Habitat Preservation, etc.

Table 7.8 – Mitigation Action Plan, Town of Knightdale

Town of Knightdale											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Pursue Grants to Acquire, Elevate and or Relocate Flood Prone Structures and Property.	3	1	Flood, Dam Failure, Hurricane & Tropical Storm	High	Knightdale Planning	Over $1m	Local, State, Federal	Ongoing - Next 5 Years	Not Started – Carry Forward	This has not been necessary since there have been no affected structures and/or property. The Town will evaluate opportunities to purchase property for future events.
P-2	Establish post-disaster clean-up procedures.	2	1	All	High	Knightdale Public Works	$250,000	Internal	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town will continuously evaluate post-disaster clean-up procedures.
P-3	Prepare debris removal and disposal plan.	2	1	Dam Failure, Earthquake, Hurricane & Tropical Storm, Landslide, Severe Weather, Severe Winter Storm, Tornado	Moderate	Knightdale Public Works	Over $1m	Internal, FEMA, NCEM	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town will continuously evaluate debris removal and disposal plan
P-4	Protect and Obtain Land for the Little River Reservoir.	3	1	Drought	Moderate	City of Raleigh Public Utilities	Over $1m	Internal, City of Raleigh	Ongoing - Next 5 Years	In-Progress – Carry Forward	City of Raleigh is responsible for implementation
Structural Projects											
SP-1	Poplar Street Drainage & Stormwater Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$450,000	Local, federal	Ongoing - Next 5 Years	New	Construction of a dry detention basin to help alleviate drainage issues downstream; addition of a swale to aid in conveyance of runoff to the dry detention basin to maximize the capture of offsite drainage
SP-2	Park Avenue Stormwater & Drainage Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$650,000	Local, federal	Ongoing - Next 5 Years	New	Redirection of stormwater drainage to alleviate flooding within a section of downtown; installation of curb and gutter and new storm system
SP-3	Forest Dr Stormwater Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$225,000	Local, federal	Ongoing - Next 5 Years	New	Capture and mitigate flash flood rain events to alleviate flooding and erosion in down stream residential area.
SP-4	Maplewood/Pebblebrook Stormwater & Drainage Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$700,000	Local, federal	Ongoing - Next 5 Years	New	installation of stormwater infrastructure to alleviate flooding in residential neighborhood

Town of Knightdale											
Emergency Services											
ES-1	Construct Fire Station #1 - 7477 Forestville Rd	3	2	All Hazards	Moderate	Knightdale Fire	$6.8 million	Internal	2-3 Years	New	Anticipated completion August 2024
ES-2	Construct Fire Station #4 - 1325 Hodge Road	3	2	All Hazards	Moderate	Knightdale Fire	$5.4 million	Internal	2-3 Years	New	Operational as of March 2024
ES-3	Construct new Law Enforcement Center - 967 Steeple Square Ct.	3	2	All Hazards	Moderate	Knightdale Administration	$13.5 million	Internal	2-3 Years	New	Anticipated completion December 2025
ES-4	Renovation of Fire Station #3 - 4828 Clifton Rd	3	2	All Hazards	Moderate	Knightdale Fire	$2.1 million	Internal	2-3 Years	New	Completed February 2024
ES-5	Purchase new fire apparatus	3	2	All Hazards	Moderate	Knightdale Fire	$2.5 million	Internal	2-3 Years	New	Two new fire pumpers have arrived and are in service. Two more are apparatus (ladder truck and pumper) are expected in late 2026.
Public Education and Awareness											
PEA-1	Develop a policy for the installation of warning signs concerning lightning, hail and thunderstorms at outdoor public facilities and begin retro-fitting existing spaces.	1	2	Severe Weather, Tornado	Moderate	Knightdale Parks & Recreation	Over $1m	Internal	2-3 years	Not Started – Carry Forward	Due to staff turnover and lack of funding this project has not been completed. This project is still a valuable tool that will be studied for future implementation
PEA-2	Expand the Town's existing fire/smoke alarm program for retro-fitting older structures to include CO alarms.	1	2	Earthquake, Severe Weather, Tornado, Hazardous Materials Incident	Low	Knightdale Fire	about $200,000	Internal, Grants	2-3 years	In-Progress – Carry Forward	The Knightdale Fire Department routinely visits residences to ensure smoke detectors are working properly and participates in the annual fire alarm canvas program.
PEA-3	Have a Town staff member that is a Certified Floodplain Manager.	2	1	Flood, Dam Failure, Hurricane & Tropical Storm	Moderate	Knightdale Engineering/Public Works	$40,000	Internal	2-3 years	In-Progress – Carry Forward	Town staff is working toward Floodplain Manager certification.
PEA-4	Issue an annual local proclamation for Severe Weather Awareness Week and conduct associated promotional activities.	1	1	All	Moderate	Knightdale Fire, Knightdale Community Relations	Staff time	Internal	Ongoing - Next 5 years	Not Started – Carry Forward	Due to staff turnover this item has not been started.
PEA-5	Incentivize the use of cool roofing products through the Town's Water Allocation Policy point system.	4	1	Extreme Heat	Low	Knightdale Planning	Staff time	Internal	3-5 years	Not Started – Carry Forward	During the update to the Town's Water Allocation Policy, this will be evaluated for inclusion.
PEA-6	Implement GovDelivery - email and SMS notification system for real time alerts on traffic advisories and closures, emergencies, etc.	1	2	All	Moderate	Knightdale Community Relations	Staff time, under $10,000	Internal	1 year	New	Launched January 2024

Table 7.9 – Mitigation Action Plan, Town of Morrisville

Town of Morrisville											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Reduce vulnerability of cyber-attack by transitioning Town staff to encrypted laptops.	3	1	Terrorism	Moderate	Town of Morrisville	$9,000 annually	Town of Morrisville	Ongoing - Next 5 years	In-Progress – Carry Forward	Still working on finalizing all computers. Still a priority for the Town.
P-2	Garden Square Lane Culvert and Greenway is Located approximately 150 feet west of the intersection of Garden Square Lane and Councilman Court and includes stormwater infrastructure within the town-maintained ROW and Garden Square Lane and the town-maintained easement along Indian Creek Greenway. Replacing and upgrading existing pipe and culvert infrastructure will mitigate road overtopping and flooding to adjacent residential structures.	3	2	Flood, Hurricane, Dam Failure	Moderate	Town of Morrisville	$1 Million	Town of Morrisville	5 years	New	N/A
P-3	Savannah Subdivision and Morrisville Carpenter Road Culvert Upsizing and replacement of existing pipe infrastructure to mitigate road overtopping and flooding to adjust residential structures. The project is located within the NCDOT-maintained right-of-way of Morrisville Carpenter Rd and with the town-maintained right-of-way of Star Magnolia Drive and Lowside of Morrisville Carpenter.	3	2	Flood, Hurricane, Dam Failure	Moderate	Town of Morrisville	$1.7 Million	NCDOT/Town of Morrisville	5 years	New	N/A
Property Protection											
PP-1	Reduce vulnerability of important data by transitioning IT Department's routine data backup to cloud storage.	3	1	Tornado, Earthquake, Severe Winter Storm, Severe Weather, Hurricane, Terrorism	High	Town of Morrisville	$42,000 annually	Town of Morrisville	Ongoing - Next 5 years	In-Progress – Carry Forward	N/A
Structural Projects											
SP-1	Construct new public works facility, which will increase Town's capacity to respond to hazards and other safety concerns.	2	1	All	Moderate	Town of Morrisville	$8,500,000	Town of Morrisville	3-5 years	In-Progress – Carry Forward	Project still required due to Aviation Pkwy widening. Design is in progress in conjunction with Wake County Solid Waste Convenience Center, Construction anticipated to begin 2026
Public Education and Awareness											

Town of Morrisville											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PEA-1	Purchase and implement new online civic engagement platform to be used in part to inform citizens on disaster preparation, emergency response training opportunities, and evacuation information.	1	1	All	Moderate	Town of Morrisville	$10,000	Town of Morrisville	1 year	In-Progress – Carry Forward	Capacity issue with staff. Still needs to be completed.

Table 7.10 – Mitigation Action Plan, Town of Rolesville

Town of Rolesville											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Provide backup power for all critical public facilities (wastewater treatment plant, sewer pump stations, Public Works and Utilities building, etc.) to ensure continued utility service during power loss.	3	1	All	Moderate	City of Raleigh	Cost varies by facility	Local	2 years	In-Progress – Carry Forward	City of Raleigh has updated sewer pump stations with backup power. The Town's new Public Works facility is equipped with a backup generator. Upgrade of other Town buildings is intended for future budgets.
P-2	Transportation Plan – Continue to address disaster preparedness (evacuation) through road interconnectivity, paved roads, and widening of roads.	3	2	All	Moderate	Rolesville Planning	Staff Time	Local	1 year	In-Progress – Carry Forward	Community Transportation Plan updated in 2021. Land Development Ordinance (LDO) updated in 2022 to require street connectivity to existing stub streets and connection recommendations from Traffic Impact Analysis (TIA) reports.
P-3	Update Rolesville Stormwater Management Plan for operation/implementation and program effectiveness and study the possible changes	4	1	Flood	Moderate	Rolesville Administration	Staff Time	Local	2-3 years	In-Progress – Carry Forward	Stormwater Mapping Project complete. Neuse River Local Program will be implemented in early 2025, and a Stormwater Master Plan will kick off later in 2025.
Property Protection											
PP-1	Install emergency power backup generator for Town Hall and Police Station to ensure continued operation of government during power loss.	3	2	All	High	Rolesville Administration	Over $100,000	Local	3 years	In-Progress – Carry Forward	The Rolesville Fire Department is designated as our EOC in the event of power loss. There are plans to build a new PD and it is projected to be completed Fall of 2027.
Emergency Services											
ES-1	Implement Wake County Everbridge text alert system to notify citizens in real time of an event of local interest with instructions.	1	2	All	High	Rolesville Administration	Staff Time	Local	1 year	In-Progress – Carry Forward	Implementation is ongoing as the town continues to explore a platform that will best serve our citizens for a text alert system.
Public Education and Awareness											
PEA-1	Town website – develop hazard mitigation section covering such items as public access, evacuation routes, emergency contact numbers, and detailed weather reports in case of emergency,	1	1	All	Moderate	Rolesville Administration	Staff Time	Local	1 year	In-Progress – Carry Forward	Town is in the process of website updates and development of a hazard mitigation section will be included.

Table 7.11 – Mitigation Action Plan, Town of Wake Forest

Town of Wake Forest											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Prepare a Storm Drainage Master Plan to include all storm drainage, infrastructure, and capacity analysis.	2	2	Flood	High	Wake Forest Engineering	$400,000	General Fund	2024	In-Progress – Carry Forward	90% complete, completion scheduled before EOY 2024.
P-2	Put electric distribution lines underground.	3	1	Hurricane, Severe Weather, Severe Winter Storm, Tornado, Wildfire	Low	Wake Forest Power	$10,000,000	Electric Fund, General Fund, and Bonds	2029	In-Progress – Carry Forward	Where feasible, electric lines have been put underground. However, there are still some lines that could be buried, and the town will look into carrying that out going forward. This is a multi-year project.
P-3	Become a CRS community	2	2	Flood	Low	Wake Forest Public Works	$100,000	General Fund	2026	In-Progress – Carry Forward	Work towards becoming a CRS community
P-4	Maintain a GIS database of building footprints and use it to regularly update a map of critical facilities and vulnerable buildings.	2	2	All	Moderate	Wake Forest GIS	Staff time	General Fund	Ongoing Annually	In-Progress – Carry Forward	Updated data will be used to identify properties that should be prioritized for mitigation. This action item is ongoing and requires regular updates as the Town of Wake Forest footprint expands.
Property Protection											
PP-1	Provide for primary or mobile generators to shelter sites.	2	1	All	Moderate	Wake County Emergency Management	$500,000	General Fund	2029	In-Progress – Carry Forward	Heritage High School is equipped with generators. The construction of Joyner Park is complete, and the site is intended to be used as a shelter. A generator is included with the building.
PP-2	Assess facilities for the need for emergency power generation, giving consideration to alternate facility sites.	2	1	All	High	Wake Forest Power	$250,000	General Fund	2028	In-Progress – Carry Forward	The town has assessed facilities for the need for emergency power generation and many facilities have been fitted with generators. However, additional facilities with emergency power generation would be useful. The Town of Wake Forest will purchase generators in FY25.
Natural Resource Protection											
NRP-1	Expansion of our greenway trail network	3	2	Flood, Hurricane, Extreme Heat	Moderate	Wake Forest Planning	$14,350,000	General Fund and Bonds	2029	In-Progress – Carry Forward	The Town has multiple greenway extensions and new routes planned. By installing greenways along our waterways, it gives the Town a better opportunity to remove fallen debris and trash that helps alleviate possible flooding. Greenway projects are currently ongoing and pending bond funding.

Town of Wake Forest											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Structural Projects											
SP-1	Conduct stream mitigation projects on Old Mill Stream, Richland Creek, and others subject to flooding or erosion.	3	2	Flood	Moderate	Wake Forest Engineering	$2,350,000	General Fund, Clean Water Management Trust Fund, Ecosystem Enhancement Program	2028	In-Progress – Carry Forward	Some mitigation projects have been conducted on these water bodies, but there is significant effort that is still needed to reduce potential erosion. Current projects include: Old Mill Stream and Richland Creek - construction plans @ 90%. Ailey Young Dam - completed June 2019; Smith Creek - quote has been requested for work to be done. Stream erosion throughout town continues to be an ongoing process as needed. Stormwater utility funding has been approved which will help assist funding projects moving forward.
Emergency Services											
ES-1	See that all nursing homes and assisted living facilities have backup generators.	1	1	All	High	Property owners	$150,000	Property owners	2028	In-Progress – Carry Forward	New facilities are being encouraged to include generators. Existing facilities without generators are financially constrained and have little ability to add generators. The town will continue to promote the installation of generators in new facilities as development progresses.
Public Education and Awareness											
PEA-1	Develop a policy and advise the public that all outside above ground LP or propane gas tanks be cut off during a major event.	1	1	All	Moderate	Wake Forest Communications	$10,000	General Fund	2025	In-Progress – Carry Forward	Past communications have included information advising the public of turning off propane tanks during a storm, but better outreach is needed to ensure this occurs. A policy should be put in place to ensure it is regularly communicated.

Table 7.12 – Mitigation Action Plan, Town of Wendell

Town of Wendell											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Amend the Town's Water Allocation Policy to add a new point category for voluntarily increasing undisturbed riparian buffer protections from 50 to 100 feet around Neuse perennial streams	4	1	Flood, Dam Failure, Hurricane	High	Wendell Planning	$10,000	N/A	1 year	In Progress – Carry Forward	Policy is being looked at wholistically and a policy update is planned.
P-2	Consider amendments to the UDO to establish minimum ingress/egress standards for new residential development based on density/# of lots	4	1	Earthquake, Flood, Dam Failure, Hurricane, Wildfire, Tornado, Severe Winter Storm, Hazardous Materials Incident, Radiological Incident, Terrorism	High	Wendell Planning	$150,000	N/A	1 year	In Progress – Carry Forward	Money has not previously been budgeted for this update. UDO update is planned in 2025 and budgeted for.
P-3	Encourage the use of low-impact development techniques through amendments to the Town's Water Allocation Policy	4	1	Flood, Dam Failure, Hurricane	High	Wendell Planning	$0	N/A	1 year	In Progress – Carry Forward	Policy is being looked at wholistically and a policy update is planned.
P-4	Evaluate potential changes to the Town's Arterial and Collector Street Plan to minimize adverse impacts to environmentally sensitive areas due to new roadway construction or widening	4	2	Flood	Moderate	Wendell Planning	$5,000	Town of Wendell	2-3 years	In Progress – Carry Forward	Two changes have already been made but more are anticipated during UDO rewrite.
P-5	Complete a tree health study to encourage a healthy tree canopy and improved public safety in conjunction with continuation of being a Tree City USA.	2	2	All	Moderate	Wendell Public Works/Parks & Rec	$40,000	Town of Wendell	3-4 years	New	N/A
P-6	Stormwater Management Plan accepted by NC to be implemented within the next permit term to include adoption of Stormwater Best Management Practices	4	2	Flood, Dam Failure, Hurricane, Severe Winter Storm	High	Wendell Public Works	$400,000	Town of Wendell	3-4 years	New	N/A
P-7	Discourage development in flood-prone areas by including density allowances through clustering of buildings and complementary mixed-use developments.	4	2	Flood, Hurricane	High	Wendell Planning	$0	Town of Wendell	2-4 years	New	N/A
Natural Resource Protection											
NRP-1	Perform environmental asset mapping in order to identify areas most key for preservation and potential acquisition due to an array of environmental factors	2	2	Flood, Drought	Moderate	Wendell Planning	$10,000	Town of Wendell	2-3 years	In Progress – Carry Forward	Ongoing project due to lack of staff and GIS capabilities. Planner III will be added FY24/25 to do this type of work.
NRP-2	Evaluate policy regarding greenway dedication requirements in order to expand greenway network and further protect riparian corridors	4	2	Flood	High	Wendell Planning	$0	Town of Wendell	2-3 years	In Progress – Carry Forward	Working on greenway map and policies as part of UDO update.

Town of Wendell											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
NRP-3	Conserve natural resources and open space especially in the key areas of Buffalo Creek and Little River.	3	2	Flood	Moderate	Wendell Planning	$400,000	Town of Wendell	3-5 years	New	N/A
Structural Projects											
SP-1	Perform improvements to existing open drainage device near intersection of 1st St & Pine St. to increase total water volume & flow	3	1	Flood	Moderate	Wendell Public Works	$5,000	Town of Wendell	3-5 years	Complete	New pipe and culvert improvements and installation.
Emergency Services											
ES-1	Develop Adverse Weather Plan Map for Public Works crew	2	1	Severe Weather, Severe Winter Storm, Hurricane	High	Wendell Planning	$5,000	N/A	1 year	In Progress – Carry Forward	Was action item in 2019 under Planning but need to move to Public Works.
ES-2	Provide written after-action report of response to severe weather and hazard events to include recommendations for process improvements and improve planning for future disasters	2	2	All	Moderate	Wendell Police Dept.	$0	Town of Wendell	2-3 years	In Progress – Carry Forward	No opportunity to complete at this time. See if opportunity occurs so that we can conduct an after-action report.
ES-3	Secure and utilize visual warning barricades for vehicular and pedestrian traffic to block properties, roadways, etc. for public safety during or following hazard events	2	1	All	Moderate	Wendell Public Works	$2,000	Town of Wendell	3-5 years	In Progress – Carry Forward	Ongoing as town grows. At this time more than $100,000 spent on class 3 barricades, message boards, light towers, etc.
ES-4	Conduct periodic training exercises, related to higher-risk hazard threats identified by the Hazard Mitigation Plan	2	2	All	Moderate	Wendell Police Dept.	$500	Town of Wendell	2-3 years	In Progress – Carry Forward	Ongoing and required for police accreditation and also best practices.
ES-5	Work with Wake County and the City of Raleigh to operate and update the County's Master Address Repository program, which will support emergency response following hazards.	2	2	All	High	Wendell Planning	$0	Town of Wendell	2-3 years	In Progress – Carry Forward	Ongoing with new developments
Public Education and Awareness											
PEA-1	Implement a new electronic app/website for citizens to report flood or other hazards to the town	1	2	Flood	Moderate	Wendell IT	To Be Determined	Town of Wendell	2-3 years	In Progress – Carry Forward	Previous app "Tell Wendell" did not contain functionality needed so a new mechanism for public reporting is needed and will be replaced within this goal.

Table 7.13 – Mitigation Action Plan, Town of Zebulon

Town of Zebulon											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Prepare Plan maintenance report.	2	2	All	High	Zebulon Planning Department	Staff time	Town of Zebulon	Annually	In Progress – Carry Forward	Plan maintenance meetings have been held annually and will continue to be held going forward.
P-2	Hiring Storm Water Manager	2	2	Flood, Hurricane, Dam Failure	High	Zebulon Planning	Staff time	Town of Zebulon	2025	New	Plan to hire a Storm Water Manager by the first quarter of FY 2025
Natural Resource Protection											
NRP-1	Working with Wake County Parks and Recreation for revitalization of Little River Park which will include enhanced storm water management to minimize potential damage from higher water levels on little river following heavy rainfall.	3	2	Flood	Moderate	Zebulon Planning	TBD	Federal, Local	Next 5 Years	New	Design award to be issued 1st quarter FY 2026
Structural Projects											
SP-1	Updating and reconfiguring storm water system in downtown to relocate old storm mains into public right of way, easements, or other accessible areas.	3	1	Flood, Hurricane	Moderate	Zebulon Planning	TBD	Town of Zebulon	2026	New	N/A
Emergency Services											
ES-1	Develop an Emergency Operations Plan	2	2	All	Moderate	Zebulon Fire Department	TBD	Town of Zebulon	2-3 Years	In-Progress – Carry Forward	The Town has been in the process of developing an Emergency Operations Plan.
Public Education and Awareness											
PEA-1	Require disclosure of flood hazard in real estate transactions.	1	1	Flood	Moderate	Zebulon Planning Department	Little to no cost	Town of Zebulon	2024	Not Started – Carry Forward	No progress to report
PEA-2	Promotion of Ready-Wake system to alert citizens of hazards.	1	2	All	Moderate	Zebulon Planning Department	Staff time	Town of Zebulon	Next 5 Years	New	This will be an on-going project.
PEA-3	Acquire additional technology to allow system-wide communication across various radio systems	1	1	All	Moderate	Zebulon Planning Department	Staff time	Town of Zebulon	Next 5 Years	New	Initial steps have been completed and will continue to monitor.

8 PLAN MAINTENANCE

Requirement §201.6(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This section discusses how the Mitigation Action Plans will be implemented by participating jurisdictions and outlines the method and schedule for monitoring, updating, and evaluating the plan. This section also discusses incorporating the plan into existing planning mechanisms and how the public will continue to be involved in the planning process. It consists of the following three subsections:

8.1 Implementation
8.2 Monitoring, Evaluation, and Enhancement
8.3 Continued Public Involvement

8.1 IMPLEMENTATION

Each jurisdiction participating in this plan update is responsible for implementing specific mitigation actions as prescribed in their Mitigation Action Plan (found in Section 7). In each Mitigation Action Plan, every proposed action is assigned to a specific local department or agency to ensure responsibility and accountability and increase the likelihood of subsequent implementation. This approach enables individual jurisdictions to update their own unique mitigation action list as needed without altering the broader focus of the regional plan.

In addition to the assignment of a local lead department or agency, an implementation timeline or a specific implementation date or window has been assigned to each mitigation action to help assess whether reasonable progress is being made toward implementation. The participating jurisdictions will seek outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for proposed actions listed in the Mitigation Action Plan.

An important implementation mechanism that is highly effective and low-cost is incorporation of the Hazard Mitigation Plan recommendations and their underlying principles into other plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement the Mitigation Action Plan. It will be the responsibility of the HMPC representatives from each participating jurisdiction to determine and pursue opportunities for integrating the requirements of this plan with other local planning documents and ensure that the goals and strategies of new and updated local planning documents for their jurisdictions or agencies are consistent with the goals and actions of the Hazard Mitigation Plan and will not contribute to increased hazard vulnerability in the planning area. Methods for integration may include:

- Monitoring other planning/program agendas;
- Attending other planning/program meetings;
- Participating in other planning processes; and
- Monitoring community budget meetings for other community program opportunities.

Table 8.1 details each jurisdiction's integration of the 2019 Wake County Multi-Jurisdictional Hazard Mitigation Plan into other local planning efforts as well as locally identified opportunities for integration of this plan update.

Table 8.1 – Integration Efforts

Jurisdiction	Integration of 2019 plan	Intended integration of this plan update
Wake County	The plan was integrated with the County's Capital Improvements Program.	Integration will be pursued as opportunities arise. There is potential for integration with the Wake County One Water Plan.
City of Raleigh	Integration occurred with the city's Resiliency Plan, Water Shortage Response Plan, and with policy and floodplain management updates. Raleigh also uses the plan to identify frequent flood prone areas during disasters. The plan aids as a notification strategy for vulnerable populations living in these locations.	Plan update will be integrated with ongoing resilience planning efforts and will continue to be used prominently during disasters.
Town of Apex	Plan integration occurred with updates to the Town's UDO and Design & Development Manual and with the Town's Transportation Plan and Bike & Pedestrian Plan updates.	Integration will be pursued as opportunities arise.
Town of Cary	Plan was integrated with the Comprehensive Plan.	Integration with the Comprehensive Plan will continue as new master plans and specialized plans are completed. The plan will also be integrated with the Neuse Basin Flood Resiliency Blueprint through Cary's participation in that effort.
Town of Fuquay-Varina	Plan integration with the Parks, Recreation & Cultural Resources Master Plan occurred.	Integration will be pursued with the Town's Stormwater Management Plan and drought policy update.
Town of Garner	Plan was integrated with the Unified Development Ordinance.	Garner will pursue implementation with stormwater policies and the Garner Transportation Plan.
Town of Holly Springs	The Emergency Water Shortage Plan was updated in 2024 to integrate hazard mitigation. Floodplain Damage Prevention Ordinance was updated in 2022 to adopt the new FIRM and FIS and include substantial damage and substantial improvement language.	Integration will continue to be pursued with updates to the town's Comprehensive Plan, floodplain development regulations, and Emergency Water Shortage Plan.
Town of Knightdale	No integration occurred.	Integration will be pursued as opportunities arise.
Town of Morrisville	Integration with the town's Land Use Plan and Emergency Operations Plan occurred.	Morrisville will continue to pursue ongoing integration with the EOP, land use plan, and the Triangle Water Supply Plan.
Town of Rolesville	No integration occurred	Integration will be pursued as opportunities arise.
Town of Wake Forest	Wake Forest integrated the plan with the updated EOP.	Integration will be pursued with a Storm Drainage Master Plan and with floodplain management activities considered as part of CRS Program participation.

Jurisdiction	Integration of 2019 plan	Intended integration of this plan update
Town of Wendell	Plan was integrated with emergency response training to improve preparedness for high risk hazards.	Wendell will seek to integrate this plan update with updates to the UDO.
Town of Zebulon	Plan was integrated with the updated Unified Development Ordinance.	Integration will be pursued as opportunities arise.

Opportunities to integrate the requirements of this plan into other local planning mechanisms shall continue to be identified through future meetings of the HMPC and through the five-year review process described herein. Although it is recognized that there are many possible benefits to integrating components of this plan into other local planning mechanisms, the development and maintenance of this stand-alone Hazard Mitigation Plan is deemed by the HMPC to be the most effective and appropriate method to implement local hazard mitigation actions at this time.

8.2 MONITORING, EVALUATION, AND ENHANCEMENT

8.2.1 ROLE OF HMPC IN IMPLEMENTATION, MONITORING AND MAINTENANCE

With adoption of this plan, each jurisdiction will be responsible for the implementation and maintenance of their mitigation actions. Wake County will take the lead in all plan monitoring and update procedures. As such, the County, led by the Director of Emergency Management, agrees to continue its relationship with the HMPC and:

- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Ensure hazard mitigation remains a consideration for community decision makers;
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Report on plan progress and recommended revisions to the County Board of Commissioners; and
- Inform and solicit input from the public.

The HMPC's primary duty moving forward is to see the plan successfully carried out and report to the County Board of Commissioners, Town and City Councils, NCEM, FEMA, and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about flood mitigation, passing concerns on to appropriate entities, and provide relevant information for posting on the County and local community websites (and others as appropriate).

Simultaneous to these efforts, it will be important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the costlier recommended actions. This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding does become available, the County and participating jurisdictions will be positioned to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and federal earmarked funds, benefit assessments, and other grant programs, including those that can serve or support multi-objective applications.

8.2.2 MAINTENANCE SCHEDULE

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized. The Wake County Emergency Manager will be responsible for convening the HMPC and initiating regular reviews. Regular maintenance will take place through quarterly meetings of the HMPC.

The HMPC will also convene to review the plan after significant hazard events. If determined appropriate or as requested, an annual report on the plan will be developed and presented to local governing bodies of participating jurisdictions to report on implementation progress and recommended changes.

The five-year written update to this plan will be submitted to the NCEM and FEMA Region 4, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. With this plan update anticipated to be adopted and fully approved by 2024, the next plan update for Wake County will be completed by 2029.

8.2.3 MAINTENANCE EVALUATION PROCESS

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or
- Increased vulnerability as a result of new development (and/or annexation).

Updates to this plan will:

- Consider changes in vulnerability due to project implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to county inventories; and
- Incorporate new project recommendations or changes in project prioritization.

In order to best evaluate any changes in vulnerability as a result of plan implementation, the HMPC will follow the following process:

The HMPC representatives from each jurisdiction will be responsible for tracking and reporting on their mitigation actions. Jurisdictional representatives should provide input on whether the action as implemented met the defined objectives and/or is likely to be successful in reducing vulnerabilities.

- If the action does not meet identified objectives, the jurisdictional representatives will determine what additional measures may be implemented and will make any required modifications to the plan.
- All monitoring and implementation information will be reported to the full HMPC, led by the Wake County Emergency Manager, during quarterly meetings. An annual plan maintenance report may be drafted as deemed necessary.

Changes will be made to the plan as needed to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential

mitigation activities will be reviewed during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the mitigation action plans will be by written changes and submissions, as is appropriate and necessary, and as approved by the appropriate jurisdiction's local governing body.

Following a disaster declaration, the plan will be revised as necessary to reflect lessons learned, or to address specific issues and circumstances arising from the event. It will be the responsibility of Wake County Emergency Management to reconvene the HMPC and ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

CRITERIA FOR QUARTERLY REVIEWS IN PREPARATION FOR 5-YEAR UPDATE

The criteria recommended in 44 CFR 201 and 206 will be utilized in reviewing and updating the plan. More specifically, quarterly reviews will monitor changes to the following information:

- Community growth or change in the past quarter.
- The number of substantially damaged or substantially improved structures by flood zone.
- The renovations to public infrastructure including water, sewer, drainage, roads, bridges, gas lines, and buildings.
- Natural hazard occurrences that required activation of the Emergency Operations Center (EOC) and whether the event resulted in a presidential disaster declaration.
- Natural hazard occurrences that were not of a magnitude to warrant activation of the EOC or a federal disaster declaration but were severe enough to cause damage in the community or closure of businesses, schools, or public services.
- For any new hazard events, the HMPC will monitor and review:
  - Dates and descriptions of hazard events.
  - Documented damages due to hazard events.
  - Closures of places of employment or schools and the number of days closed.
  - Road or bridge closures due to the hazard and the length of time closed.
  - An assessment of the number of private and public buildings damaged and whether the damage was minor, substantial, major, or if buildings were destroyed. The assessment will include residences, mobile homes, commercial structures, industrial structures, and public buildings, such as schools and public safety buildings.
- Changes in federal, state, and local policies to determine the impact of these policies on the community and if and how the policy changes can or should be incorporated into the Hazard Mitigation Plan.
- The implementation status of projects (mitigation strategies) including projects that are completed. Projects behind schedule will include a reason for delay of implementation.

8.3 CONTINUED PUBLIC INVOLVEMENT

Continued public involvement is imperative to the overall success of the plan's implementation. The quarterly review process will provide an opportunity to solicit participation from new and existing stakeholders and to publicize success stories from the plan implementation and seek additional public comment. Efforts to involve the public in the maintenance, evaluation and revision process may include:

- Advertising HMPC meetings in the local newspaper, public bulletin boards and/or City and County office buildings;
- Designating willing citizens and private sector representatives as official members of the HMPC;

- Utilizing local media to update the public of any maintenance and/or review activities;
- Utilizing City and County websites to advertise any maintenance and/or review activities;
- Maintaining copies of the plan in public libraries or other appropriate venues;
- Posting annual progress reports on the Plan to City, County and Town websites;
- Heavy publicity of the plan and potential ways for the public to be involved after significant hazard events, tailored to the event that has just happened;
- Keeping websites, social media outlets, etc. updated;
- Drafting articles for the local community newspapers/newsletters;
- Utilizing social media accounts (e.g. Twitter, Facebook)

PUBLIC INVOLVEMENT FOR FIVE-YEAR UPDATE

When the HMPC reconvenes for the five-year update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the plan. In reconvening, the HMPC will be responsible for coordinating the activities necessary to involve the greater public, including disseminating information through a variety of media channels detailing the plan update process. As part of this effort, public meetings will be held and public comments will be solicited on the plan update draft.

9 PLAN ADOPTION

Requirement §201.6(c)(5): [The plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).

The purpose of formally adopting this plan is to secure buy-in, raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 (Adopt the Plan) of the 10-step planning process, in accordance with the requirements of DMA 2000. FEMA Approval Letters and community adoption resolutions are provided below.

U.S. Department of Homeland Security
Region 4
3005 Chamblee Tucker Road
Atlanta, GA 30341

FEMA

November 20, 2024

Mr. Steve McGugan
State Hazard Mitigation Officer
Assistant Director / Mitigation Section Chief
Division of Emergency Management, NC Department of Public Safety
200 Park Offices Drive
Durham, NC 27713

Reference: Wake County Hazard Mitigation Plan

Dear Mr. McGugan:

We are pleased to inform you the Wake County Hazard Mitigation Plan update complies with the Federal hazard mitigation planning requirements resulting from the Disaster Mitigation Act of 2000, as contained in 44 CFR §201.6. Effective November 20, 2024, the plan is approved for a period of five (5) years to November 19, 2029.

Enclosed is the status of all participating jurisdictions. Approved jurisdictions are eligible applicants through the State for the following mitigation grant programs administered by the Federal Emergency Management Agency (FEMA):

- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance (FMA)
- Building Resilient Infrastructure and Communities (BRIC)

Please note that all funding requests will be evaluated individually according to the program's specific eligibility requirements.

The State and all plan participants should be commended for their close coordination and communications with our office in the review and subsequent approval of the plan. If you or any plan participant need assistance, please do not hesitate to contact Kymberly Kudla, of my staff, at (202) 655-6712.

Sincerely,

Kristen M. Martinenza, P.E., CFM
Branch Chief, Risk Analysis Branch

Enclosure

Enclosure: Plan Participant Status List

Attached is the list of participating jurisdictions in the referenced hazard mitigation plan.

Community Name	Jurisdiction Status	Date Approved by FEMA
1) Apex town	Approved	11/20/24
2) Cary town	APA	
3) Fuquay-Varina town	APA	
4) Garner town	APA	
5) Holly Springs town	APA	
6) Knightdale town	Approved	11/20/24
7) Morrisville town	APA	
8) Raleigh city	APA	
9) Rolesville town	APA	
10) Wake County	Approved	11/20/24
11) Wake Forest town	APA	
12) Wendell town	APA	
13) Zebulon town	APA	

U.S. Department of Homeland Security
Region 4
3005 Chamblee Tucker Road
Atlanta, GA 30341

FEMA

May 29, 2025

Mr. Steve McGugan
State Hazard Mitigation Officer
Assistant Director / Mitigation Section Chief
Division of Emergency Management, NC Department of Public Safety
200 Park Offices Drive
Durham, NC 27713

Reference: Wake County Hazard Mitigation Plan

Dear Mr. McGugan:

This is a follow-up to our previous correspondence of November 20, 2024, in which we approved the Wake County Hazard Mitigation Plan and all participating jurisdictions that originally submitted adoption resolutions. We have recently received and approved additional resolution(s) for inclusion. FEMA approval does not include the review or approval of content that exceeds the applicable FEMA mitigation planning requirements.

Enclosed is the status of all participating jurisdictions. Approved jurisdictions are eligible applicants through the State for the following mitigation grant programs administered by the Federal Emergency Management Agency (FEMA):

- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance (FMA)

Please note that all funding requests will be evaluated individually according to the program's specific eligibility requirements.

If you or any plan participant need assistance, please do not hesitate to contact Kymberly Kudla, of my staff, at (202) 655-6712.

Sincerely,

Kristen M. Martinenza, P.E.
Risk Analysis Branch Chief

Enclosure

Enclosure: Plan Participant Status List

Attached is the list of participating jurisdictions in the referenced hazard mitigation plan.

Jurisdiction Name	Jurisdiction Status	Date Approved by FEMA
1) Apex town	Approved	11/20/24
2) Cary town	Approved	2/10/25
3) Fuquay-Varina town	Approved	5/29/25
4) Garner town	Approved	5/29/25
5) Holly Springs town	Approved	2/10/25
6) Knightdale town	Approved	11/20/24
7) Morrisville town	Approved	4/11/25
8) Raleigh city	Approved	2/10/25
9) Rolesville town	Approved	4/11/25
10) Wake County	Approved	11/20/24
11) Wake Forest town	Approved	2/10/25
12) Wendell town	Approved	5/29/25
13) Zebulon town	Approved	5/29/25

WAKE COUNTY
NORTH CAROLINA

WAKE COUNTY BOARD OF COMMISSIONERS RESOLUTION
Adopting the 2025 Wake County Multi-Jurisdictional Hazard Mitigation Plan

WHEREAS, the County of Wake is vulnerable to an array of natural hazards that can cause loss of life and damages to public and private property; and

WHEREAS, the County of Wake desires to seek ways to mitigate situations that may aggravate such circumstances; and

WHEREAS, the development and implementation of a hazard mitigation plan can result in actions that reduce the long-term risk to life and property from natural hazards; and

WHEREAS, it is the intent of the Board of Commissioners to protect its citizens and property from the effects of natural hazards by preparing and maintaining a local hazard mitigation plan; and

WHEREAS, it is also the intent of the Board of Commissioners to fulfill its obligation under North Carolina General Statutes, Chapter 166A: North Carolina Emergency Management Act and Section 322: Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to remain eligible to receive state and federal assistance in the event of a declared disaster affecting the County of Wake; and

WHEREAS, the County of Wake, in coordination with Wake County, Apex, Cary, Fuquay-Varina, Garner, Holly Springs, Knightdale, Morrisville, Raleigh, Rolesville, Wake Forest, Wendell and Zebulon has prepared a multi-jurisdictional hazard mitigation plan with input from the appropriate local and state officials;

WHEREAS, the North Carolina Division of Emergency Management has reviewed the Wake County Multi-Jurisdictional Hazard Mitigation Plan for legislative compliance and has approved the plan pending the completion of local adoption procedures; and

WHEREAS, the Federal Emergency Management Agency requires adoption of the plan by a jurisdictional governing body;

NOW, THEREFORE, BE IT RESOLVED that the County of Wake hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan; and
2. Agrees to take such other official action as may be reasonably necessary to carry out the proposed actions of the Plan.

ADOPTED this the 21st day of October 2024.

Shinica Thomas, Chair
Wake County Board of Commissioners

RES. 2024-054

RESOLUTION

ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL

HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within the Town of Apex are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Apex desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Parts 3, 5, and 8 of Article 19 of Chapter 160A; and Article 8 of Chapter 160A of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (*State emergency assistance funds*) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five-year cycle; and

WHEREAS, the Town of Apex has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management.

WHEREAS, it is the intent of the Town Council of the Town of Apex to fulfill this obligation in order that the Town will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the Town;

NOW, THEREFORE, be it resolved that the Town Council of the Town of Apex hereby:

RESOLUTION ADOPTING WAKE CO. MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

2. Vests Town of Apex Planning with the responsibility, authority, and the means to:

   (a) Inform all concerned parties of this action.
   (b) Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.

3. Appoints Town of Apex Planning to ensure that the Hazard Mitigation Plan is reviewed annually and every five years as specified in the Plan to assure that the Plan complies with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Wake County Board of Commissioners for consideration.

4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

ADOPTED, this the 22nd day of October, 2024.

APEX 1873 NORTH CAROLINA

Jacques K. Gilbert
Mayor

Attest:

Allen Coleman, CMC, NCCCC
Town Clerk

Page **2** of **2**

RESOLUTION
ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within Cary are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire;

WHEREAS, Cary desires to seek ways to mitigate the impact of identified hazard risks;

WHEREAS, the Legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Parts 3, 5, and 8 of Article 19 of Chapter 160A; and Article 8 of Chapter 160A of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry;

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (*State emergency assistance funds*) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act;

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle;

WHEREAS, Cary, in cooperation with Wake County and its other municipalities, has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management; and

WHEREAS, it is the intent of the Cary Town Council to fulfill this obligation in order that the Cary will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting Cary.

NOW, THEREFORE, be it resolved that the Cary Town Council hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

1

2. Vests the appropriate Emergency Management staff with the responsibility, authority, and the means to:

(a) Inform all concerned parties of this action.
(b) Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.

3. Appoints the appropriate Emergency Management staff to assure that the Hazard Mitigation Plan is reviewed annually and every five years as specified in the Plan to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Cary Town Council for consideration.

4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted this the 12th day of December, 2024.

Harold Weinbrecht, Mayor

Attest:

Virginia Johnson, Town Clerk

Certified by: Town of Cary (SEAL)

Date: 12-12-24

Resolution No. 24-1904

Fuquay-Varina Board of Commissioners

December 2, 2024

A RESOLUTION ADOPTED BY THE BOARD OF COMMISSIONERS
OF THE TOWN OF FUQUAY-VARINA, NC
ADOPTING THE WAKE COUNTY MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN

WHEREAS, the Town of Fuquay-Varina is vulnerable to an array of natural hazards that can cause loss of life and damages to public and private property; and

WHEREAS, the Town of Fuquay-Varina desires to seek ways to mitigate situations that may aggravate such circumstances; and

WHEREAS, the development and implementation of a hazard mitigation plan can result in actions that reduce the long-term risk to life and property from natural hazards; and

WHEREAS, it is the intent of the Town Board of Commissioners to protect its citizens and property from the effects of natural hazards by preparing and maintaining a local hazard mitigation plan; and

WHEREAS, it is also the intent of the Town Board of Commissioners to fulfill its obligation under North Carolina General Statutes, Chapter 166A: North Carolina Emergency Management Act and Section 322: Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to remain eligible to receive state and federal assistance in the event of a declared disaster affecting the Town of Fuquay-Varina; and

WHEREAS, the Town of Fuquay-Varina, in coordination with Wake County, Apex, Cary, Garner, Holly Springs, Knightdale, Morrisville, Raleigh, Rolesville, Wake Forest, Wendell and Zebulon has prepared a multi-jurisdictional hazard mitigation plan with input from the appropriate local and state officials;

WHEREAS, the North Carolina Division of Emergency Management and the Federal Emergency Management Agency have reviewed the Wake County Multi-Jurisdictional Hazard Mitigation Plan for legislative compliance and has approved the plan pending the completion of local adoption procedures;

NOW, THEREFORE, BE IT RESOLVED by the Board of Commissioners of the Town of Fuquay-Varina hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan; and

2. Agrees to take such other official action as may be reasonably necessary to carry out the proposed actions of the Plan.

BE IT FURTHER RESOLVED, by the Board of Commissioners of the Town of Fuquay-Varina that this ordinance shall take effect immediately upon its adoption.

Resolution No. 24-1904
Page 2 of 2
December 2, 2024

This Resolution of the Town of Fuquay-Varina Board of Commissioners is hereby adopted this 2nd day of December in the year 2024 in Fuquay-Varina, North Carolina.

FUQUAY-VARINA, NORTH CAROLINA

J. Blake Massengill, Mayor

ATTEST

Teresa Wilder, Town Clerk

(TOWN SEAL)

TOWN OF FUQUAY-VARINA
a dash more
NORTH CAROLINA

CERTIFICATION BY RECORDING OFFICER

The undersigned duly qualified and acting Town Clerk of the Town of Fuquay-Varina does hereby certify: That the above/attached resolution is a true and correct copy of the resolution authorizing the adoption of the 2024 Wake County Multi-Jurisdictional Hazard Mitigation Plan, as regularly adopted at a legally convened meeting of the Town Board of Commissioners duly held on the 2nd day of December, 2024; and, further, that such ordinance has been fully recorded in the journal of proceedings and records in my office. IN WITNESS WHEREOF, I have hereunto set my hand this 2nd day of December, 2024.

(Signature of Recording Officer)

Town Clerk
(Title of Recording Officer)

RESOLUTION NO. (2024) 2620

RESOLUTION ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within the Town of Garner are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storms, lightning, thunderstorm wind/high winds, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Garner desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Articles 1, 7, 8, 10 and 11 of Chapter 160D of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (State emergency assistance funds) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said plan must be updated and adopted within a five-year cycle; and

WHEREAS, the Town of Garner, together with Wake County, has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management; and

WHEREAS, it is the intent of the Town of Garner Town Council to fulfill this obligation in order that Wake County and the Town of Garner will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting Wake County.

NOW, THEREFORE, BE IT RESOLVED by the Town Council of the Town of Garner, North Carolina that they hereby:

Section 1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

Section 2. Vests Wake County Emergency Management with the responsibility, authority, and the means to:

(a) Inform all concerned parties of this action.

(b) Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.

Section 3. Appoints Wake County Emergency Management to assure that the Hazard Mitigation Plan is reviewed annually and every five years as specified in the Plan to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Town of Garner Town Council for consideration.

Section 4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Duly adopted this 17th day of December 2024.

Buddy Gupton, Mayor

ATTEST:

Stella L. Gibson, Town Clerk

APPROVED AS TO FORM:

Terri A. Jones, Town Attorney

Resolution No. 24-28
Date Adopted: November 19, 2024
Effective Date: November 19, 2024

RESOLUTION ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within THE TOWN OF HOLLY SPRINGS are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Holly Springs desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Parts 3, 5, and 8 of Article 19 of Chapter 160A; and Article 8 of Chapter 160A of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (*State emergency assistance funds*) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle; and

WHEREAS, the Town of Holly Springs has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management; and

WHEREAS, it is the intent of the Town Council of the Town of Holly Springs to fulfill this obligation in order that the County will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the County;

NOW, THEREFORE, BE IT RESOLVED THAT THE TOWN COUNCIL OF THE TOWN OF HOLLY SPRINGS, NORTH CAROLINA HEREBY:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

2. Vests the Town of Holly Springs Emergency Management with the responsibility, authority, and the means to:

(a) Inform all concerned parties of this action.
(b) Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.

3. Appoints the Town of Holly Springs Emergency Management to assure that the Hazard Mitigation Plan is reviewed annually and every five years as specified in the Plan to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Holly Springs Town Council for consideration.

4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted by the Holly Springs Town Council on this, the 19th day of November, 2024.

Town of Holly Springs by

Sean Mayefskie, Mayor

ATTEST:

Linda McKinney, Town Clerk

TOWN OF KNIGHTDALE

950 Steeple Square Court
Knightdale, NC 27545
KnightdaleNC.gov

RESOLUTION #24-10-16-001
RESOLUTION ADOPTING THE WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, the residents and property within the Town of Knightdale are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Knightdale desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Chapter 160D of the North Carolina General Statutes delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (State emergency assistance funds) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle; and

WHEREAS, the Town has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management.

WHEREAS, it is the intent of the Town Council of the Town of Knightdale to fulfill this obligation in order that the County will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the County;

NOW, THEREFORE, BE IT RESOLVED that the Town Council of the Town of Knightdale hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan

2. Vests Town of Knightdale Emergency Management with the responsibility, authority, and the means to:
    a. Inform all concerned parties of this action.
    b. Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.
3. Appoints Town of Knightdale Emergency Management to assure that the Hazard Mitigation Plan is reviewed annually, and every five years as specified in the Plan to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Knightdale Town Council for consideration.
4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

This the 16th day of October, 2024.

BY: _____
Jessica Day, Mayor

ATTEST: _____
Heather M. Smith, Town Clerk

TOWN OF KNIGHTDALE

950 Steeple Square Court
Knightdale, NC 27545
KnightdaleNC.gov

RESOLUTION #24-10-16-001
RESOLUTION ADOPTING THE WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, the residents and property within the Town of Knightdale are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Knightdale desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Chapter 160D of the North Carolina General Statutes delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (State emergency assistance funds) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle; and

WHEREAS, the Town has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management.

WHEREAS, it is the intent of the Town Council of the Town of Knightdale to fulfill this obligation in order that the County will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the County;

NOW, THEREFORE, BE IT RESOLVED that the Town Council of the Town of Knightdale hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan

2. Vests Town of Knightdale Emergency Management with the responsibility, authority, and the means to:
    a. Inform all concerned parties of this action.
    b. Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.
3. Appoints Town of Knightdale Emergency Management to assure that the Hazard Mitigation Plan is reviewed annually, and every five years as specified in the Plan to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Knightdale Town Council for consideration.
4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

This the 16th day of October, 2024.

BY: _____
Jessica Day, Mayor

ATTEST: _____
Heather M. Smith, Town Clerk

TOWN OF MORRISVILLE * 100 TOWN HALL DRIVE * MORRISVILLE, NC 27560

RESOLUTION 2024-366-0 AUTHORIZING WAKE COUNTY HAZARD MITIGATION PLAN 2024 UPDATE

WHEREAS, the Town of Morrisville is vulnerable to an array of natural hazards that can cause loss of life and damages to public and private property and desires to seek ways to mitigate situations that may aggravate such circumstances; and

WHEREAS, the development and implementation of a hazard mitigation plan can result in actions that reduce the long-term risk to life and property from natural hazards; and

WHEREAS, it is the intent of the Town Council to protect its residents and property from the effects of natural hazards by preparing and maintaining a local hazard mitigation plan; and

WHEREAS, it is also the intent of the Town Council to fulfill its obligation under North Carolina General Statutes, Chapter 166A: North Carolina Emergency Management Act and Section 322: Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, to remain eligible to receive state and federal assistance in the event of a declared disaster affecting the Town of Morrisville; and

WHEREAS, the Town of Morrisville, in coordination with the Wake County municipalities of Apex, Cary, Fuquay-Varina, Garner, Holly Springs, Knightdale, Raleigh, Rolesville, Wake Forest, Wendell, and Zebulon, has prepared a multi-jurisdictional hazard mitigation plan with input from the appropriate local and state officials; and

WHEREAS, the North Carolina Division of Emergency Management has reviewed the Wake County Multi-Jurisdictional Hazard Mitigation Plan for legislative compliance and has approved the plan. Wake County Commissioners approved the plan on October 21, 2024; and

WHEREAS, the Morrisville Planning and Zoning Board reviewed the plan at a public comment session held on November 7, 2024 and recommended approval by a vote of 5 "yes" and 0 "no"; and

WHEREAS, following due and proper notice in accordance with all legal requirements, the Morrisville Town Council held public hearings on the proposed plan on November 26, 2024, and December 10, 2024.

NOW, THEREFORE, BE IT RESOLVED THAT THE MORRISVILLE TOWN COUNCIL hereby adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan dated January 1, 2025, and agrees to take such other official action as may be reasonably necessary to carry out the proposed actions of the Plan.

Adopted this the 10th day of December 2024.

TJ Cawley, Mayor

ATTEST:

Erin Hudson, Interim Town Clerk

Page 1 of 1

REVISED 12/18/24

RESOLUTION NO. 2024 - 623

ADOPTION OF 2025 WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, the City of Raleigh is vulnerable to various natural hazards that can cause loss of life and damage to public and private property; and

WHEREAS, the City of Raleigh desires to seek ways to mitigate situations that may aggravate such circumstances; and

WHEREAS, developing and implementing a hazard mitigation plan can reduce long-term risks to life and property from natural hazards; and

WHEREAS, the Raleigh City Council intends to protect its citizens and property from the effects of natural hazards by preparing and maintaining a local hazard mitigation plan; and

WHEREAS, the Raleigh City Council also intends to fulfill its obligation under the North Carolina Emergency Management Act (N.C.G.S. Chapter 166A) and Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to remain eligible to receive state and federal assistance in the event of a declared disaster affecting the City of Raleigh; and

WHEREAS, Section 322 of the Stafford Act requires local governments to develop an All-Hazards Mitigation Plan in order to be eligible to receive Hazard Mitigation Grant Program Funds and other disaster-related assistance and that said plan must be updated and adopted within a five-year cycle; and

WHEREAS, in 2019, Wake County adopted the Wake County Multi-Jurisdictional Hazard Mitigation Plan (the "Plan"), which the City of Raleigh adopted by Resolution 2019-993 on December 3, 2019; and

WHEREAS, the City of Raleigh, in coordination with Wake County, Apex, Cary, Fuquay-Varina, Garner, Holly Springs, Knightdale, Morrisville, Rolesville, Wake Forest, Wendell and Zebulon performed a comprehensive review and evaluation of the Plan and has updated the Plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management;

WHEREAS, the North Carolina Division of Emergency Management has reviewed and approved the updates to the Plan and has submitted the updated Plan to the Federal Emergency Management Agency for final review and approval; and

WHEREAS, the Federal Emergency Management Agency requires adoption of the updated Plan by each municipality within Wake County.

1

REVISED 12/18/24

NOW, THEREFORE, BE IT RESOLVED THAT THE CITY COUNCIL OF RALEIGH HEREBY:

1. Adopts the 2025 Wake County Multi-Jurisdictional Hazard Mitigation Plan; and
2. Agrees to take such other official action as may be reasonably necessary to implement the Plan's proposed actions.

Adopted: November 19, 2024

Effective: November 19, 2024

Distribution: Emergency Management
Fire Department
Management

Louis M. Buonpane, City Clerk

(SEAL)

2

RESOLUTION
ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within the Town of Rolesville are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Rolesville desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Article 5, Section 160D-501 of Chapter 160D of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (*State emergency assistance funds*) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle; and

WHEREAS, the Town of Rolesville has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management.

WHEREAS, it is the intent of the Board of Commissioners of Town of Rolesville to fulfill this obligation in order that the Town will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the Town;

NOW, THEREFORE, be it resolved that the Board of Commissioners of the Town of Rolesville hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

1

2. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted this the November 7, 2024.

Ronnie I. Currin, Mayor
Town of Rolesville Board of Commissioners

Attest:

Christina Ynclan, Clerk
Town of Rolesville Board of Commissioners

Certified by: CHRISTINA YNCLAN (SEAL)

Date: MARCH 13, 2025

TOWN OF ROLESVILLE INCORPORATED 1941 NORTH CAROLINA

2

ORDINANCE 2024-33

ORDINANCE OF THE BOARD OF COMMISSIONERS OF THE TOWN OF WAKE FOREST TO ADOPT THE WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN (CPA-24-03)

WHEREAS, the Town of Wake Forest is vulnerable to an array of natural hazards that can cause loss of life and damages to public and private property; and

WHEREAS, the Town of Wake Forest desires to seek ways to mitigate situations that may aggravate such circumstances; and

WHEREAS, the development and implementation of a hazard mitigation plan can result in actions that reduce the long-term risk to life and property from natural hazards; and

WHEREAS, it is the intent of the Town Board of Commissioners to protect its citizens and property from the effects of natural hazards by preparing and maintaining a local hazard mitigation plan; and

WHEREAS, the application submitted by the Town of Wake Forest to update the Wake County Multi-Jurisdictional Hazard Mitigation Plan was duly filed with the Planning Department; and

WHEREAS, the Planning Board held a public comment session on November 12, 2024 and the Board of Commissioners held a public hearing on December 17, 2024; and

WHEREAS, a print ad was published in a paper of general circulation for the public hearing pursuant with G.S. § 160D-602 and the Unified Development Ordinance; and

WHEREAS, the Planning Board at their November 12, 2024 meeting voted unanimously to recommend approval of said application to adopt the Wake County Multi-Jurisdictional Hazard Mitigation Plan; and

NOW, THEREFORE, BE IT ORDAINED by the Board of Commissioners of the Town of Wake Forest adopt the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

Adopted and effective this 17 day of December 2024.

Vivian A. Jones
Mayor

TOWN OF WAKE FOREST INCORPORATED SEAL FEB. 20, 1909 NORTH CAROLINA

ATTEST:

Ella Dowtin
Deputy Town Clerk

APPROVED AS TO FORM:

Hassan Kingsberry
Town Attorney

R-42-2024
RESOLUTION ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within Town of Wendell are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Parts 3, 5, and 8 of Article 19 of Chapter 160A; and Article 8 of Chapter 160A of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (*State emergency assistance funds*) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle; and

WHEREAS, the Town of Wendell has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management.

WHEREAS, it is the intent of the Board of Commissioners of the Town of Wendell to fulfill this obligation in order that the County will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the County;

NOW, THEREFORE, be it resolved that the Board of Commissioners of Wendell hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

1

2. Vests Wake County Emergency Management with the responsibility, authority, and the means to:

(a) Inform all concerned parties of this action.
(b) Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map and identify floodplain areas, and cooperate with neighboring communities with respect to management of adjoining floodplain areas in order to prevent exacerbation of existing hazard impacts.

3. Appoints Wake County Emergency Management to assure that the Hazard Mitigation Plan is reviewed annually and every five years as specified in the Plan to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Town of Wendell Board of Commissioners for consideration.

4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted this the 25th day of November, 2024.

Virginia Gray

Virginia Gray, Mayor

Attest:

Mary Beth Tew

Mary Beth Tew, Town Clerk

(SEAL)

Date: 11/25/2024

2

RESOLUTION 2025-14
ADOPTING WAKE COUNTY MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN

WHEREAS, the citizens and property within the Town of Zebulon are subject to the effects of natural hazards that pose threats to lives and cause damage to property, and with the knowledge and experience that certain areas of the county are particularly vulnerable to drought, extreme heat, hailstorm, hurricane and tropical storm, lightning, thunderstorm wind/high wind, tornado, winter storm and freeze, flood, hazardous material incident, and wildfire; and

WHEREAS, the Town of Zebulon desires to seek ways to mitigate the impact of identified hazard risks; and

WHEREAS, the Legislature of the State of North Carolina has in Article 5, Section 160D-501 of Chapter 160D of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has enacted General Statute Section 166A-19.41 (*State emergency assistance funds*) which provides that for a state of emergency declared pursuant to G.S. 166A-19.20(a) after the deadline established by the Federal Emergency Management Agency pursuant to the Disaster Mitigation Act of 2002, P.L. 106-390, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act; and.

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local governments must develop an All-Hazards Mitigation Plan in order to be eligible to receive future Hazard Mitigation Grant Program Funds and other disaster-related assistance funding and that said Plan must be updated and adopted within a five year cycle; and

WHEREAS, the Town of Zebulon has performed a comprehensive review and evaluation of each section of the previously approved Hazard Mitigation Plan and has updated the said plan as required under regulations at 44 CFR Part 201 and according to guidance issued by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management.

WHEREAS, it is the intent of the Board of Commissioners of Town of Zebulon to fulfill this obligation in order that the Town will be eligible for federal and state assistance in the event that a state of disaster is declared for a hazard event affecting the Town;

NOW, THEREFORE, be it resolved that the Board of Commissioners of the Town of Zebulon hereby:

1. Adopts the Wake County Multi-Jurisdictional Hazard Mitigation Plan.

1

2. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted this the 5th day of May 2025.

Glenn L. York, Mayor
Town of Zebulon Board of Commissioners

Attest:

Lisa M. Markland, CMC - Town Clerk
Town of Zebulon Board of Commissioners

A. WAKE COUNTY UNINCORPORATED AREAS

A.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of unincorporated Wake County. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within unincorporated Wake County. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

A.1.1 CRITICAL FACILITIES

Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table A.1 provides a count of critical facilities by FEMA lifeline category within unincorporated Wake County. Figure A.1 shows the locations of all critical facilities within unincorporated Wake County.

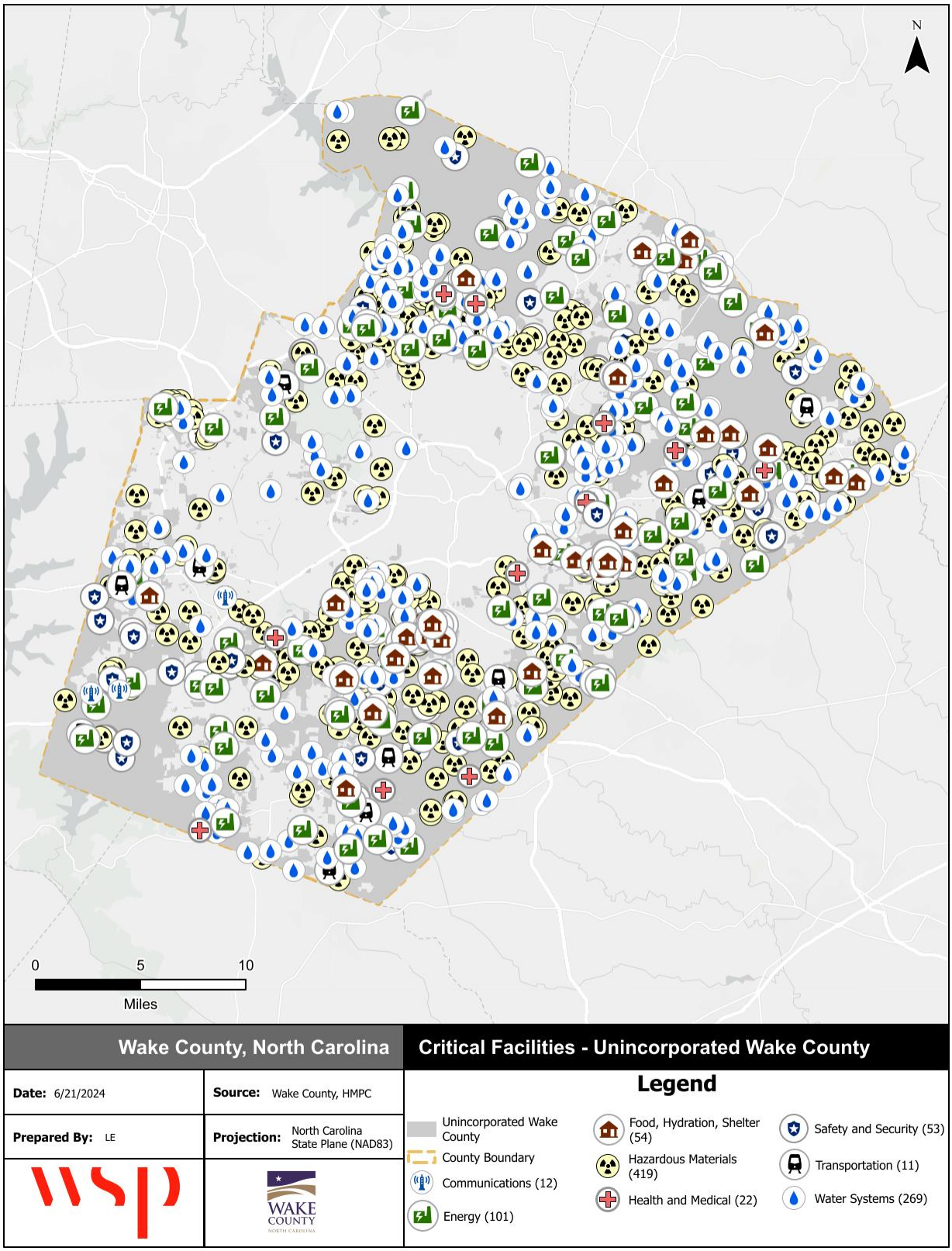
Table A.1 – Critical Facilities by Type, Unincorporated Wake County

Facility Type	Count of Facility Type	Structure Value
Communications	6	$441,436
Energy	59	$794,142,598
Food, Hydration, Shelter	208	$4,786,013,503
Hazardous Materials	213	$1,769,659,066
Health and Medical	12	$7,489,498
Safety and Security	32	$880,935,762
Transportation	7	$740,064,975
Water Systems	156	$830,734,337
Total	**693**	**$9,809,481,175**

Source: Wake County, HMPC

Note: Values were not available for some facilities in the IRISK database

Figure A.1 – Unincorporated Wake County Critical Facilities



Source: Wake County, HMPC

A.1.2 DAM FAILURE

Table A.2 lists all high hazard dams located in unincorporated Wake County that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor."

Table A.2 – High Hazard Dams in Unincorporated Wake County with Condition Assessment of "Poor"

Dam Name	NID ID	Inspection Date	Nearest Downstream City & Distance (mi.)	EAP in Place
Panther Lake Dam	NC00876	01/08/2026	Smithfield (35 mi)	No
Ballentine Farms Pond Dam	NC04441	12/01/2022		No
Ransdell-Wake Chapel Dam	NC06435	01/01/2025		No
Charleston Village Pond Dam	NC07086	05/01/2035		No
Marshall Pond #2 Dam	NC04576	02/02/2024	Forestville (0 mi.)	No
North Ridge Country Club Hole #13 Dam	NC06197	02/01/2024		No
Kildaire Farms Dam	NC04949	03/22/2025		Yes

Source: North Carolina Dam Inventory, February 2024

A.1.3 FLOOD

Table A.3 details the acreage of unincorporated Wake County's total area by flood zone on the effective DFIRM. Per this assessment, over 10 percent of the unincorporated area in the County falls within the mapped 1%-annual-chance floodplains.

Table A.3 – Flood Zone Acreage in Unincorporated Wake County

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	33,965.7	10.4
Zone X (500-year)	1,223.3	0.37
Zone X Unshaded	291,765.5	89.2
Total	**326,954.6**	--

Source: FEMA Effective DFIRM; Wake County GIS

Table A.4 provides building counts and values for critical facilities by flood zone in unincorporated Wake County.

Table A.4 – Critical Facilities Exposed to Flooding, Unincorporated Wake County

Flood Zone	Critical Facility Count	Structure Value
AE	130	$5,586,720,501
X	553	$3,961,236,894
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	10	$261,523,780
Total	**693**	**$9,809,481,175**

Source: FEMA Effective DFIRM

To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $14.8 million in building related damages. The results of the Hazus loss estimate are summarized in Table A.5.

Table A.5 – HAZUS 100-Year Flood Results, Unincorporated Wake County

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	35	$2,083,000	$220,000	$665,000	$885,000	42%
Commercial	25	$1,802,000	$260,000	$590,000	$850,000	47%
Educational	0	$0	$0	$0	$0	0%
Government	0	$0	$0	$0	$0	0%
Industrial	36	$490,000	$137,000	$298,000	$435,000	89%
Religious	3	$520,000	$25,000	$174,000	$199,000	38%
Residential	235	$14,451,000	$8,255,000	$4,173,000	$12,428,000	86%
Total	**334**	**$19,346,000**	**$8,897,000**	**$5,900,000**	**$14,797,000**	**76%**

Source: FEMA Natural Hazards Risk Assessment Program

A.1.4 WILDFIRE

Table A.6 summarizes the acreage in unincorporated Wake County that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 23 percent of unincorporated Wake County is not included in the WUI.

Table A.6 – Wildland Urban Interface Acreage, Unincorporated Wake County

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	76,096.0	23.3%
	LT 1hs/40ac	30,706.3	9.4%
	1hs/40ac to 1hs/20ac	25,734.7	7.9%
	1hs/20ac to 1hs/10ac	34,746.0	10.6%
	1hs/10ac to 1hs/5ac	41,242.4	12.6%
	1hs/5ac to 1hs/2ac	57,766.1	17.7%
	1hs/2ac to 3hs/1ac	59,521.4	18.2%
	GT 3hs/1ac	674.6	0.2%
	Total	**326,487.5**	**100%**

Source: Southern Wildfire Risk Assessment

Table A.7 provides the count and estimated value of all structures that intersect with areas of unincorporated Wake County that are rated moderate to high on the WUI Risk Index.

Table A.7 – Structures at Risk to Moderate-High WUI Risk Index, Unincorporated Wake County

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	516	$109,329,567	$109,329,567	$218,659,134
Commercial	175	$132,022,772	$132,022,772	$264,045,544
Education	62	$285,824,133	$285,824,133	$571,648,266
Government	222	$826,374,227	$826,374,227	$1,652,748,454
Industrial	99	$212,271,166	$318,406,749	$530,677,915
Religious	184	$188,731,526	$188,731,526	$377,463,052
Residential	39,709	$16,538,287,492	$8,269,143,746	$24,807,431,238
Total	**40,967**	**$18,292,840,883**	**$10,129,832,720**	**$28,422,673,603**

Source: Southern Wildfire Risk Assessment

Table A.8 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table A.8 – Critical Facilities Exposed to Wildfire, Unincorporated Wake County

Type	Critical Facility Count	Structure Value
Communications	4	$372,001
Energy	48	$792,837,963
Food, Hydration, Shelter	186	$4,451,653,874
Hazardous Materials	133	$993,839,442
Health and Medical	11	$6,813,153
Safety and Security	24	$874,217,992
Transportation	3	$738,721,299
Water Systems	108	$821,108,597
Total	**517**	**$8,679,564,321**

Source: Southern Wildfire Risk Assessment

A.2 MITIGATION STRATEGY

Wake County											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Conduct a groundwater assessment using a network of wells and leading to a groundwater model that can enhance the understanding of groundwater capacity, threats and vulnerabilities in response to growth and weather.	1	1	Drought	High	Wake Environmental Services, Wake Water Partnership, USGS	$1,565,000	Non-departmental operating expense and USGS	3-5 years	In-Progress – Carry Forward	Contract renewed with USGS to continue groundwater gauge monitoring. Groundwater flow model set to be complete June 2025.
P-2	Continue to coordinate with City of Raleigh on Flood Early Warning System Future: Reference modeling data and municipal gauge networks to Identify gaps in coverage and install gauges to support flood projections and emergency response.	1	2	Flood	Moderate	Wake County Community Services	To be determined	Local, Federal	Ongoing – Next 5 years	New	N/A
P-3	Establish and implement a proactive review process for dam emergency action plans and condition with property owners.	2	2	Flood, Dam Failure	Moderate	Wake County Community Services	To be determined	Local, Federal	Ongoing – Next 5 years	New	N/A
Property Protection											
PP-1	Provide support and advocacy for long term solutions to address orphan roads in Wake County, including legislative solutions and incentives for developers to turn roads over to NCDOT for state maintenance.	3	1	All	Moderate	Wake County Community Services	$50,000,000	State and Federal Funds	Ongoing - Next 5 years	In Progress – Carry Forward	Wake County Orphan Road Program finances road repair, paid back by property owners. Outside funding is needed.
PP-2	Ponderosa Sanitary Sewer Improvements	3	3	Flood Hurricane & Tropical Storm, Severe Weather	High	County Administration	To be determined	FEMA HHDPR, BRIC, Local Funding	5 years	Carry Forward	To apply for FEMA BRIC implementation funding, Wake County adopted this mitigation action as part of an amendment to the 2019 Wake County HMP. Applied for funding in 2023.
PP-3	Assist in reinstating water and sewer services post disaster	1	1	All	Low	Wake County Community Services	$50,000,000	Local and Federal Grant	Ongoing - Next 5 years	In-Progress – Carry Forward	Wake County Water, Sewer Financial policy allows county to repair and restore water and sanitation.
Natural Resource Protection											
NRP-1	Partner with other governmental units and other interested parties to jointly identify and acquire 30,000 acres of open space lands.	3	2	Flood, Drought, Landslide, Extreme Heat	High	Wake County Community Services	$335,000,000	Open Space Bonds	3-5 years	In-Progress – Carry Forward	Continuing to purchase and protect via partnerships. Protected just under 10k (total-2400 since 2019) acres county wide through partnerships with municipalities. Nearing the end of bond allocation funding. Spending down mitigation money form the DOT. County goal is still 30k acres to be protected

Wake County											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
											open space. Additional bonds 2026 but unconfirmed.
NRP-2	Reference modeling data associated with Wake County One Water Plan (in development, est. completion date Dec. 2025) and existing flood data to identify locations to implement nature-based solutions such as green stormwater infrastructure projects, stormwater wetlands and floodplain restoration.	2	2	Flood	Moderate	Wake County Community Services	To be determined	Local, Federal	Ongoing – Next 5 years	New	N/A
Structural Projects											
SP-1	Replace emergency generators located at facilities that serve as emergency shelter locations based on their scheduled end of life cycle.	3	1	All	Moderate	Wake County Facilities Design & Construction	$1,400,000	Local and Federal Grant	More than 5 years	In Progress – Carry Forward	Sanderson remains unreplaced. Due to some additional funding coming available it will be replaced by end of 2025. Garner, Middle Creek, and Heritage by end of 2024. Completed schools are SE Raleigh and Knightdale are complete. JC will edit the dates for purposes. Supply chain - award contract and wait.
Emergency Services											
ES-1	Recovery Plan. Develop a comprehensive disaster recovery plan for Wake County consistent with the vision and goals described in PPD-8 and the National Disaster Recovery Framework.	4	2	All	Moderate	Wake County Emergency Management	$150,000	Local	3-5 years	In-Progress – Carry Forward	County wishes to pursue this effort. Covid and staff time committed to "routine" efforts have postponed this project. The County desires to keep it on the project list in hopes of seeking grant funding to accomplish.
ES-2	Upload dam failure inundation maps to Everbridge system for notification and evacuation.	1	2	Dam Failure	High	Wake County Emergency Management	Staff time	Local	1 year	In-Progress – Carry Forward	Staff time and resources are insufficient. County wishes to pursue this effort and to keep it on the project list in hopes of seeking gran funding to accomplish.
ES-3	Create a critical infrastructure inventory and expand situational awareness capabilities. This project will focus on identifying, cataloguing and monitoring essential assets to enhance resiliency and response capabilities.	2	2	All	Moderate	Wake County Emergency Management	$2,000,000	Local, State, and Federal Funds	Ongoing – 5 Years	New	N/A
Public Education and Awareness											
PEA-1	Increase public awareness and participation in the Ready Wake program and resources.	1	1	All	Moderate	Wake County Fire Services, Emergency Management	$10,000	Federal Grants and Local	2-3 years	In-Progress – Carry Forward	Since the last plan update, the County has hired a full-time staffer for this purpose, developed paper and electronic media, conducted scores of public events; and, signed up thousands to the ReadyWake notification system. Even with all these efforts, we have only touched a portion of our population, and this is an on-going effort.

B. CITY OF RALEIGH

B.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the City of Raleigh. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the City of Raleigh. The hazards included in this section are: Dam Failure, Flood, Extreme Heat, and Wildfire.

B.1.1 CRITICAL FACILITIES

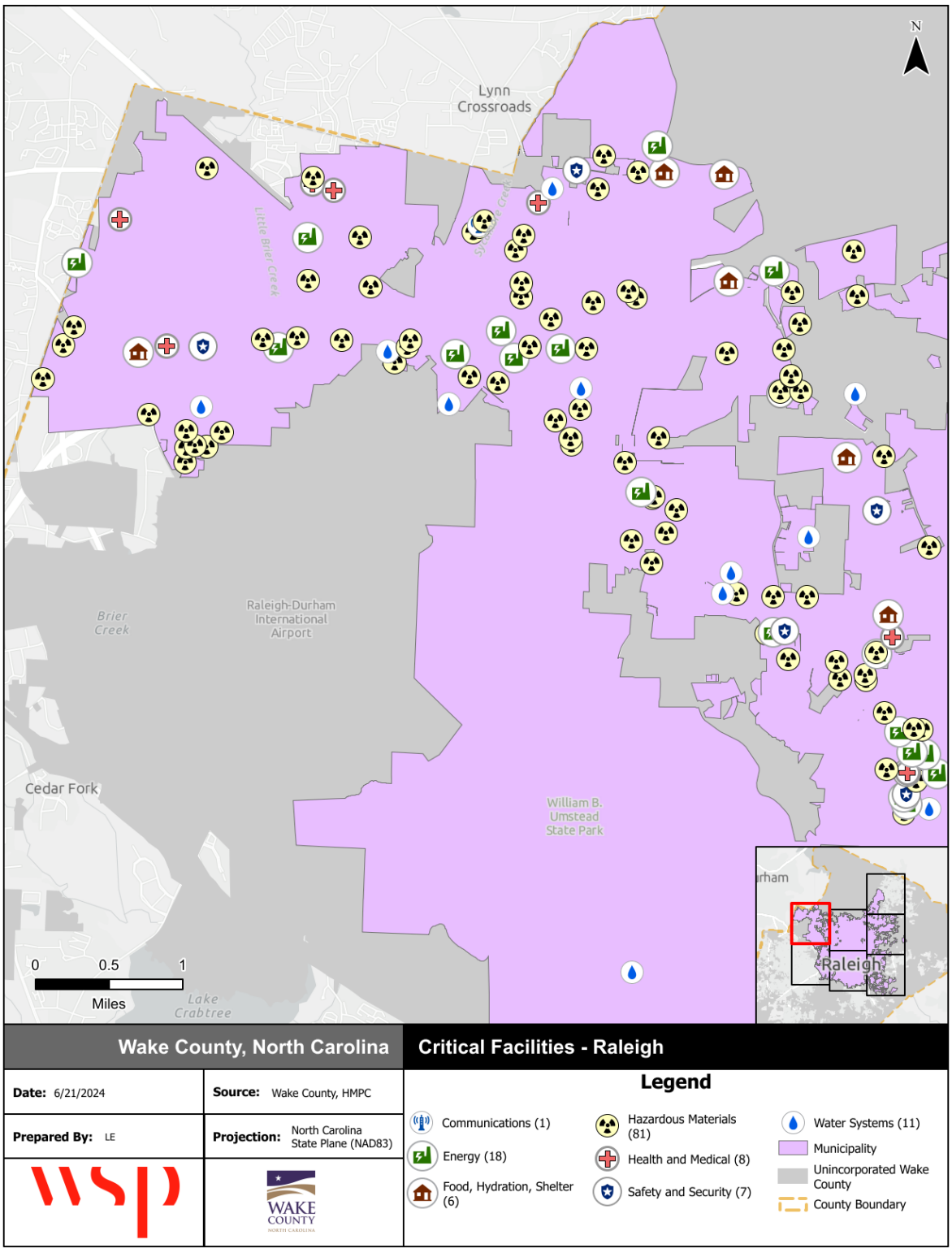
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table B.1 provides a count of critical facilities by FEMA lifeline category within the City of Raleigh. Figure B.1 through Figure B.7 shows the locations of all critical facilities within the City of Raleigh.

Table B.1 – Critical Facilities by Type, City of Raleigh

Facility Type	Count of Facility Type	Structure Value
Communications	2	$49,644,171
Energy	205	$1,574,361,201
Food, Hydration, Shelter	73	$1,550,196,219
Hazardous Materials	720	$8,942,152,702
Health and Medical	268	$3,829,567,731
Safety and Security	99	$2,310,380,729
Transportation	6	$721,135,466
Water Systems	151	$1,269,094,615
Total	**1524**	**$20,246,532,834**

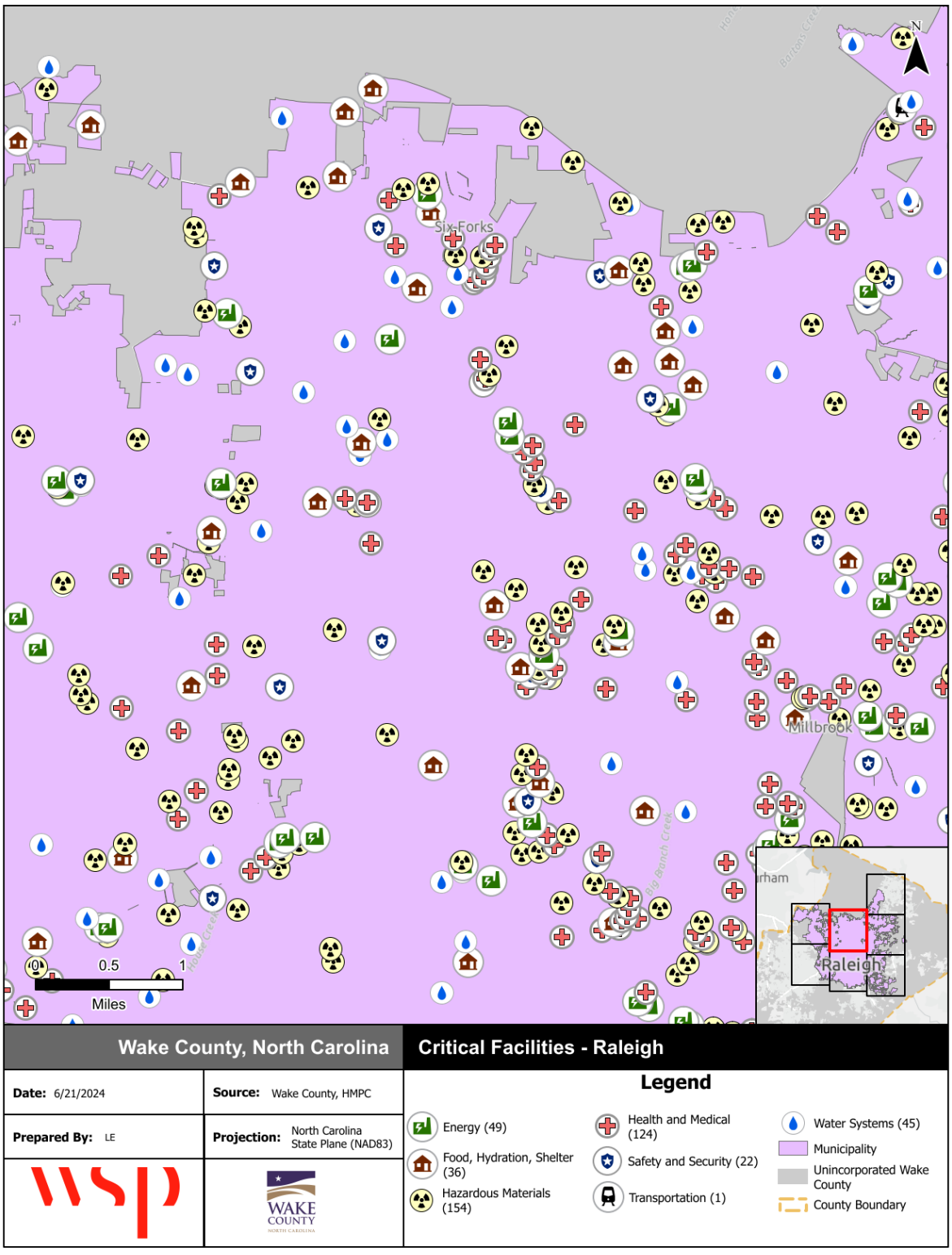
Source: Wake County, HMPC

Figure B.1 – City of Raleigh Critical Facilities, Inset 1



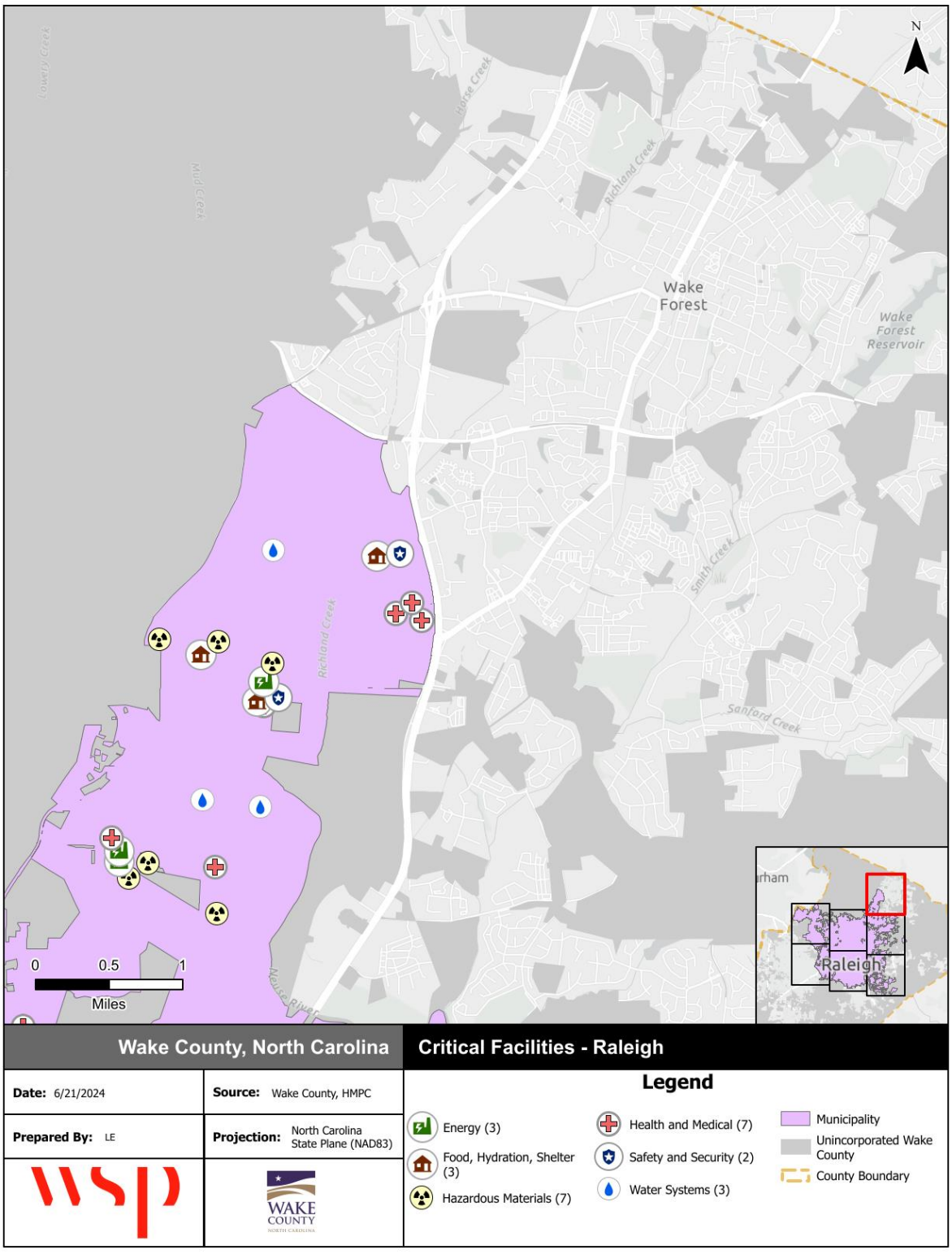
Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

Figure B.2 – City of Raleigh Critical Facilities, Inset 2



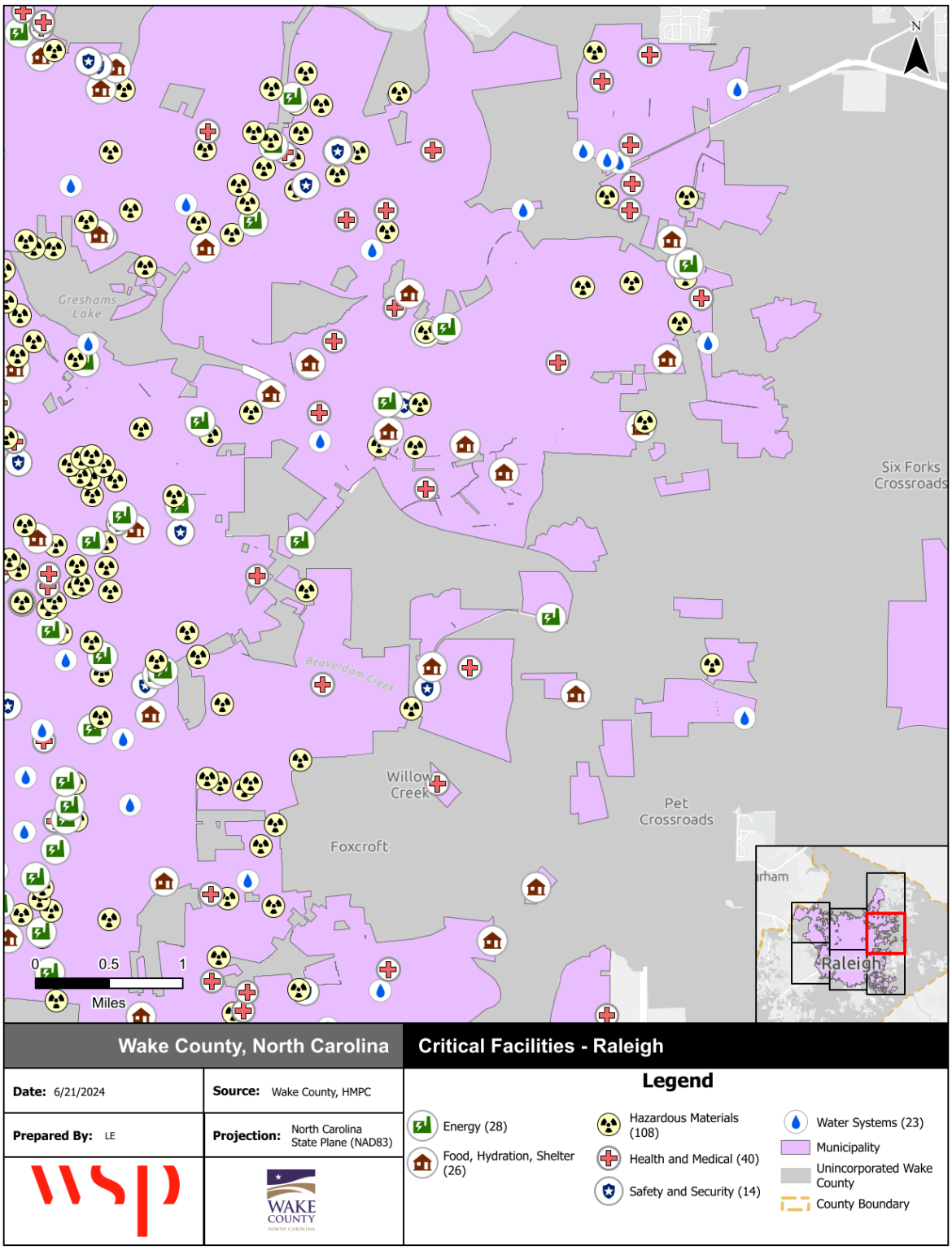
Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

Figure B.3 – City of Raleigh Critical Facilities, Inset 3



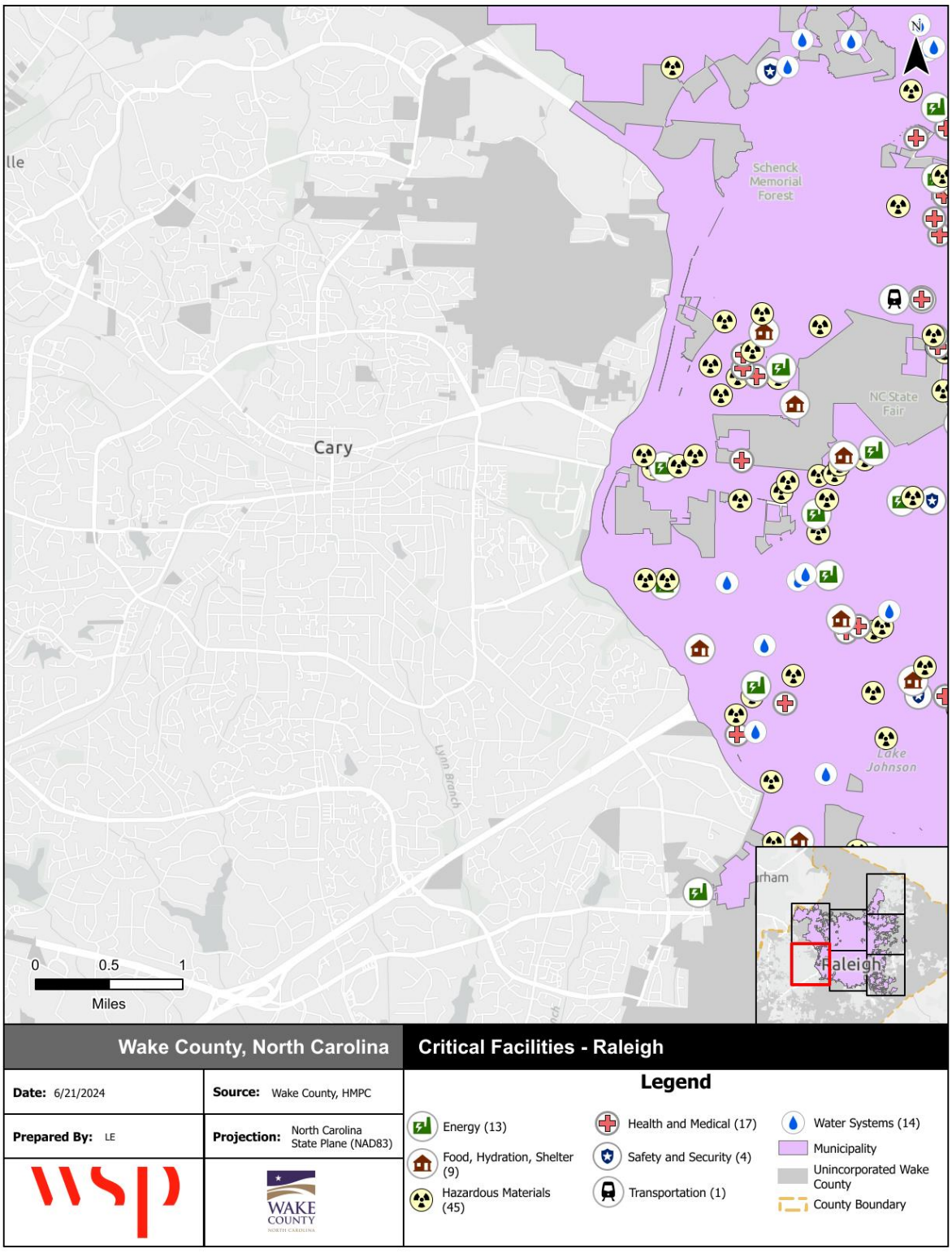
Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

Figure B.4 – City of Raleigh Critical Facilities, Inset 4



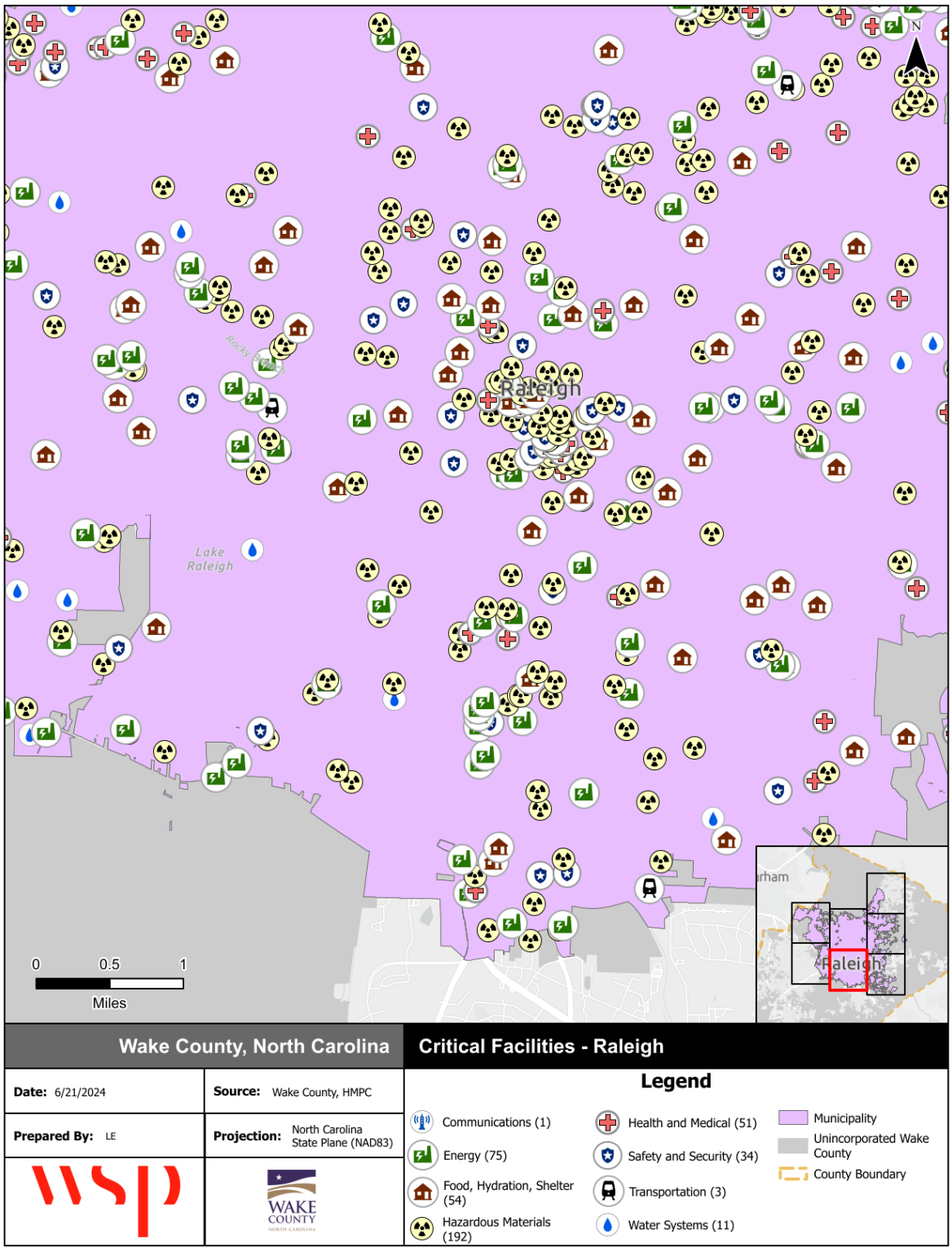
Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

Figure B.5 – City of Raleigh Critical Facilities, Inset 5



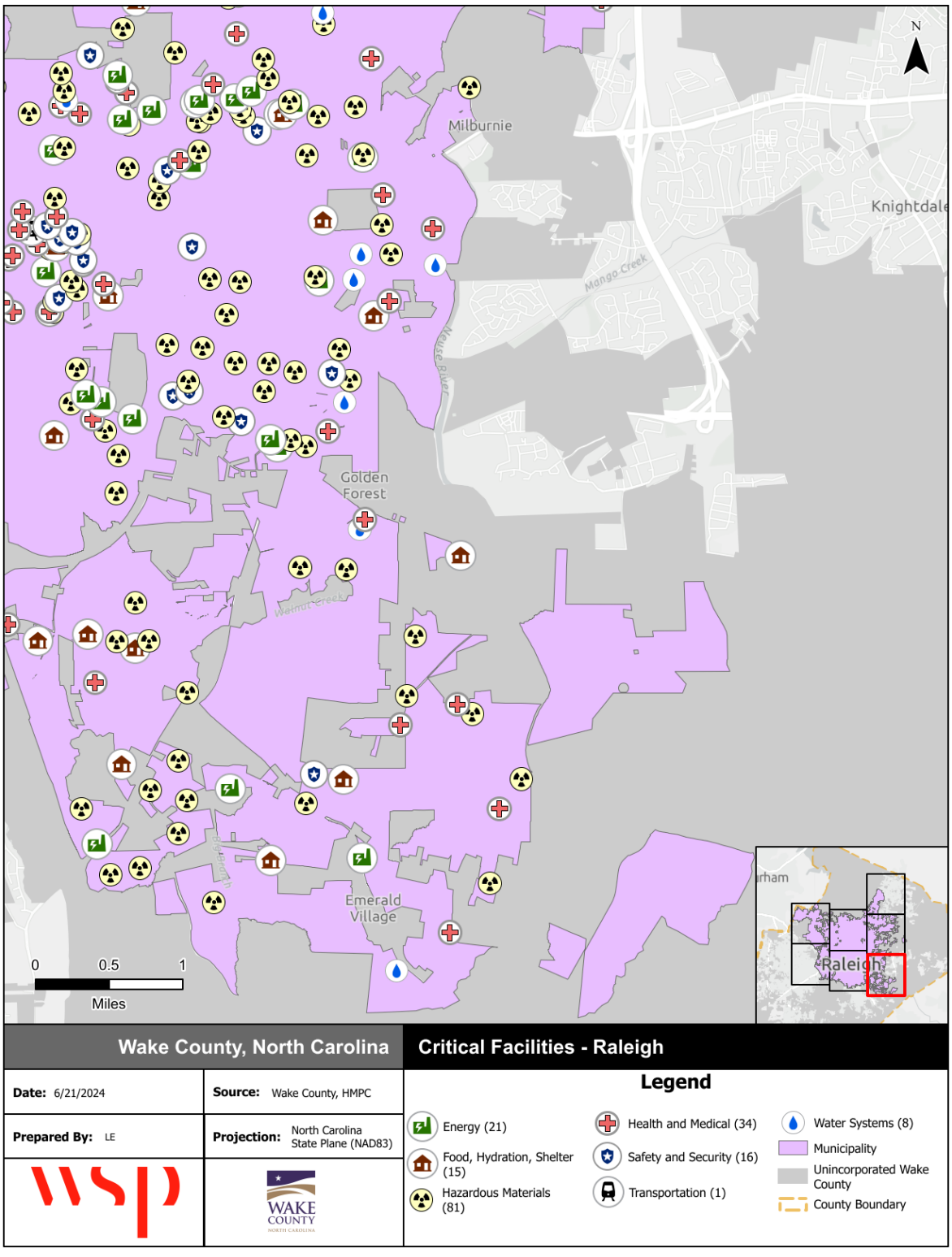
Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

Figure B.6 – City of Raleigh Critical Facilities, Inset 6



Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

Figure B.7 – City of Raleigh Critical Facilities, Inset 7



Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

B.1.2 DAM FAILURE

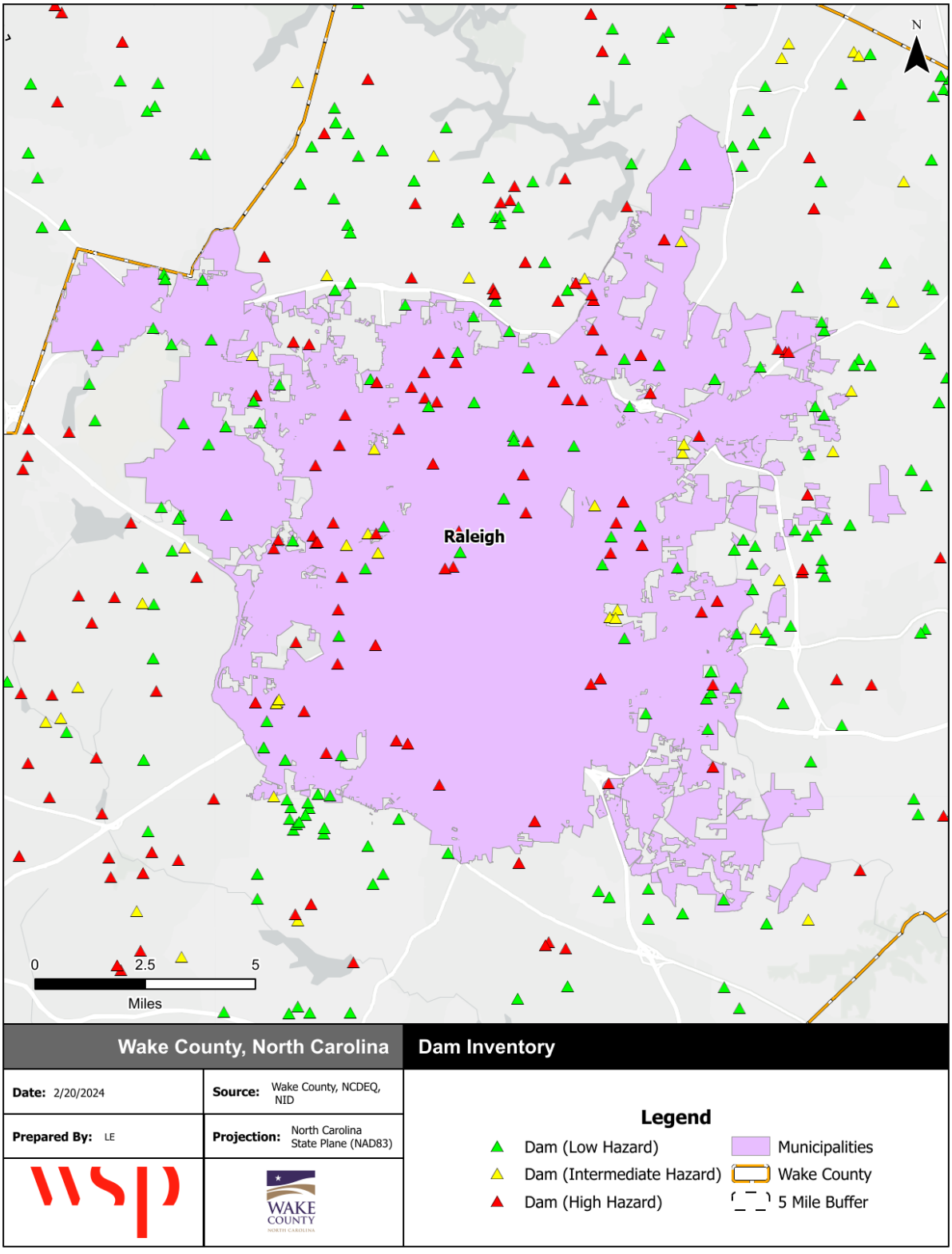
Table B.2 lists all high hazard dams located in the City of Raleigh that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure B.8 shows the location of all dams in the City of Raleigh.

Table B.2 – High Hazard Dams in the City of Raleigh with Condition Assessment of "Poor"

Dam Name	NID ID	Inspection Date	Nearest Downstream City & Distance (mi.)	EAP in Place
Pine Knoll Dam	NC06093	03/07/2025	Raleigh (0 mi.)	No
Bullard and Patterson Dam	NC04504	03/01/2025	Raleigh (0 mi.)	No
Camp Pond Dam	NC04519	11/24/2022	Raleigh (0 mi.)	Yes

Source: North Carolina Dam Inventory, February 2024

Figure B.8 – Dam Inventory, City of Raleigh



Source: North Carolina Dam Inventory, February 2024

B.1.3 FLOOD

Table B.3 details the acreage of the City of Raleigh's total area by flood zone on the effective DFIRM. Per this assessment, about 7 percent of the city falls within the mapped 1%-annual-chance floodplains.

Table B.3 – Flood Zone Acreage in the City of Raleigh

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	7,133.7	7.4
Zone X (500-year)	170.8	0.2
Zone X Unshaded	89,547.3	92.5
Total	**96,851.7**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure B.9 reflects the effective mapped flood hazard zones for the City of Raleigh, and Figure B.10 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table B.4 provides building counts and values for critical facilities by flood zone in the City of Raleigh.

Table B.4 – Critical Facilities Exposed to Flooding, City of Raleigh

Flood Zone	Critical Facility Count	Structure Value
AE	202	$7,547,048,869
X	1,301	$12,556,417,023
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	21	$143,066,942
Total	**1,524**	**$20,246,532,834**

Source: FEMA Effective DFIRM

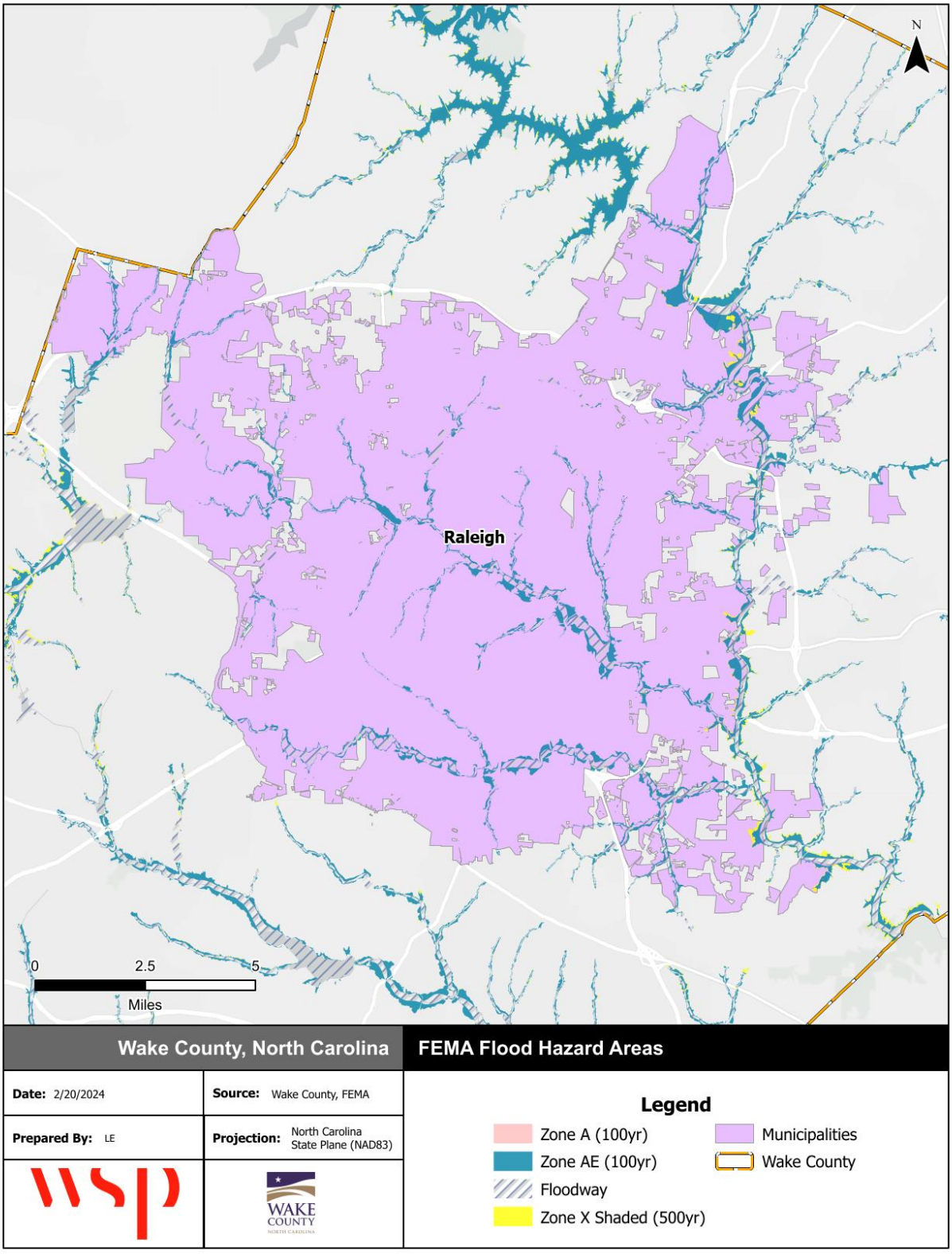
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $306.2 million in building related damages. The results of the Hazus loss estimate are summarized in Table B.5.

Table B.5 – HAZUS 100-Year Flood Results, City of Raleigh

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	18	$1,689,000	$162,000	$564,000	$726,000	43%
Commercial	264	$378,060,000	$33,329,000	$96,027,000	$129,356,000	34%
Educational	33	$25,571,000	$977,000	$6,296,000	$7,273,000	28%
Government	28	$49,531,000	$856,000	$5,108,000	$5,964,000	12%
Industrial	126	$26,814,000	$6,720,000	$15,176,000	$21,896,000	82%
Religious	47	$13,272,000	$723,000	$5,067,000	$5,790,000	44%
Residential	619	$172,650,000	$86,916,000	$48,335,000	$135,251,000	78%
Total	**1,135**	**$667,587,000**	**$129,683,000**	**$176,573,000**	**$306,256,000**	**46%**

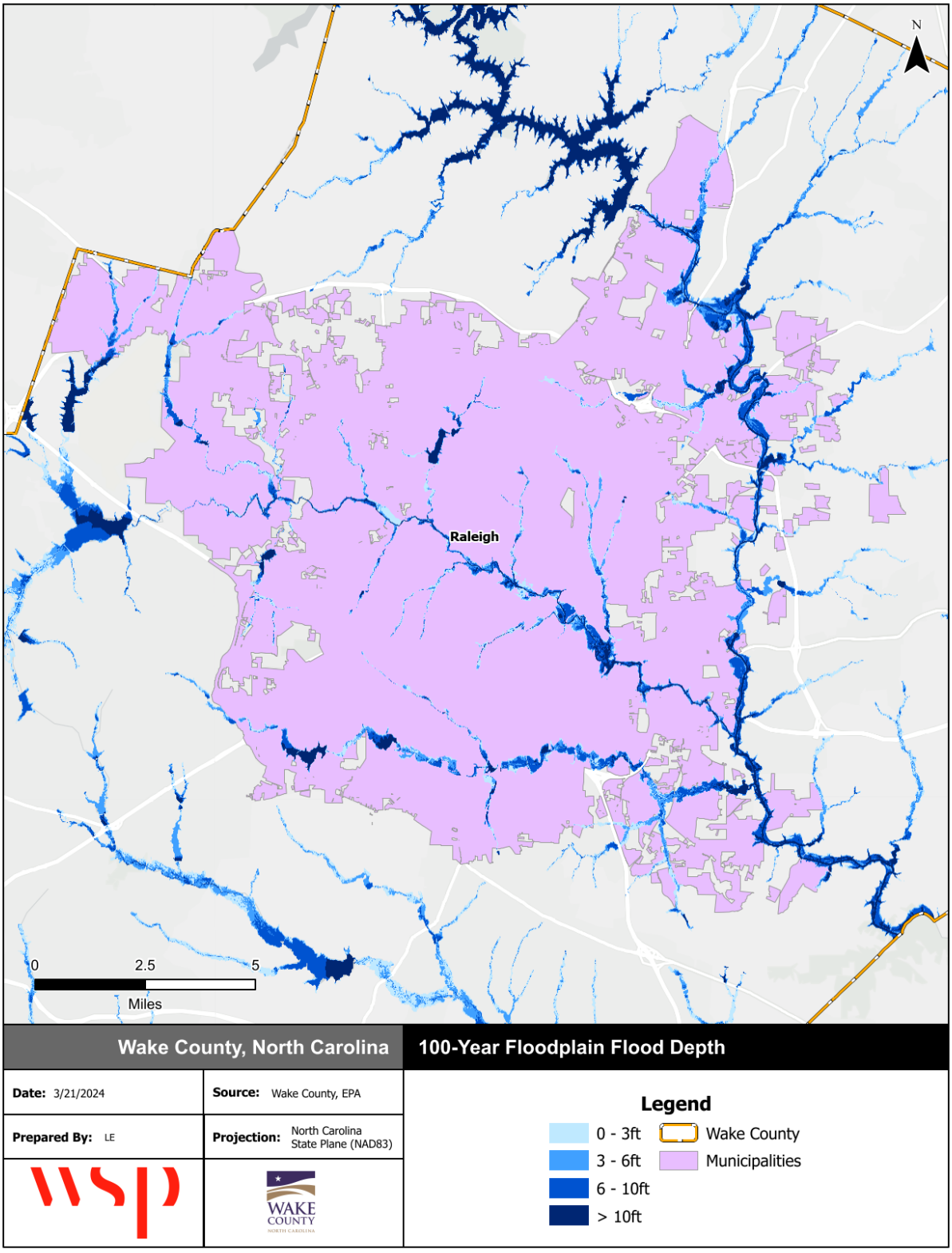
Source: FEMA Natural Hazards Risk Assessment Program

Figure B.9 – FEMA Flood Hazard Areas, City of Raleigh



Source: FEMA Effective DFIRM

Figure B.10 – Flood Depth, 1%-Annual Chance Floodplain, City of Raleigh

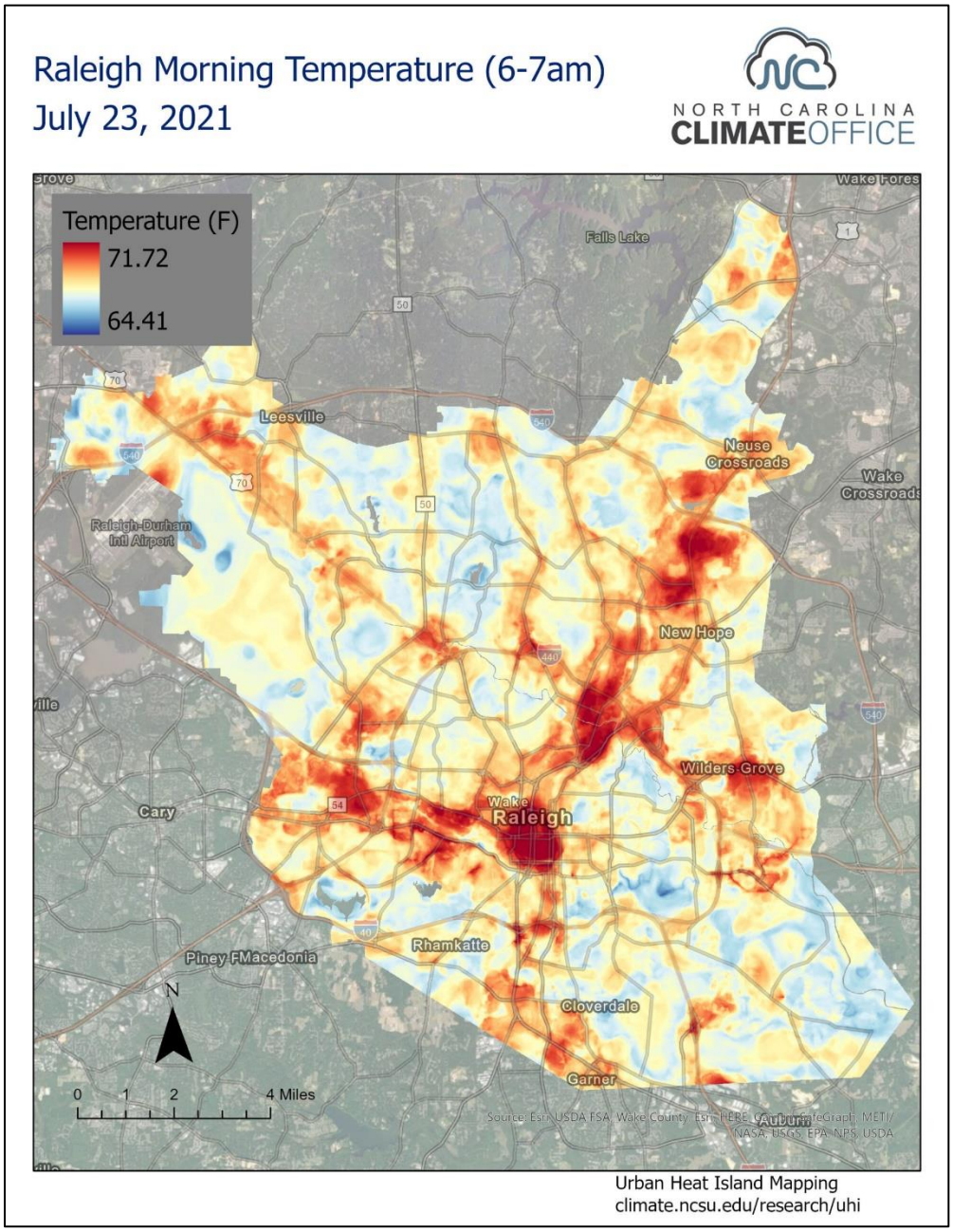


Source: FEMA Effective DFIRM

B.1.4 EXTREME HEAT

In 2021, the City of Raleigh was selected to participate in the NIHHIS-CAPA HeatWatch Campaign. With the help of local stakeholders, scientists, and community volunteers the campaign gathered data to map locations where the hottest zones are found within the planning area. This project revealed that areas with paved surfaces such as roads and buildings could be as much as 20 degrees hotter than areas shaded by trees. Figure B.11 highlights where these urban heat islands exist within the City of Raleigh and provides insight to areas of the community that are most vulnerable when combating extreme heat.

Figure B.11 – Urban Heat Islands, City of Raleigh



Source: North Carolina State Climate Office

B.1.5 WILDFIRE

Table B.6 summarizes the acreage in the City of Raleigh that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 18 percent of the City of Raleigh is not included in the WUI.

Table B.6 – Wildland Urban Interface Acreage, City of Raleigh

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	17,896.87	18.5%
	LT 1hs/40ac	3,214.69	3.3%
	1hs/40ac to 1hs/20ac	1,786.20	1.8%
	1hs/20ac to 1hs/10ac	2,307.08	2.4%
	1hs/10ac to 1hs/5ac	3,001.81	3.1%
	1hs/5ac to 1hs/2ac	6,028.08	6.2%
	1hs/2ac to 3hs/1ac	46,738.87	48.3%
	GT 3hs/1ac	15,864.56	16.4%
	Total	**96,838.16**	**100%**

Source: Southern Wildfire Risk Assessment

Figure B.12 depicts the WUI for the City of Raleigh. Figure B.13 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure B.14 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest on the western border of the City of Raleigh; however, this area has lower burn probability and is largely outside of the WUI, meaning little to no development is at risk. The City of Raleigh overall has relatively low burn probability – the highest being in the southwest, although much of this area is outside of the WUI.

Table B.7 provides the count and estimated value of all structures that intersect with areas of the City of Raleigh that are rated moderate to high on the WUI Risk Index.

Table B.7 – Structures at Risk to Moderate-High WUI Risk Index, City of Raleigh

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	45	$9,189,025	$9,189,025	$18,378,050
Commercial	3271	$8,410,352,337	$8,410,352,337	$16,820,704,674
Education	520	$2,865,682,469	$2,865,682,469	$5,731,364,938
Government	816	$2,931,009,121	$2,931,009,121	$5,862,018,242
Industrial	964	$1,718,499,501	$2,577,749,252	$4,296,248,753
Religious	557	$978,591,720	$978,591,720	$1,957,183,440
Residential	121191	$49,475,709,834	$24,737,854,917	$74,213,564,751
Total	**127,364**	**$66,389,034,007**	**$42,510,428,841**	**$108,899,462,848**

Source: Southern Wildfire Risk Assessment

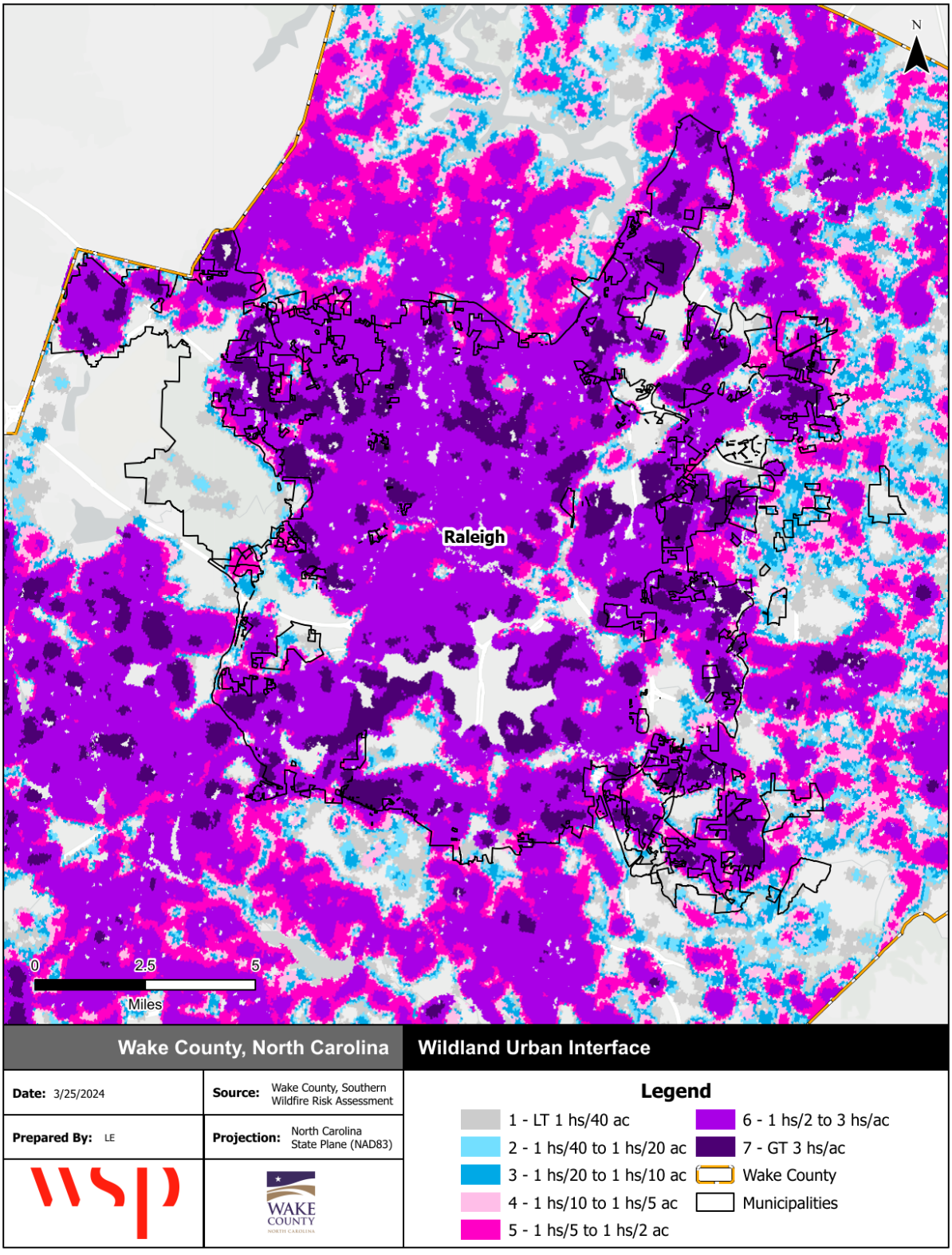
Table B.8 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table B.8 – Critical Facilities Exposed to Wildfire, City of Raleigh

Type	Critical Facility Count	Structure Value
Communications	1	$2,644,211
Energy	158	$1,506,412,243
Food, Hydration, Shelter	65	$1,459,101,764
Hazardous Materials	470	$6,299,528,660
Health and Medical	230	$3,167,312,646
Safety and Security	84	$1,673,171,550
Transportation	5	$721,003,879
Water Systems	131	$1,224,742,818
Total	**1,144**	**$16,053,917,771**

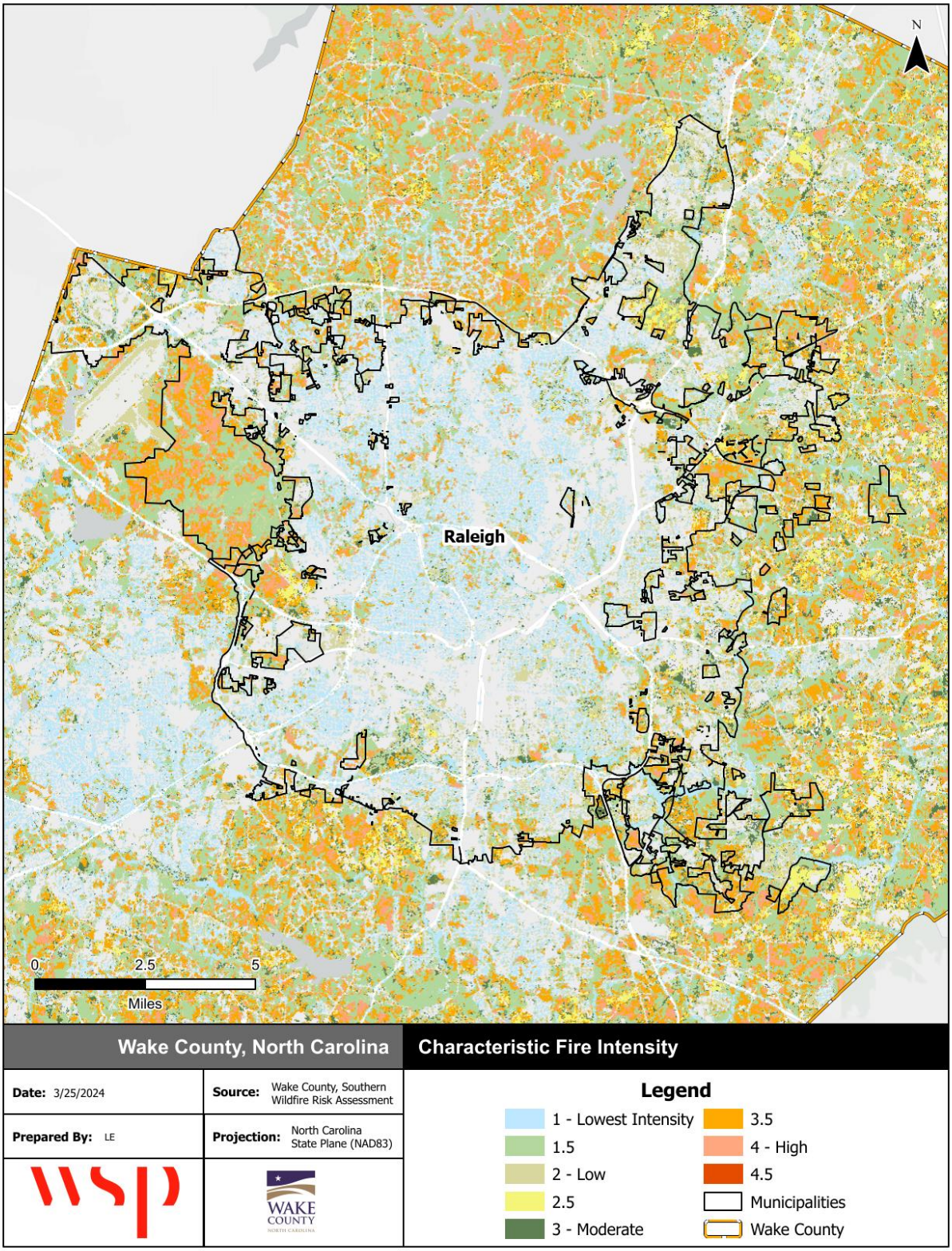
Source: Southern Wildfire Risk Assessment

Figure B.12 – Wildland Urban Interface, City of Raleigh



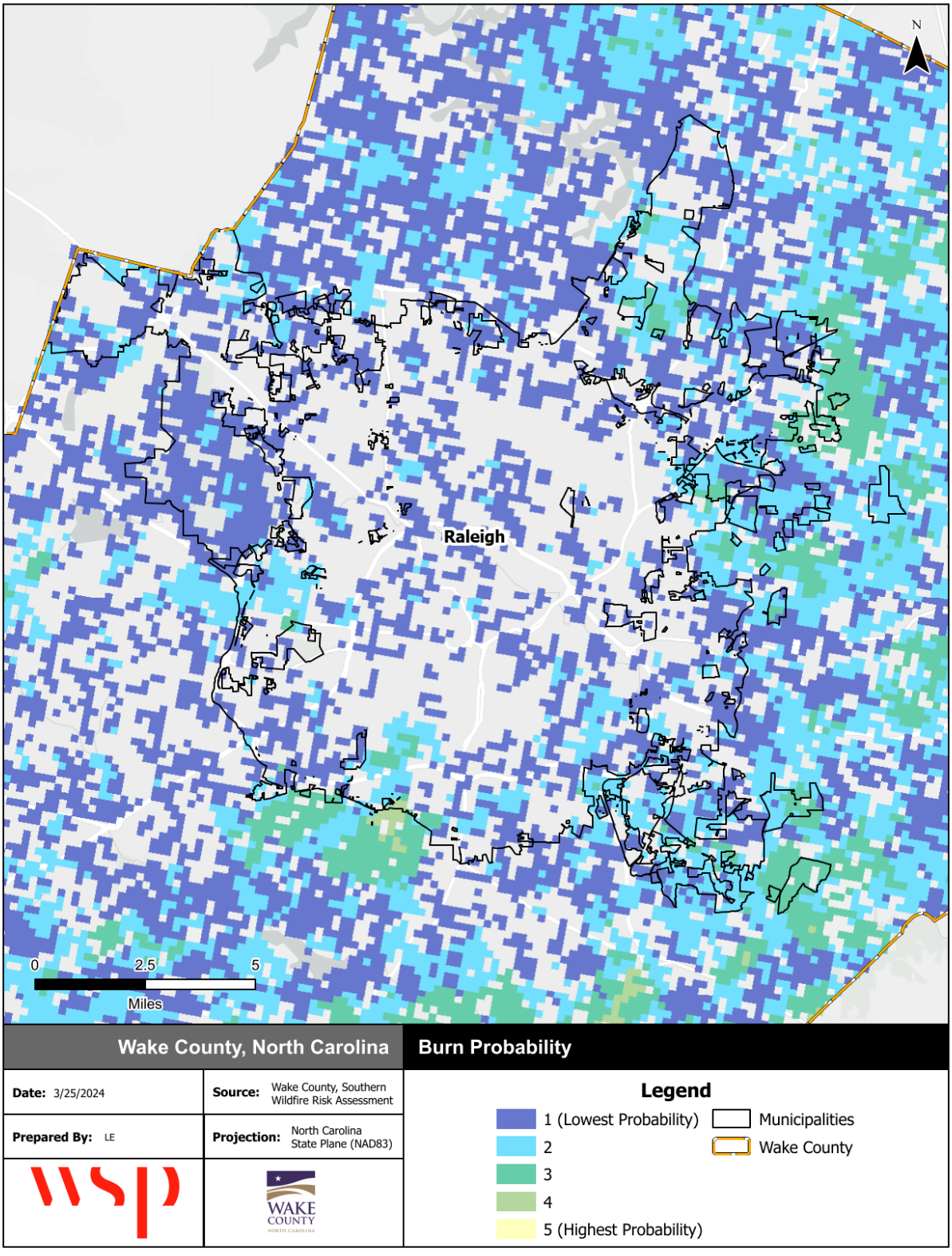
Source: Southern Wildfire Risk Assessment

Figure B.13 – Fire Intensity Scale, City of Raleigh



Source: Southern Wildfire Risk Assessment

Figure B.14 – Burn Probability, City of Raleigh



Source: Southern Wildfire Risk Assessment

B.2 MITIGATION STRATEGY

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Develop ongoing multi-year program of detailed basin studies for each watershed in City's jurisdiction. Fifteen basin studies are complete with 10 additional studies budgeted in the capital program. (CRS 410).	2	2	Flood	Moderate	Raleigh Engineering Services	$100,000 - $1m	Local	1 year	In-Progress – Carry Forward	The detailed basin study program has been established but the studies themselves will be ongoing. The City is conducting approximately 3 basin studies per year.
P-2	Update and maintain GIS data of building footprints, parcels, and critical facilities, and use it to regularly identify buildings in need of mitigation.	2	2	All	Moderate	Raleigh Information Technology, GIS staff	Staff time	Local	Ongoing - Next 5 years	In-Progress – Carry Forward	Currently, critical facilities aren't maintained and/or integrated with the Enterprise GIS System, taken as an action item to further develop layers/datasets.
P-3	Develop a local floodplain mapping program to produce regular mapping updates to flood hazard maps.	2	2	Flood	Moderate	Raleigh Engineering Services	$100,000- $1m	Local, Federal	Ongoing - Next 5 years	New	The City is continuing to gather information on how data produced through ongoing detailed basin studies can be used for mapping updates, outlining criteria for where and how often mapping updates will be conducted, and evaluating potential budgetary and resource needs.
P-4	Continue active lake level management activities at Lake Johnson to reduce flood risk to downstream Walnut Creek properties during storm events.	3	2	Flood, Hurricane	Moderate	Raleigh Engineering Services	Less than $100,000	Local	Ongoing - Next 5 years	New	Staff uses a web-based software to remotely control the actuators, valves and gates at Lake Johnson. This allows us to remotely lower the lake prior to large storm events which gives us more storage in the lake to capture runoff during storm events and help reduce flooding downstream. We will be looking at adding this type of system to other Lakes and SCMs in the area over the next few year.
P-5	Proactively review dam emergency action plans and condition with property owners as part of the City's dam public education and outreach program.	1	2	Flood, Hurricane	Moderate	Raleigh Engineering Services	$100,000 and staff time	Local	Ongoing - Next 5 years	New	N/A
Property Protection											
PP-1	Develop ongoing program designed to utilize grant resources to assist private property owners in acquiring, relocating, elevating, or floodproofing existing structures located in flood hazard zones	3	2	Flood	Moderate	Raleigh Engineering Services	$100,000 - $1m	Local, Federal	3-5 years	In-Progress – Carry Forward	The City has established a Floodplain Management team to manage mitigation projects going forward. A prioritization model has also been developed to score and evaluate potential mitigation properties.

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PP-2	Program to install emergency electrical generators at all public utility facilities. Current focus on redundant generators at critical facilities, second fuel truck and completion of 100% generator coverage in Garner area.	3	1	All	High	Raleigh Public Utilities	$100,000 - $1m	Local	2-3 years	In-Progress – Carry Forward	Received supplemental funding for FY25, working to obtain quotes but looking at supporting sustainability by using natural gas.
Structural Projects											
SP-1	Install cameras in flood prone areas throughout the City of Raleigh to allow us to view these locations and make informed decisions as it relates to flooding	2	2	Flood, Hurricane	Moderate	City of Raleigh Transportation	$100,000 to $1m	Unknown	3-5 years	In-Progress – Carry Forward	Addition of cameras is ongoing. We currently have 18 cameras installed and have 6 more in-house to be installed. Over the next few years we are looking to have a total of 31 cameras in flood prone areas.
SP-2	Implement stormwater improvement projects that improve conveyance, retention, and/or detention capabilities, particularly in areas that frequently experience flooding.	3	2	Flood	High	Raleigh Engineering Services	$100,000 - $1m, >$1m	Local	Ongoing - Next 5 years	In-Progress – Carry Forward	Continue the study and design of major improvement projects (Rose Lane, Smoky Hollow, etc.). Continue with drainage assistance projects/GSI installs. Approximately 4 residential properties benefited from drainage assistance projects/GSI installs over the last year.
Emergency Services											
ES-1	Provide and enhance technical rescue capabilities more equitably throughout the city.	2	1	Dam Failure, Flood, Hurricane, Severe Weather, Severe Winter Storm, Tornado, Wildfire	High	Raleigh Fire	$100,000 - $1m	Local	2-3 years	In-Progress – Carry Forward	As the square mileage of the city continues to grow, the ability for a single rescue unit and two squads to respond in a timely manner is becoming challenging. A second dedicated rescue unit will be needed in the near future to address reasonable response times to all areas of the city. We continue to successfully train all members of the technical rescue team in various aspects of rescue. Training our team is a continuous goal due to attrition of team members through separation and promotion.
ES-2	Provide after-action report of emergency response to severe weather events in order to improve planning for future disasters.	2	2	Hurricane, Severe Weather, Severe Winter Storm, Tornado	High	Raleigh Fire and Emergency Management	$100,000 - $1m	Local	Ongoing- Post Event	In-Progress – Carry Forward	AAR's are an on-going and adaptive concern. Information derived from AAR's should be used to drive change in emergency response.
ES-3	Maintain a standard operating guideline to direct operational planning prior to anticipated weather emergencies.	2	1	All	High	Raleigh Fire and Emergency Management	$100,000 - $1m	Local	Ongoing – next 5 years	In-Progress – Carry Forward	EOPs and SOGs are an ever-changing condition.

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-4	Continue to conduct disaster tabletop exercise program.	2	1	All	Low	Raleigh Public Utilities, Fire, Police, City Manager, Emergency Management, and Engineering Services	$100,000 - $1m	Local	Ongoing – next 5 years	In-Progress – Carry Forward	Continuing effort with new Emergency Management staff, broaden exercise topics from natural/tropical hazards to all-hazards along with routine/quarterly Working Group meetings on various topics/trainings/exercises
ES-5	Establish cross-functional team to develop Debris Management Plan. Team should work to identify and prepare additional debris management sites.	2	1	Flood, Tornado, Earthquake, Severe Winter Storm, Severe Weather, Hurricane	Moderate	City of Raleigh Transportation	$100,000	FEMA, City of Raleigh general fund support	1 year	In-Progress – Carry Forward	Group between three partner departments formed in 2019 to investigate our debris management and plan for how the City manages debris long term. City Real Estate assisted with identification of sites at that time and resulted in 4 proposed sites, Thornton Rd, Old Battle Bridge Rd, Patriot Dr (rear of current Yard Waste Facility) and Tarheel Club Rd (Parks Site). Also, Hertz Dr site was discussed as an intermediate drop site and/or use for grinding debris. At this time sites have not been studied for impact to flood plain or for proper permitting by Solid Waste Services.
ES-6	Develop a Substantial Damage Management Plan	2	2	Flood, Hurricane	High	Raleigh Engineering Services	Less than $100,000	Local	Ongoing – 1 Year	New	Communities that participate in the Community Rating System (CRS) can receive credit points for going beyond those basic standards by developing a detailed, written plan for managing the susceptibility of buildings within their jurisdictions to substantial damage from floods and other hazardous events. Such a plan helps increase awareness of flood risk areas, identifies vulnerable structures and neighborhoods, and ensures that there is a strategy in place for making damage determinations and enforcing the substantial damage requirements if a flood occurs. In addition, the plan, and the process of producing it, fosters communication with residents and elected officials and helps develop long-term actions to mitigate properties and reduce future losses.

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Public Education and Awareness											
PEA-1	Enhance flood monitoring and warning capabilities by expanding the City's Flood Early Warning System and through the continued use and addition of gages, sensors, signs, and cameras.	1	2	Flood	Moderate	Raleigh Engineering Services	$3m - $4m	Local, Federal	Ongoing – Next 5 years	New	The Flood Early Warning System (FEWS) is being developed to predict, monitor, report, and notify on flooding events. The system has Gauge Adjusted Radar Rainfall that updates every 5-minutes, predictive current rainfall gauge data, Watchpoints at stream gauge locations that shows current observations and predictions of the stream level over the next several hours that updates every 5-minutes, alerts and notifications that can be programed and received via text, email or phone call, post event reports that can be ran to get the 5-minute data from all the system throughout the storm event, forecasts from national models are built into the system, and a "What if" scenario app that can be used to pull in the current forecast or a made up scenario to see how a rainfall event might affect the creek level during that event. In the program we also have flood sensors that active flashing signs along the roadway for motorist to be aware of flooded road conditions. We currently have 9 locations with this system and should soon have another system in place. We also use low-cost cellular and solar powered cameras to deploy in locations that the Traffic cameras can't be installed. We currently have 21 of these cameras and look to have 62 in place over the next few years.
PEA-2	Educate residents on emergency preparedness, clearing storm drains, and reporting illicit discharges.	1	1	Flood, Hurricane	High	Raleigh Engineering Services, Emergency Management, Public Utilities	Less than $100,000	Local	Ongoing - Next 5 years	New	Informed residents are better able to protect themselves, their property, and natural floodplain functions when they are prepared. Outreach is done through various Community Rating System (CRS) projects (e.g., in our water bill mailer, on our website, etc,).
PEA-3	Promote flood insurance.	1	1	Flood, Hurricane	High	Raleigh Engineering Services	Less than $100,000	Local	Ongoing - Next 5 years	New	With an NFIP flood insurance policy, residents and business owners can recover faster and more fully after a disaster. Promotional outreach is done through various Community Rating System (CRS) projects (e.g., in our water bill mailer, on our website, etc.).

City of Raleigh											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PEA-4	Community Climate Education for a Resilient Raleigh: grant from NOAA Office of Education's Environmental Literacy Program for a three-year project to improve the climate resilience of Raleigh's vulnerable communities	1	1	Flood, Heat	Moderate	Raleigh Sustainability and Stormwater	~$440,000	Federal	Ongoing - Next 3 years	New	This is a flagship program and three-year $440,000 Federal grant through the National Oceanic and Atmospheric Administration (NOAA). Partners include: the City of Raleigh, Partners for Environmental Justice (PEJ), the State of North Carolina's Climate Office and many more stakeholders representing local neighborhoods, government, non-profit, business and more. There are 3 main activities for this grant, which include education and outreach through the expansion of the Watershed Learning Network in partnership with PEJ to develop cohorts of residents that are empowered on climate resilience; community capacity building for resilience action in local communities including the Ready Raleigh Emergency Preparedness Guide; and climate resilience planning efforts.

C. TOWN OF APEX

C.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Apex. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Apex. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

C.1.1 CRITICAL FACILITIES

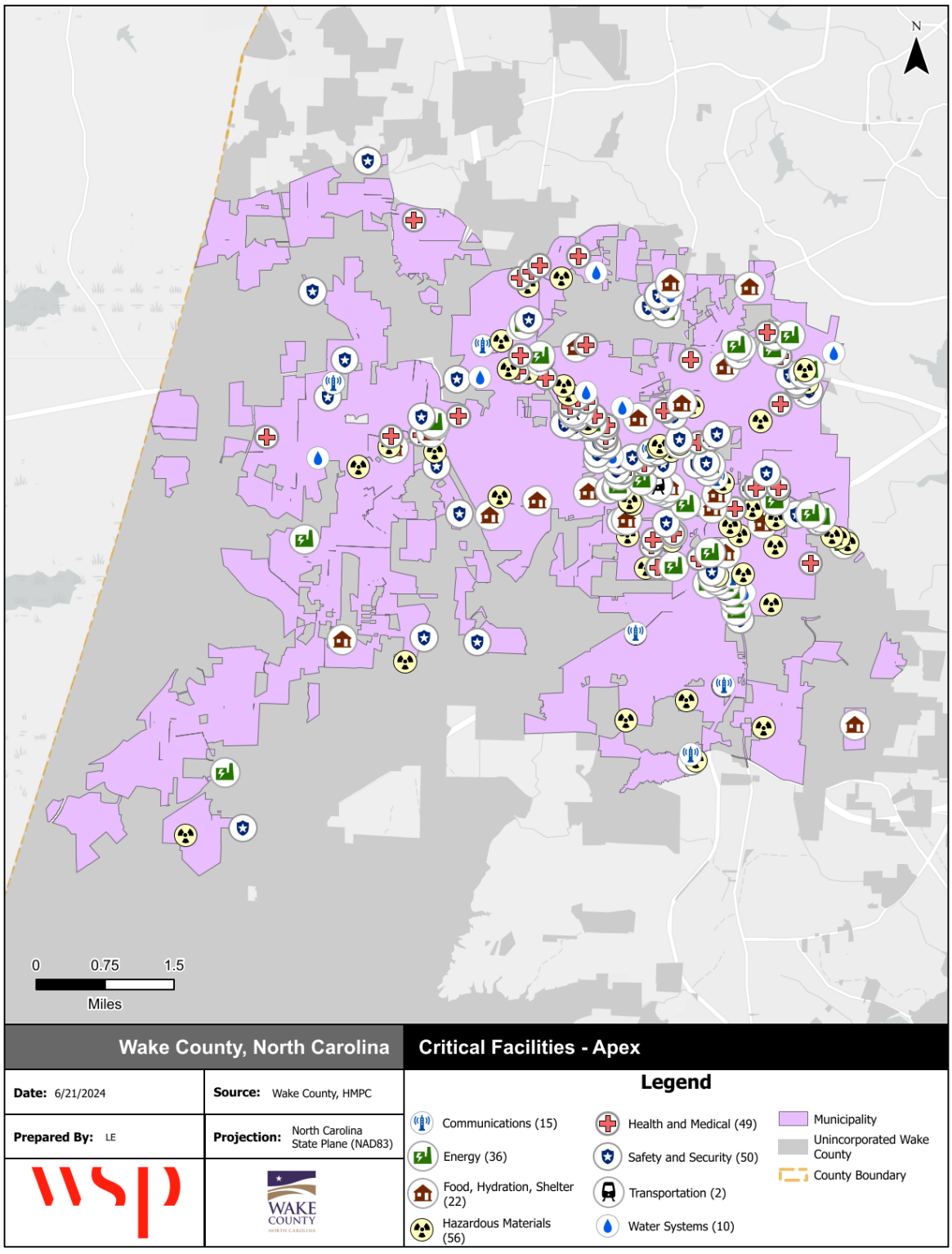
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table C.1 provides a count of critical facilities by FEMA lifeline category within the Town of Apex. Figure C.1 shows the locations of all critical facilities within the Town of Apex.

Table C.1 – Critical Facilities by Type, Town of Apex

Facility Type	Count of Facility Type	Structure Value
Communications	17	$30,354,720
Energy	38	$104,756,854
Food, Hydration, Shelter	11	$65,258,730
Hazardous Materials	84	$336,197,986
Health and Medical	49	$212,376,831
Safety and Security	55	$230,213,125
Transportation	5	$19,976,201
Water Systems	14	$3,595,609
Total	**273**	**$1,002,730,056**

Source: Wake County, HMPC

Figure C.1 – Town of Apex Critical Facilities



Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

C.1.2 DAM FAILURE

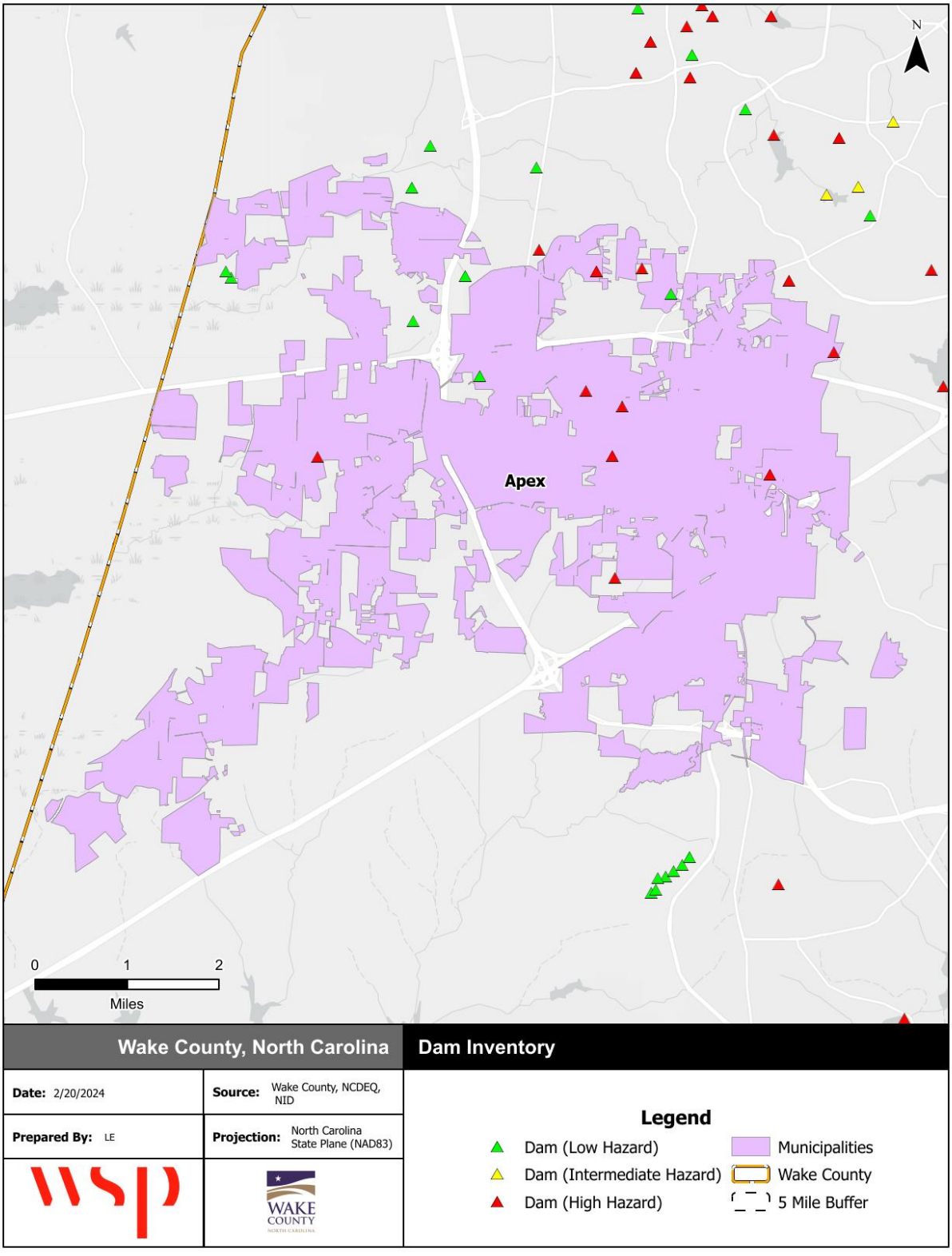
Table C.2 lists all high hazard dams located in the Town of Apex that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure C.2 shows the location of all dams in the Town of Apex.

Table C.2 – High Hazard Dams in the Town of Apex with Condition Assessment of "Poor"

Dam Name	NID ID	Inspection Date	Nearest Downstream City & Distance (mi.)	EAP in Place
Grey Lake Dam	NC01706	03/01/2025	Apex (0 mi.)	No

Source: North Carolina Dam Inventory, February 2024

Figure C.2 – Dam Inventory, Town of Apex



Source: North Carolina Dam Inventory, February 2024

C.1.3 FLOOD

Table C.3 details the acreage of the Town of Apex total area by flood zone on the effective DFIRM. Per this assessment, over 4 percent of the Town of Apex falls within the mapped 1%-annual-chance floodplains.

Table C.3 – Flood Zone Acreage in the Town of Apex

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	779.6	4.6
Zone X (500-year)	6.3	0.03
Zone X Unshaded	16,039.5	95.3
Total	**16,825.3**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure C.3 reflects the effective mapped flood hazard zones for the Town of Apex, and Figure C.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table C.4 provides building counts and values for critical facilities by flood zone in the Town of Apex.

Table C.4 – Critical Facilities Exposed to Flooding, Town of Apex

Flood Zone	Critical Facility Count	Structure Value
AE	17	$26,042,943
X	254	$973,768,575
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	2	$2,918,538
Total	**273**	**$1,002,730,056**

Source: FEMA Effective DFIRM

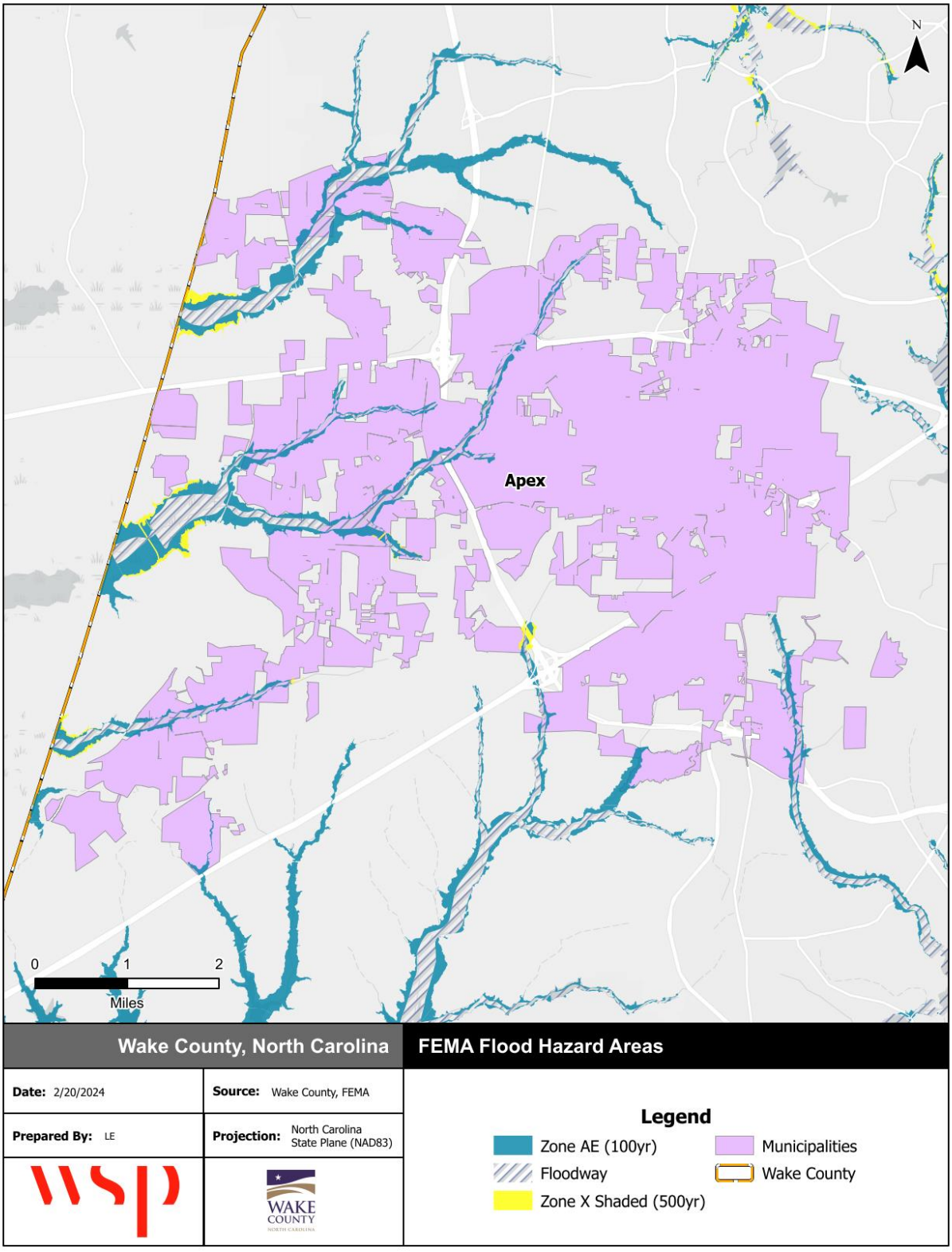
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $11.7 million in building related damages. The results of the Hazus loss estimate are summarized in Table C.5.

Table C.5 – HAZUS 100-Year Flood Results, Town of Apex

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	0	$0	$0	$0	$0	0%
Commercial	21	$5,134,000	$306,000	$1,127,000	$1,433,000	28%
Educational	0	$0	$0	$0	$0	0%
Government	0	$0	$0	$0	$0	0%
Industrial	6	$313,000	$65,000	$179,000	$244,000	78%
Religious	0	$0	$0	$0	$0	0%
Residential	75	$13,068,000	$6,635,000	$3,456,000	$10,091,000	77%
Total	**102**	**$18,515,000**	**$7,006,000**	**$4,762,000**	**$11,768,000**	**64%**

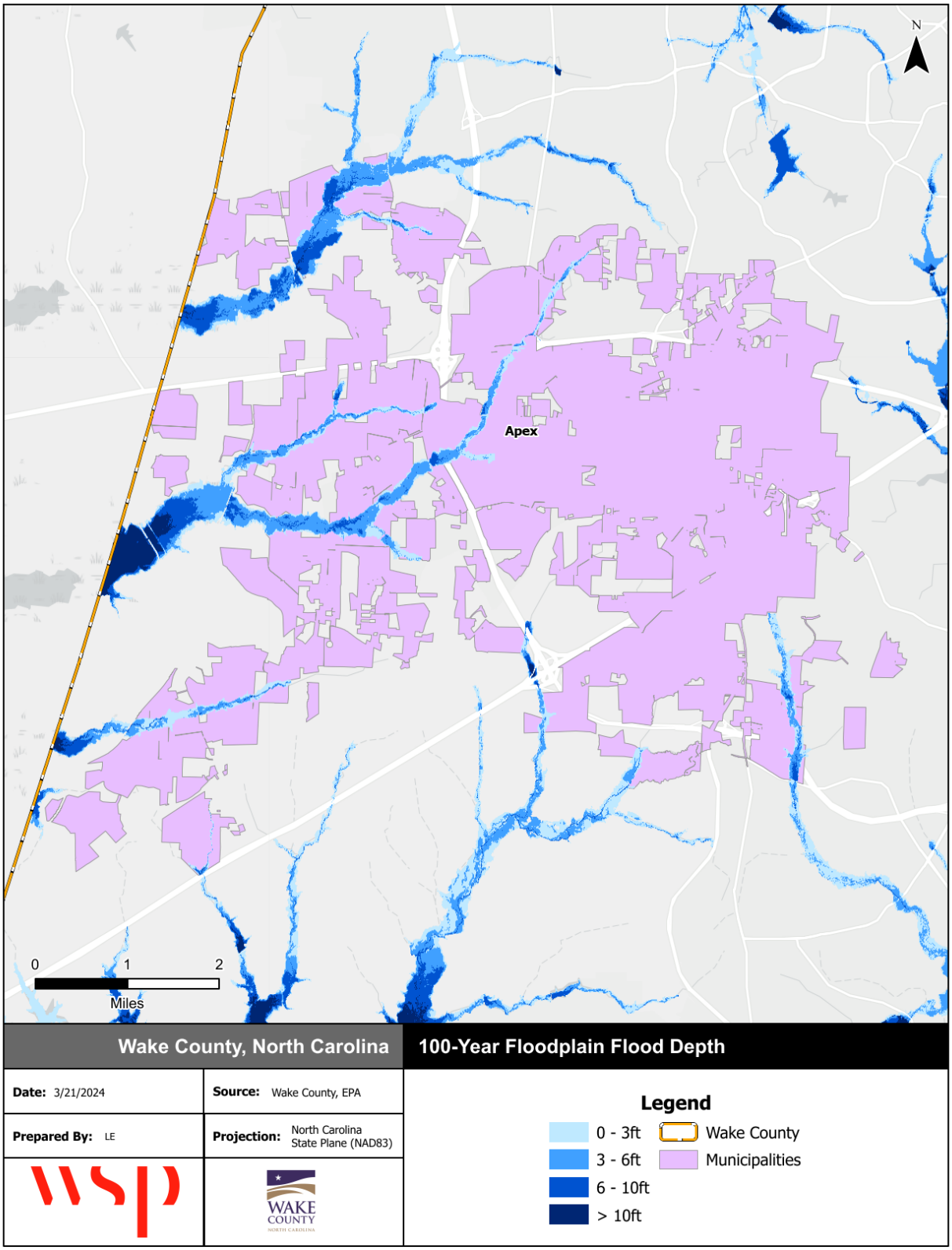
Source: FEMA Natural Hazards Risk Assessment Program

Figure C.3 – FEMA Flood Hazard Areas, Town of Apex



Source: FEMA Effective DFIRM

Figure C.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Apex



Source: FEMA Effective DFIRM

C.1.4 WILDFIRE

Table C.6 summarizes the acreage in the Town of Apex that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 20 percent of the Town of Apex is not included in the WUI.

Table C.6 – Wildland Urban Interface Acreage, Town of Apex

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	3,450.33	20.5%
	LT 1hs/40ac	1,725.59	10.3%
	1hs/40ac to 1hs/20ac	1,293.36	7.7%
	1hs/20ac to 1hs/10ac	1,476.03	8.8%
	1hs/10ac to 1hs/5ac	1,361.57	8.1%
	1hs/5ac to 1hs/2ac	1,243.99	7.4%
	1hs/2ac to 3hs/1ac	4,570.84	27.2%
	GT 3hs/1ac	1,697.14	10.1%
	Total	**16,818.84**	**100%**

Source: Southern Wildfire Risk Assessment

Figure C.5 depicts the WUI for the Town of Apex. Figure C.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure C.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in southern and western part of the Town of Apex; however, these areas, as with much of the town, have lower burn probability and are outside of the WUI. Much of the most densely developed area in the WUI have low to moderate fire intensity.

Table C.7 provides the count and estimated value of all structures that intersect with areas of the Town of Apex that are rated moderate to high on the WUI Risk Index.

Table C.7 – Structures at Risk to Moderate-High WUI Risk Index, Town of Apex

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	28	$37,682,863	$37,682,863	$75,365,726
Commercial	360	$600,015,005	$600,015,005	$1,200,030,010
Education	24	$206,808,376	$206,808,376	$413,616,752
Government	48	$129,053,344	$129,053,344	$258,106,688
Industrial	120	$317,841,179	$476,761,769	$794,602,948
Religious	59	$147,223,584	$147,223,584	$294,447,168
Residential	15754	$6,519,250,871	$3,259,625,436	$9,778,876,307
Total	**16,393**	**$7,957,875,222**	**$4,857,170,376**	**$12,815,045,598**

Source: Southern Wildfire Risk Assessment

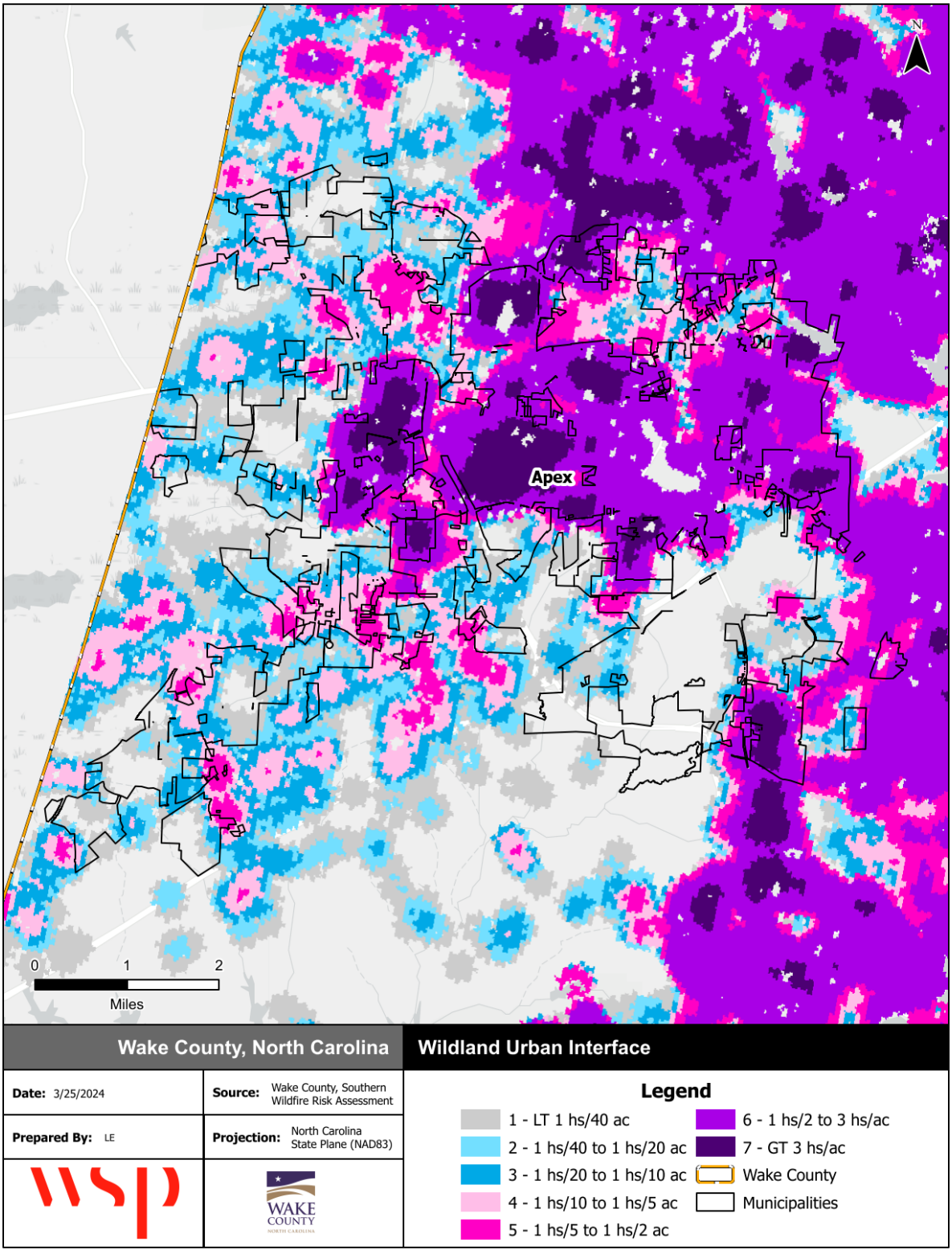
Table C.8 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table C.8 – Critical Facilities Exposed to Wildfire, Town of Apex

Type	Critical Facility Count	Structure Value
Communications	11	$27,465,960
Energy	26	$91,154,692
Food, Hydration, Shelter	11	$65,258,730
Hazardous Materials	47	$215,783,785
Health and Medical	44	$199,850,248
Safety and Security	40	$172,770,472
Transportation	2	$19,523,509
Water Systems	10	$2,549,528
Total	**191**	**$794,356,924**

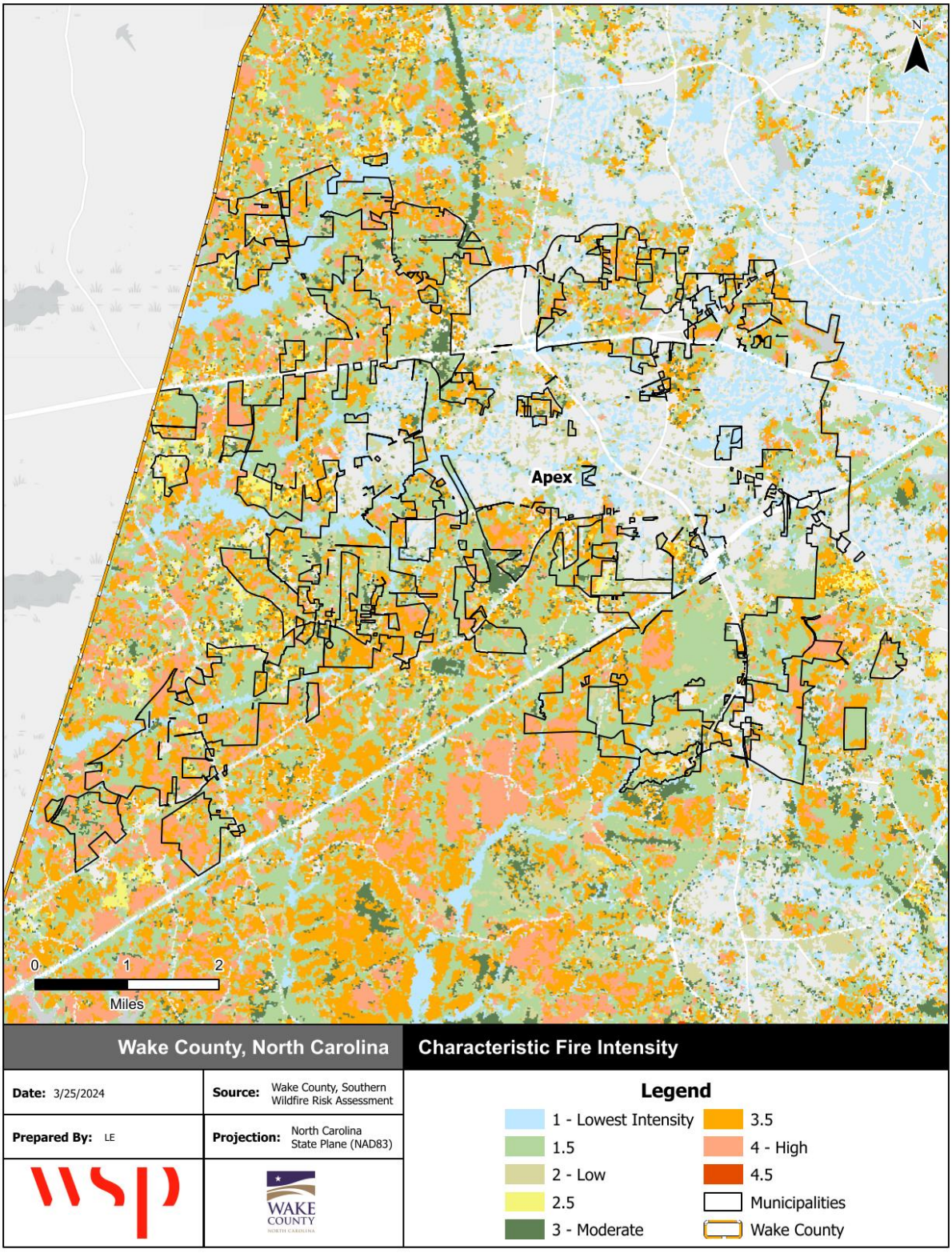
Source: Southern Wildfire Risk Assessment

Figure C.5 – Wildland Urban Interface, Town of Apex



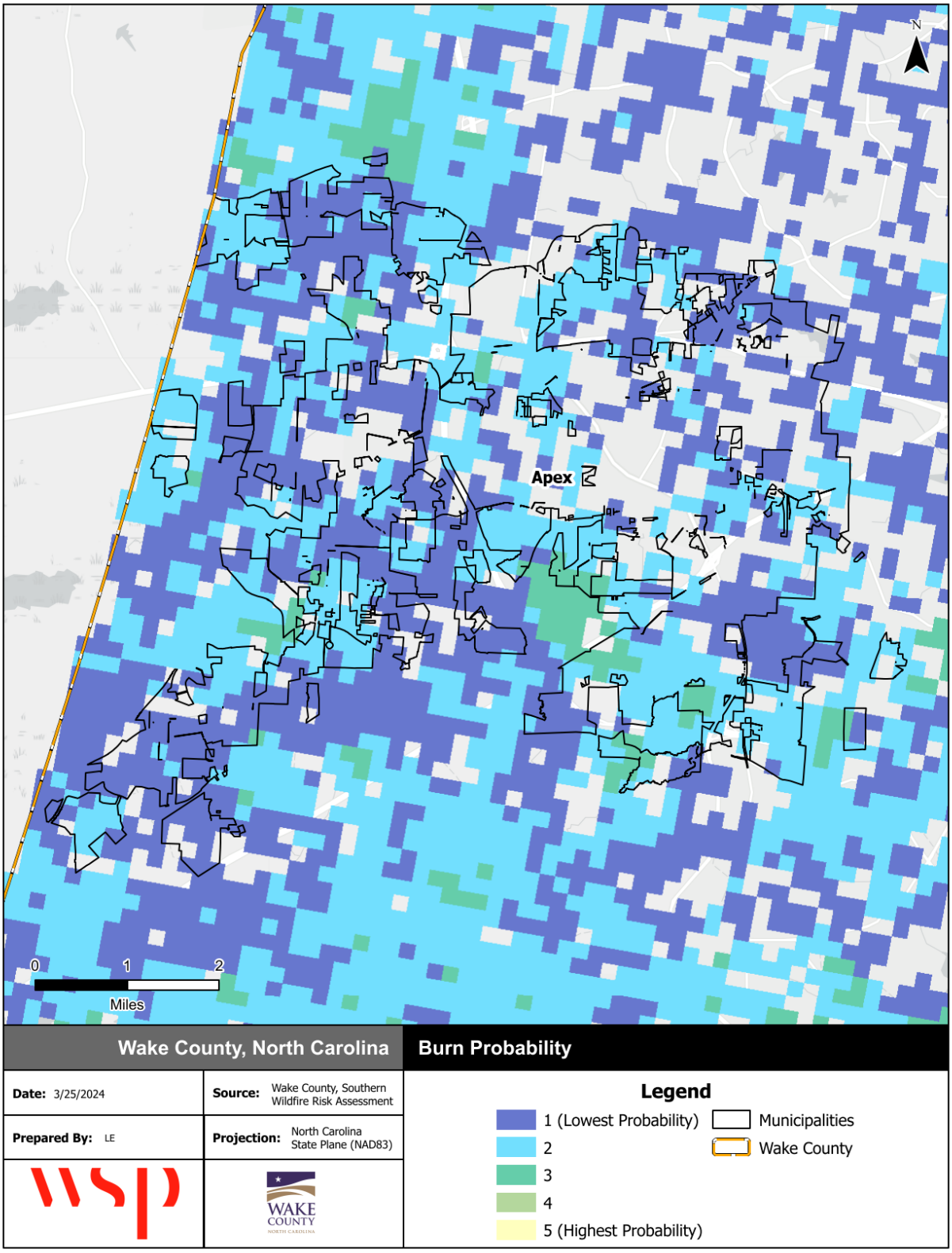
Source: Southern Wildfire Risk Assessment

Figure C.6 – Fire Intensity Scale, Town of Apex



Source: Southern Wildfire Risk Assessment

Figure C.7 – Burn Probability, Town of Apex



Source: Southern Wildfire Risk Assessment

C.2 MITIGATION STRATEGY

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Sanitary Sewer Condition Assessment	3	1	Flood, Hazardous Materials, Severe Weather	High	Water Resources	$400,000	Federal Grant	2-3 Years	New	Funding for a flow and visual infrastructure analysis.
P-2	Stormwater System Condition Assessment	3	1	Flood, Hurricane, Tornado, Severe Weather	High	Water Resources	$461,300	Town Funds; Federal Grant	2-3 Years	New	N/A
P-3	Assess equipment capacity for adverse weather response and disaster debris management.	2	1	Hurricane, Tornado, Severe Weather, Winter Storm	Moderate	Public Works	Staff Time	Town Funds	1-3 Years	New	N/A
Property Protection											
PP-1	Restore streams to slow the speed of water and reduce erosion to prevent both private property loss and public infrastructure damage.	3	2	Flood	Moderate	Water Resources (Director)	Over $500,000	Local & Federal	Ongoing - Next 5 years	In-Progress – Carry Forward	Evaluating Funding Opportunities
Natural Resource Protection											
NRP-1	Middle Creek Greenway (Miramonte to Holly Springs).	3	2	Flood; Evacuation	Moderate	Apex Parks and Recreation	$6.1 million	Town Funds	3-5 years	In-Progress – Carry Forward	Under construction
NRP-2	White Oak Creek Corridor Preservation & Maintenance study – including purchase of additional property near Wimberly Road Par	3	2	Flood; Evacuation	Moderate	Apex Parks & Recreation; Cary Parks & Recreation; Triangle Land Conservancy	Unknown	Apex Town Funds; Cary Town Funds; TLC Funds	3-5 years	In-Progress – Carry Forward	Purchased 1 parcel; negotiating the purchase of 2nd parcel; and final draft plan to be presented to the public in mid-2024
NRP-3	Beaver Creek Greenway (PHI, PHIA, & PHII)	3	2	Flood; Evacuation	Moderate	Apex Parks and Recreation	$14.5 million	Bond, Federal and Town	1-2 Years	In-Progress – Carry Forward	NCDOT releasing for bid and construction
NRP-4	Apex West Greenway	3	2	Flood; Evacuation	Moderate	Apex Parks and Recreation	$712,000	County and Town	1-2 Years	In-Progress – Carry Forward	USACOE permitting then Bid and Construction
NRP-5	Big Branch Greenway	3	2	Flood; Evacuation	Low	Apex Parks and Recreation	$8.45 million	Town Funds	5 Years	New	N/A
NRP-6	Reedy Branch Greenway (Abbington-Kelly Road West to Goliath Lane	3	2	Flood; Evacuation	Low	Apex Parks and Recreation	$3.3 million	Town Funds	5 years	New	N/A
NRP-7	Middle Creek Greenway (Gladstone North to Center Street)	3	2	Flood; Evacuation	Low	Apex Parks and Recreation	$4.6 million	Town Funds	5+ years	New	N/A

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Structural Projects											
SP-1	Improve communications abilities for emergency response by building new fiber optic internet infrastructure and replacing current radio systems. Set up dedicated fiber connections to Cary for their radios. 3-5 years from replacing radios for PD, Fire & PW.	2	1	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Police Dept; Fire Dept; Public Works; Information Technology	$915,000	Town Funds	3-5 years	Carry Forward – In Progress	Partway done.
SP-2	GPS Emergency Vehicle Preemption - allow emergency vehicles to interrupt normal traffic signal timing during an emergency	2	1	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$660,000	Town Funds	3-5 years	New	N/A
SP-3	Jessie Drive Phase 1 - Build Jessie Drive to connect Ten Ten Rd future Production Dr.	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$11.5 million	Town Funds	3-5 years	Carry Forward – Not Started	Separated phases into 2 items; Preparing to conduct property appraisals in advance of land acquisition; Public Open House held on May 20, 2024.
SP-4	Jessie Drive phase 2 - Build Jessie Drive to connect future Production Dr. and NC-55	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$11.5 million	Town Funds	More than 5 Years	Carry Forward – Not Started	Feasibility study complete, no final design.
SP-5	Finish the SW Peakway loop connector road	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	High	Transportation & Infrastructure Development	$30 million	Town Funds	3-5 years	Carry Forward – In Progress	Awaiting NCDOT approval of signal plans; Under Construction as of Dec. 2024
SP-6	Finish SE Peakway Loop connector road	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	High	Transportation & Infrastructure Development	$27.3 million	Town Funds	More than 5 years	Carry Forward – In Progress	Feasibility study complete; final design not yet funded

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
SP-7	Justice Heights St. Extension	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	High	Transportation & Infrastructure Development	$750,000 - 1 million	Town Funds	1-2 years	New	Design in review. Environmental permitting in progress. Public open house anticipated in June/July
SP-8	Apex Peakway North Widening (Center St to Old Raleigh Rd)- widen from a 2- to 4-lane road to handle congestion.	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$5.75 million	Town Funds	2 years	New	N/A
SP-9	Pristine Water Drive Connector (Pristine Water Dr. to Lufkin Rd)	3	2	All - provide greater connectivity, faster emergency response times, and faster & safer evacuation.	Moderate	Transportation & Infrastructure Development	$3.5 million	Town Funds	2-3 years	New	N/A
SP-10	Construct Electric Substation #4 for North West Side of town (Jenks Rd/Hwy 64). This will allow systems redundancy in the event of major damages.	3	2	All Hazards	Moderate	Electric Department (Electric Utilities Director)	$5 million	Town Funds	Ongoing – Next 5 years	Carry Forward – In Progress	Working on land acquisition
SP-11	Upgrade the East Williams St. Substation - Add two 40 MVA Power Transformers	3	1	All Hazards	Moderate	Electric Department (Electric Utilities Director)	$1.8 million	Town Funds	5+ years	New	N/A
SP-12	Construct new feeder lines in strategic locations to tie electric substations together & move power around town during emergencies.	3	1	All Hazards	Moderate	Electric Department (Electric Utilities Director)	$200,000	Town Funds	1-2 years	New	Beginning design
SP-13	Determine temporary storage site during for debris removal during disaster or storm cleanup	3	2	Hurricane, Tornado, Severe Weather	Moderate	Public Works	$500,000	Town Funds	2-5 year	Carry Forward – In Progress	Beginning negotiations
SP-14	Change location of the backup data disaster recovery site.	2	1	All: reduces risk of data loss during a disaster	Moderate	Information Technology	$250,000	Town Funds	1-2 year	Carry Forward – In Progress	Completed once; reviewing a new move
SP-15	Stream relocation in Nature Park to prevent impact on sewer line.	3	2	Flood	Moderate	Water Resources (Stormwater)	$690,000	Town Funds & NCLWF Grant	More than 5 years	Carry Forward – In Progress	Currently in design
SP-16	New 1.5 MG Water Tower (Pleasant Park)	3	1	Drought, All Hazards	High	Water Resources	$8.6 million	Town Funds & ARPA Funds	1-2 years	New	Currently in the surveying & design process

Town of Apex											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Emergency Services											
ES-1	Construct Public Safety Station #7 (Olive Chapel Road and Richardson Road Area)	3	2	All Hazards	Moderate	Apex Fire Dept.	$10.7 million	Town Funds	5+ years	Carry Forward – In Progress	Location being evaluated.
ES-2	Relocate Fire Department Administration from its existing location to Station 1 because of the impacts of widening NC-55.	3	1	All Hazards	Moderate	Apex Fire Dept.	$6.5 million	Town Funds	2-5 years	Carry Forward – In Progress	No progress to report
ES-3	Fire Station 3 Renovation	3	2	All Hazards	Moderate	Apex Fire Dept.	$3.5 million	Town Funds	2-5 years	New	N/A
ES-4	Police Department Addition & Renovation – add office space	3	2	All Hazards	Moderate	Apex Police Dept.	$6.6 million	Town Funds	5+ years	New	N/A
ES-5	Public Safety Station 8	3	1	All Hazards	Moderate	Apex Fire Dept.	$11 million	Town Funds	5+ years	New	N/A
ES-6	Create a town wide plan for staging and distribution of resources and emergency services – location would need to be near a large park or similar	2	2	All Hazards	Moderate	Apex Fire Dept. & Apex Parks & Recreation	$500,000	Town Funds	2-5 years	Carry Forward – In Progress	No progress to report
ES-7	Camera Project in downtown & Town Campus	2	2	All Hazards	Moderate	Apex Fire Dept, Apex Police Dept & IT	$950,000	Town Funds	2-5 years	New	N/A
Public Education and Awareness											
PEA-1	Include Environment Education Station and classroom at Nature Park.	1	1	All	Moderate	Apex Parks and Recreation	$5.2 million	Town Funds	3-5 years	In-Progress – Carry Forward	Looking for funding options.
PEA-2	Post warning signage at local parks for lightning.	1	1	Severe Weather	Low	Apex Parks and Recreation	$15,000	Town Funds	3-5 years	In-Progress – Carry Forward	No progress to report

D. TOWN OF CARY

D.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Cary. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Cary. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

D.1.1 CRITICAL FACILITIES

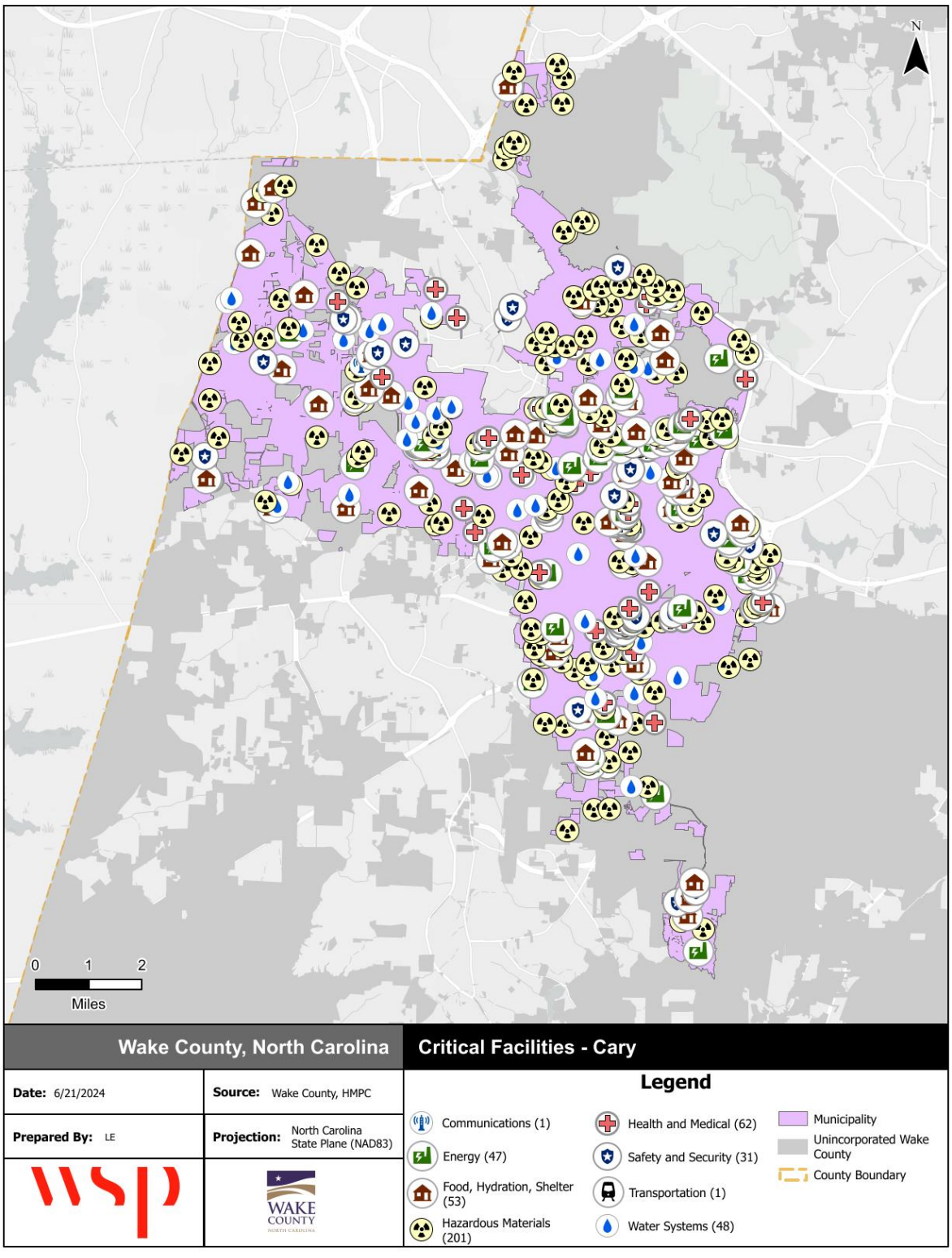
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table D.1 provides a count of critical facilities by FEMA lifeline category within the Town of Cary. Figure D.1 shows the locations of all critical facilities within the Town of Cary.

Table D.1 – Critical Facilities by Type, Town of Cary

Facility Type	Count of Facility Type	Structure Value
Communications	1	$0
Energy	47	$68,084,642
Food, Hydration, Shelter	17	$134,179,214
Hazardous Materials	206	$1,838,823,686
Health and Medical	62	$620,212,500
Safety and Security	30	$512,052,941
Transportation	1	$133,593,267
Water Systems	52	$273,464,475
Total	**416**	**$3,580,410,725**

Source: Wake County, HMPC

Figure D.1 – Town of Cary Critical Facilities

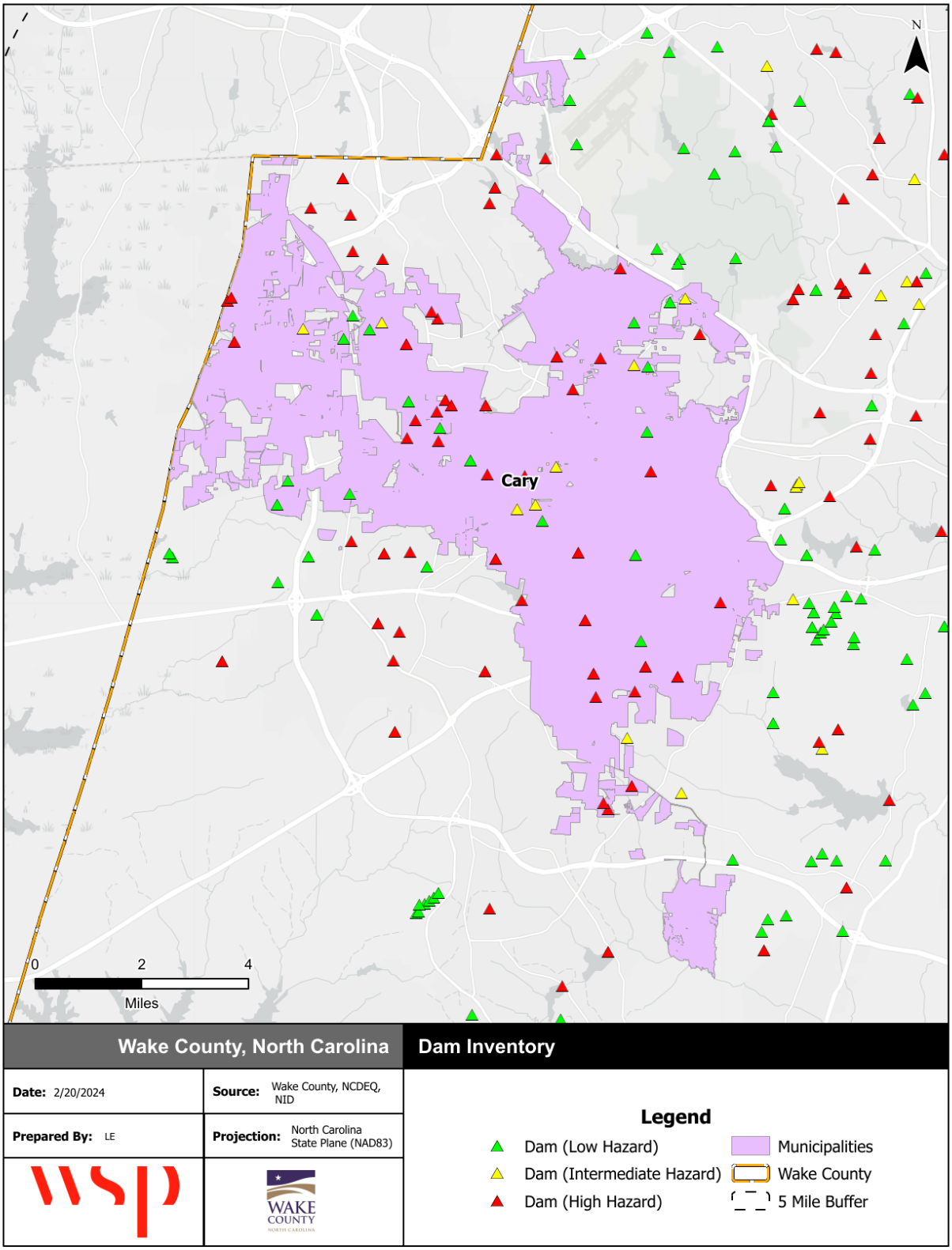


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

D.1.2 DAM FAILURE

Currently, the Town of Cary has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure D.2 shows the location of all dams in the Town of Cary.

Figure D.2 – Dam Inventory, Town of Cary



Source: North Carolina Dam Inventory, February 2024

D.1.3 FLOOD

Table D.2 details the acreage of the Town of Cary total area by flood zone on the effective DFIRM. Per this assessment, over 7 percent of the Town of Cary falls within the mapped 1%-annual-chance floodplains.

Table D.2 – Flood Zone Acreage in the Town of Cary

Flood Zone	Acreage	Percent of Total (%)
Zone A	1.8	0.004
Zone AE	3,041.7	7.9
Zone X (500-year)	107.1	0.3
Zone X Unshaded	35,139.3	91.8
Total	**38,289.9**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure D.3 reflects the effective mapped flood hazard zones for the Town of Cary, and Figure D.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table D.3 provides building counts and values for critical facilities by flood zone in the Town of Cary.

Table D.3 – Critical Facilities Exposed to Flooding, Town of Cary

Flood Zone	Critical Facility Count	Structure Value
AE	47	$789,469,512
X	368	$2,785,377,270
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	1	$5,563,943
Total	**416**	**$3,580,410,725**

Source: FEMA Effective DFIRM

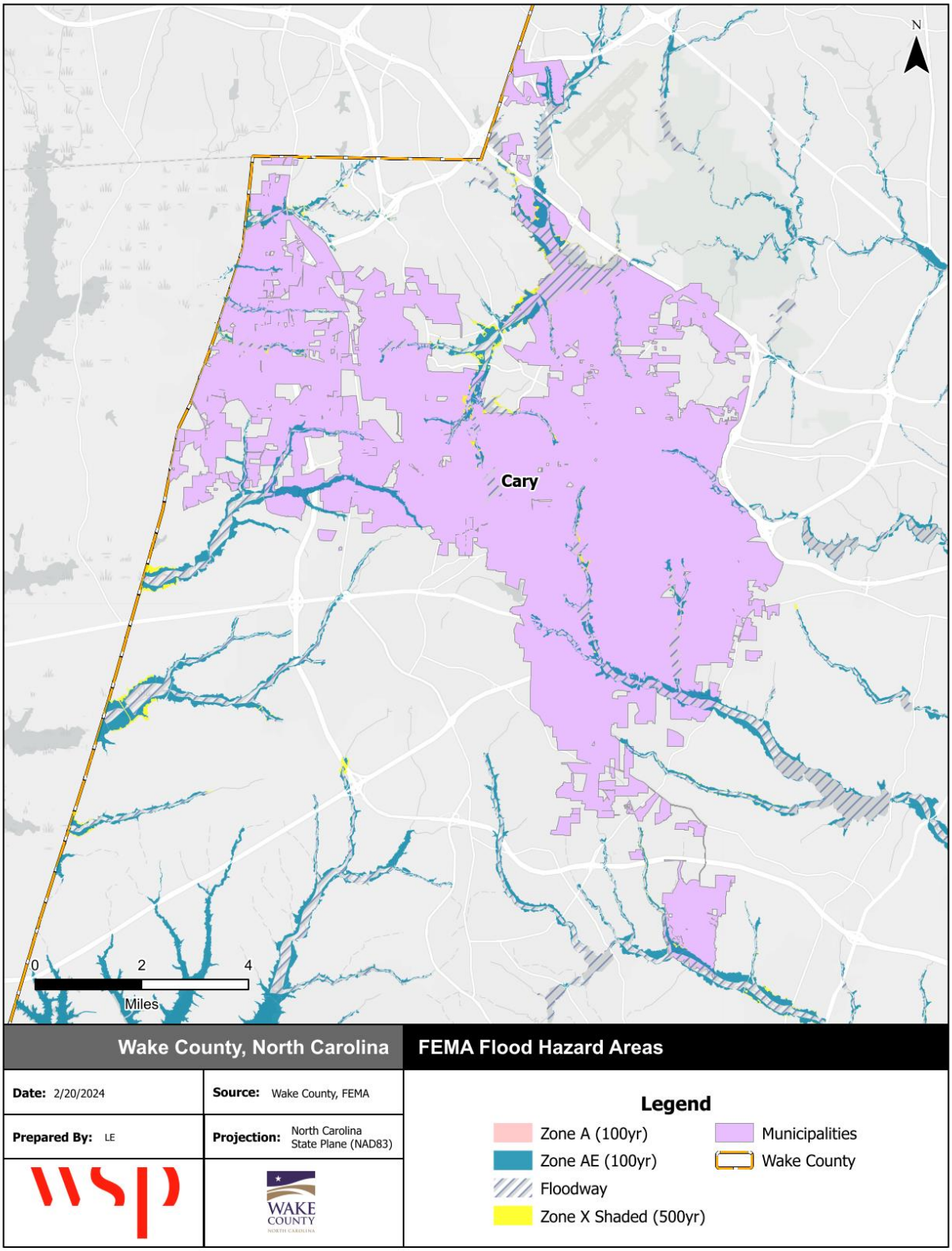
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $67,000 in building related damages. The results of the Hazus loss estimate are summarized in Table D.4.

Table D.4 – HAZUS 100-Year Flood Results, Town of Cary

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	8	$515	$51	$170	$221	43%
Commercial	84	$58,022	$4,505	$14,139	$18,644	32%
Educational	10	$2,787	$139	$830	$969	35%
Government	3	$808	$15	$105	$120	15%
Industrial	39	$3,813	$1,088	$2,057	$3,145	82%
Religious	10	$897	$47	$352	$399	44%
Residential	193	$61,533	$28,661	$15,762	$44,423	72%
Total	**347**	**$128,375**	**$34,506**	**$33,415**	**$67,921**	**53%**

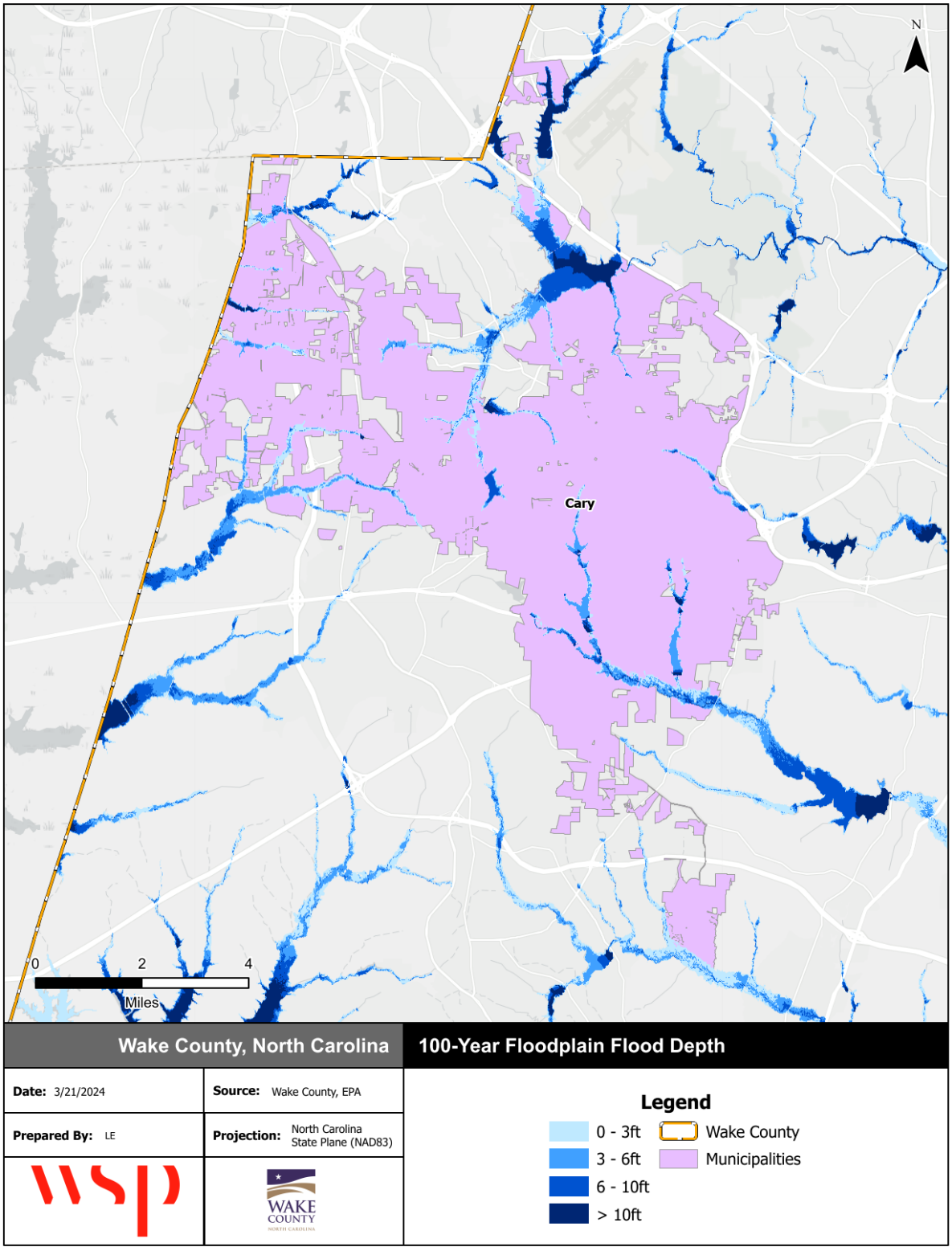
Source: FEMA Natural Hazards Risk Assessment Program

Figure D.3 – FEMA Flood Hazard Areas, Town of Cary



Source: FEMA Effective DFIRM

Figure D.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Cary



Source: FEMA Effective DFIRM

D.1.4 WILDFIRE

Table D.5 summarizes the acreage in the Town of Cary that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 12 percent of the Town of Cary is not included in the WUI.

Table D.5 – Wildland Urban Interface Acreage, Town of Cary

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	4,772.92	12.5%
	LT 1hs/40ac	1,158.14	3.0%
	1hs/40ac to 1hs/20ac	949.71	2.5%
	1hs/20ac to 1hs/10ac	1,328.23	3.5%
	1hs/10ac to 1hs/5ac	1,474.12	3.8%
	1hs/5ac to 1hs/2ac	2,645.71	6.9%
	1hs/2ac to 3hs/1ac	21,868.33	57.1%
	GT 3hs/1ac	4,068.38	10.6%
	Total	**38,265.54**	**100%**

Source: Southern Wildfire Risk Assessment

Figure D.5 depicts the WUI for the Town of Cary. Figure D.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure D.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in west and northeast Cary; while these areas are within the WUI, these areas have lower burn probability. Because these areas fall within the WUI, there is development potentially at risk to wildfire.

Table D.6 provides the count and estimated value of all structures that intersect with areas of the Town of Cary that are rated moderate to high on the WUI Risk Index.

Table D.6 – Structures at Risk to Moderate-High WUI Risk Index, Town of Cary

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	23	$5,039,494	$5,039,494	$10,078,988
Commercial	1116	$3,179,564,684	$3,179,564,684	$6,359,129,368
Education	114	$853,097,093	$853,097,093	$1,706,194,186
Government	157	$422,454,168	$422,454,168	$844,908,336
Industrial	136	$237,096,864	$355,645,296	$592,742,160
Religious	128	$410,224,372	$410,224,372	$820,448,744
Residential	48433	$24,491,314,762	$12,245,657,381	$36,736,972,143
Total	**50,107**	**$29,598,791,437**	**$17,471,682,488**	**$47,070,473,925**

Source: Southern Wildfire Risk Assessment

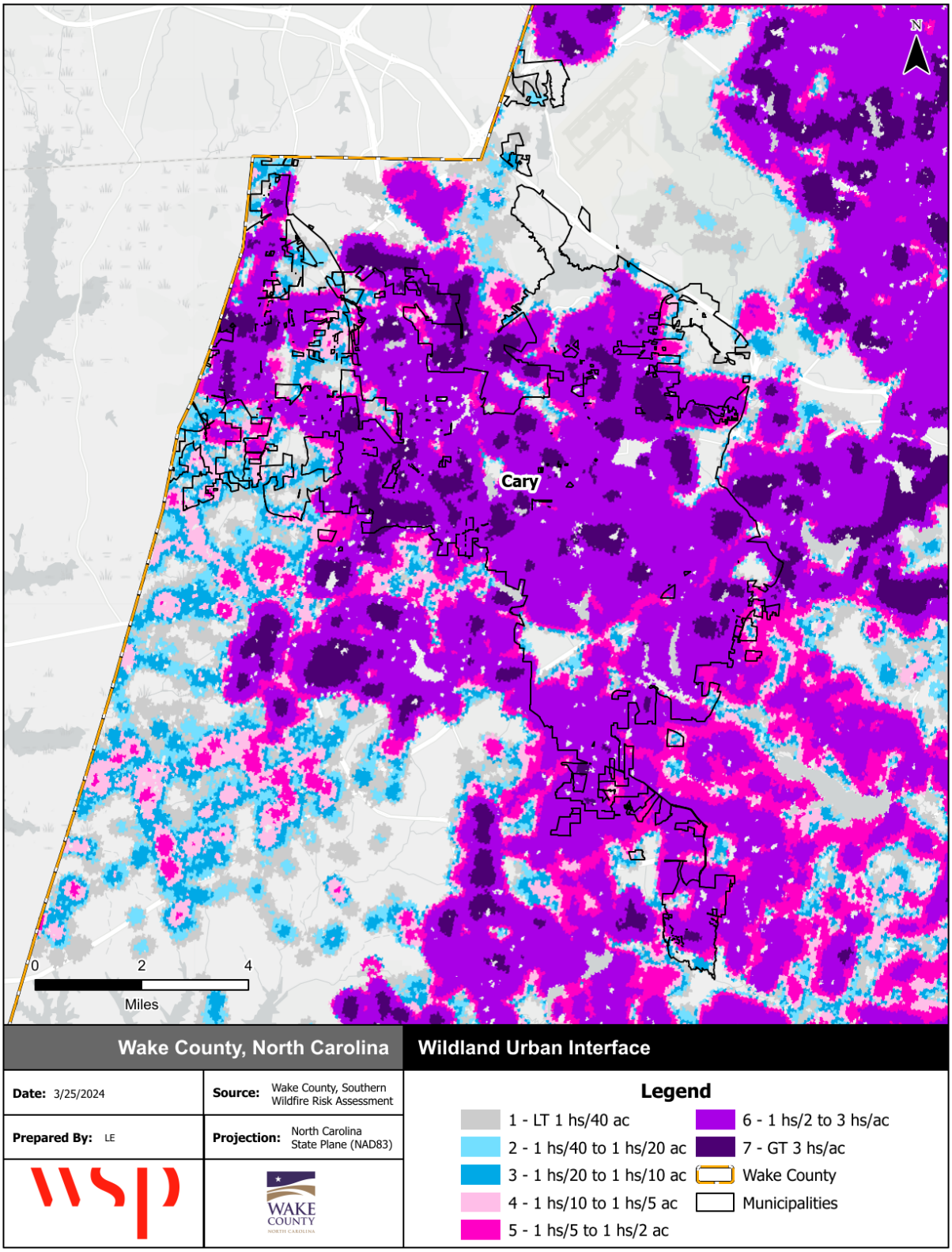
Table D.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table D.7 – Critical Facilities Exposed to Wildfire, Town of Cary

Type	Critical Facility Count	Structure Value
Communications	1	$0
Energy	40	$51,425,418
Food, Hydration, Shelter	14	$121,467,478
Hazardous Materials	136	$1,393,389,996
Health and Medical	57	$609,314,312
Safety and Security	29	$508,614,175
Transportation	1	$133,593,267
Water Systems	45	$155,815,027
Total	**323**	**$2,973,619,673**

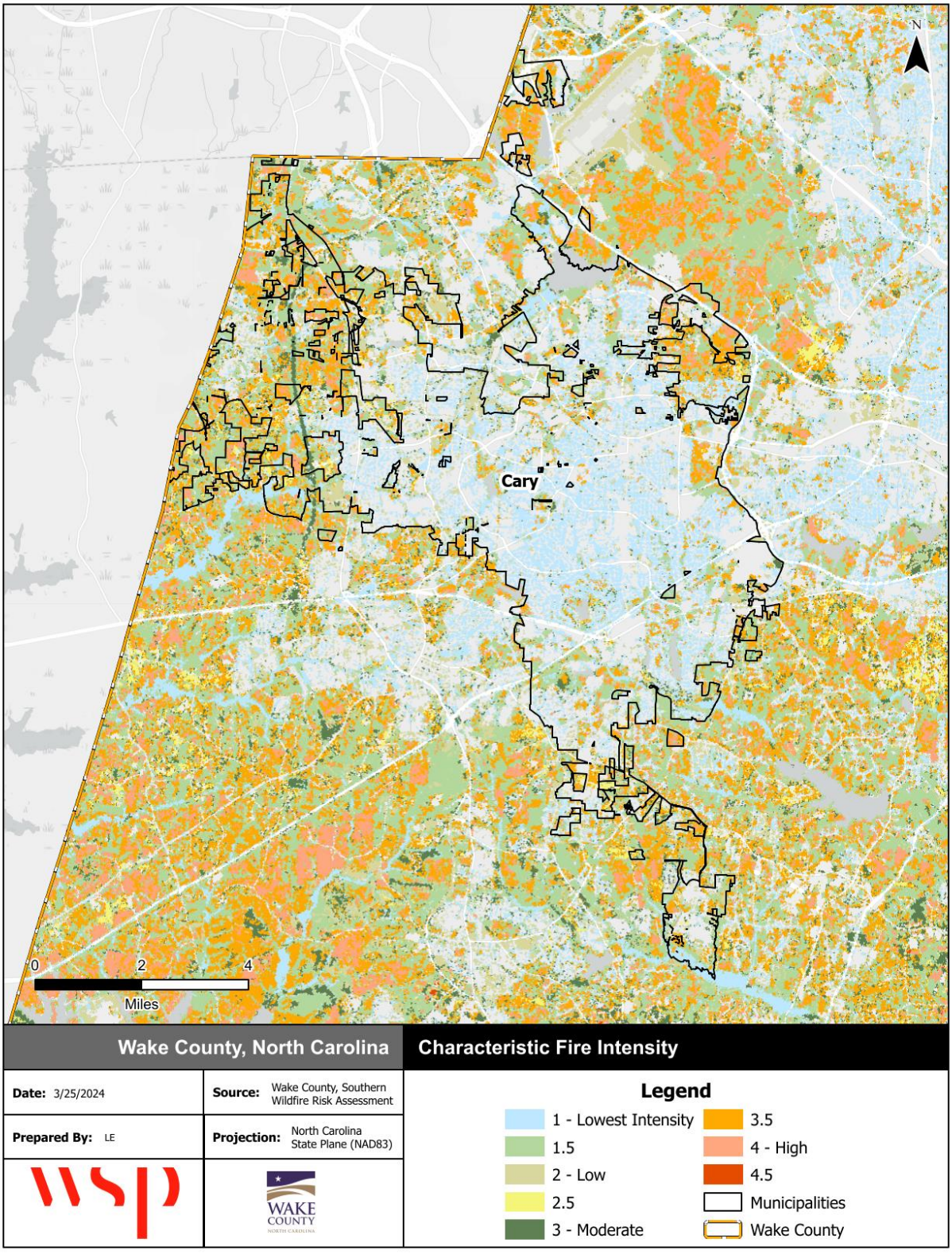
Source: Southern Wildfire Risk Assessment

Figure D.5 – Wildland Urban Interface, Town of Cary



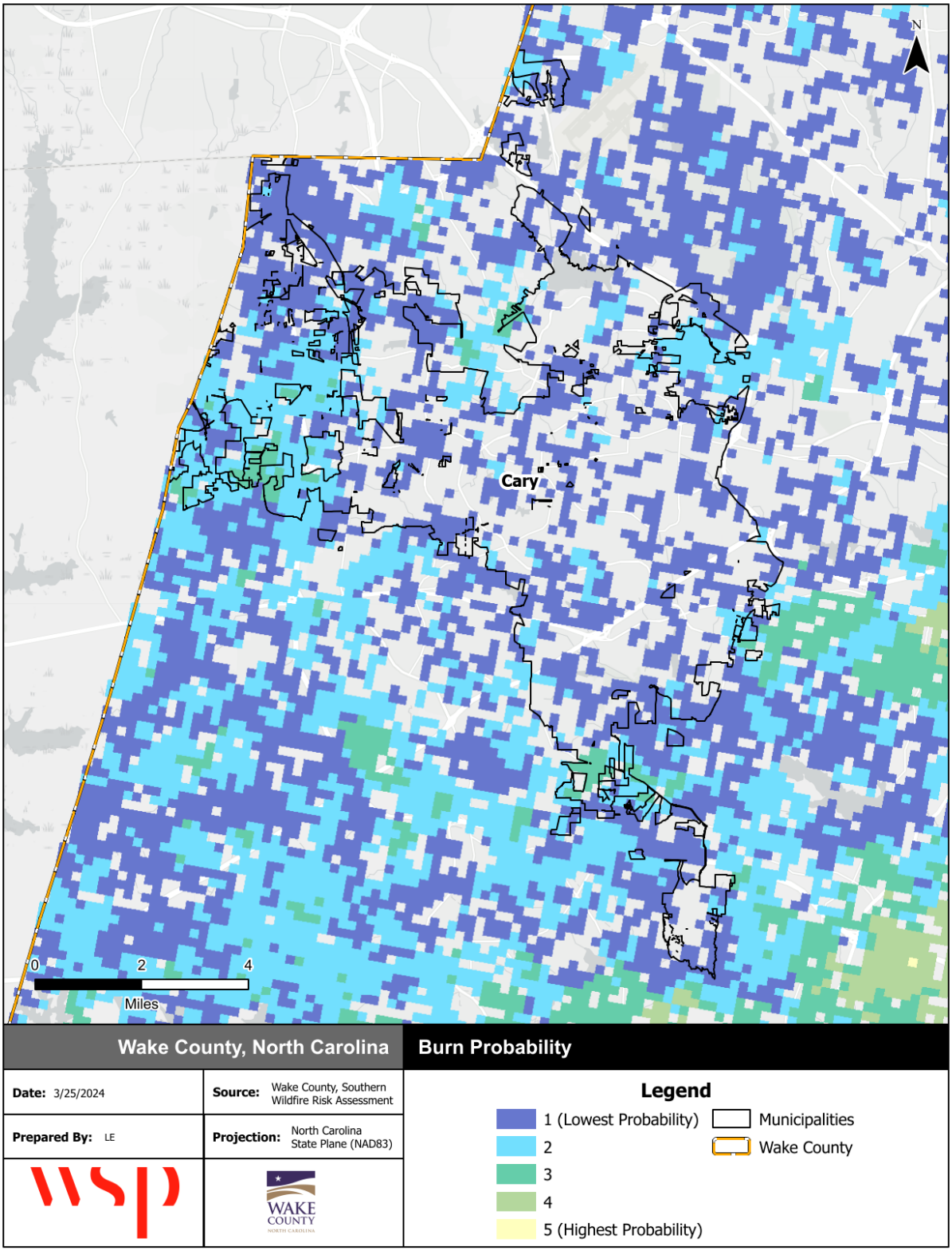
Source: Southern Wildfire Risk Assessment

Figure D.6 – Fire Intensity Scale, Town of Cary



Source: Southern Wildfire Risk Assessment

Figure D.7 – Burn Probability, Town of Cary



Source: Southern Wildfire Risk Assessment

D.2 MITIGATION STRATEGY

Town of Cary											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Town's Comprehensive Plan- The Town has an existing comprehensive plan which includes land use, parks and recreation, open space, transportation, utilities, and environment.	4	2	All	High	Cary Planning	$1M for plan development; implementation ongoing	General Fund	2-3 years	In-Progress – Carry Forward	This is Cary's 2040 Comprehensive Plan. The plan will continue to be updated as new master plans and specialized plans are complete.
P-2	Adaptive Approach to Stormwater	4	1	Flood	High	Cary Stormwater	$900,000	General Fund and $300K Grant	Ongoing	In-Progress – Carry Forward	Multi-pronged approach including 5 key components: 1) Working Group of residents and local experts to learn and advise 2) Maintenance, including Condition Assessment (a separately listed "action") 3) Open Space, examining how open space and tree canopy provide stormwater benefits 4) Model, hiring a firm to build a dynamic rainfall-runoff model to establish a baseline and test solutions and scenarios 5) Ordinance, looking at the stormwater ordinance as a way to achieve our risk mitigation goals.
P-3	Stormwater Condition Assessment Program	4	2	Flood	High	Cary Stormwater	$750,000	General Fund	2-3 years	In-Progress – Carry Forward	In phase 4, (1-GIS Assessment Tool, 2-GIS Mapping Data and assessment, 3-Modeling, 4-Maintenance) Assessment Tool completed. GIS Mapping 99% completed.
P-4	Develop flood model for upper Swift Creek watershed	2	2	Flood, Hurricane	High	Cary Stormwater	$1.2 Million	Town Funds and Grants	2 years	In-Progress – Carry Forward	1st phase complete, but additional phases added, and grant funding acquired. Additional phases are underway.
P-5	Conduct study and develop improvement plan for Twin Lakes dam	2	2	Dam Failure	High	Cary Stormwater	$5 Million	Town Funds	2 years	In-Progress – Carry Forward	In progress; permitting with Dam Safety
P-6	Participant & collaborator for Neuse Basin Flood Resiliency Blueprint	4	2	Flood	High	NC DEQ	No Cost	N/A	2 years	New	Working with local stakeholders, interagency partners, academics, and technical experts, DEQ's Division of Mitigation Services plans a comprehensive approach to identify problems, address barriers, and prioritize solutions to increase community resilience to flooding throughout North Carolina's River basins.
P-7	CRS membership	2	2	Flood	High	Cary Stormwater	Unknown	Town Funds	1 year	New	Seeking membership in CRS
Property Protection											
PP-1	Lake Pine and Brookgreen culvert replacements	3	1	Flood	High	Cary Stormwater	$4 million	General Fund	2 years	New	Culvert replacement project that will reduce flooding upstream of Kildaire Farm Lake within the Swift Creek Watershed
PP-2	Cedar Street Drainage Improvements	3	1	Flood	High	Cary Stormwater	$600,000	General Fund	1 year	New	Retrofits to aging stormwater network to reduce both structural flooding and flooding of Cedar St.

Town of Cary											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PP-3	Meridian Regional Wetland SCM	3	1	Flood	High	Cary Stormwater and Private Developer	$750,000	General Fund/Private Funds	2 years	New	Public-Private partnership to construct regional wetland device within swift creek watershed and retrofit outfalls to mitigate historical flooding of downstream structures
PP-4	Walnut Creek Floodplain Buyout	3	2	Flood	High	Cary Stormwater	$10 million	General Fund	3 years	New	Town initiative to purchase flood prone properties within the Walnut Creek corridor for demolition and open space restoration
Natural Resource Protection											
NRP-1	Buffer and UTB Protection	3	2	Flood	High	Cary Stormwater and Cary Planning	Over $10,000,000	Private (Developer) Funds	Ongoing - Next 5 Years	In-Progress – Carry Forward	Extra 50-foot buffer (UTB) on USGS streams; no buffers platted in lots.
NRP-2	Urban Park Bioretention Filtration Conveyance (BFC)	3	1	Flood	Moderate	Cary Stormwater	$300,000	General Funds	2-3 Funds	New	GSI installation and retrofit to improve water quality and reduce peak flows into Walnut Creek.
NRP-3	Lions Park BFC	3	1	Flood	Moderate	Cary Stormwater	$300,000	General Funds	2-3 Funds	New	GSI installation and retrofit to improve water quality and reduce peak flows into Swift Creek.
Structural Projects											
SP-1	Update Water Shortage Response Plan	2	4	Drought	High	Town of Cary	Staff Time	N/A	1 year	In-Progress – Carry Forward	No progress to report
SP-2	Water System Risk Analysis	3	1	All	High	Town of Cary	$89,000	General Fund	Ongoing - 1 Year	In-Progress – Carry Forward	The Water System Risk Analysis is a comprehensive look at the risks to our water system. It is being done to comply with the American Water Infrastructure Act of 2018. It will result in a new emergency response plan for our water system.
SP-3	Woodland Drive Culvert Replacement	3	2	Flood	Moderate	Cary Stormwater	$225,000	General Fund	2 years	New	Culvert replacement to replace undersized/old culvert and mitigate upstream flooding within Crabtree Watershed
Emergency Services											
ES-1	Provide and enhance technical rescue capabilities throughout the Town.	2	1	All	High	Cary Fire	Unknown	Local	Ongoing – initiative for preparation	In-Progress – Carry Forward	Cary's Fire Department has a technical rescue training program that we coordinate with Morrisville and Apex, NC. We train on all disciplines of technical rescue.
ES-2	Provide after-action report of emergency response to severe weather events in order to improve planning for future disasters.	2	2	All	High	Cary Fire, Water Resources, and Facilities Design & Transportation Services	Unknown	General Fund	Ongoing – initiative for preparation	In-Progress – Carry Forward	Cary's key emergency response departments have formal after-action meetings to learn from what went well and seek opportunities to improve. This occurs after each event, so is ongoing in nature.

Town of Cary											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-3	Establish a relationship/partnership with the Renaissance Computing Institute (RENCI) to create a web-based tool capable of providing real-time flood data to emergency managers and historic data for future emergency response planning.	2	2	All	Low	Cary Fire and Technology Services	Unknown	General Fund	Ongoing – Next 5 Years	In-Progress – Carry Forward	Efforts for developing a dedicated Public Safety IT division are ongoing.
ES-4	Partnership with FBI Terrorism Task Force	2	2	Terrorism	Moderate	Town of Cary, Town of Cary Police	$100,000	General Fund	Ongoing – Next 5 Years	In-Progress – Carry Forward	Since 2011 the Town of Cary Police have an officer assigned full time to the FBI Terrorism Task Force to maintain a relationship with the FBI. FBI Terrorism Task Force located in the FBI Raleigh Office located in the Town of Cary off Cary Parkway near US 1. Wake County Emergency Management has a plan for large scale events that impact Wake County. Those plans include guidance for law enforcement as part of a multi-agency response to all sorts of issues that could include the unlikely event of a terrorist attack.
ES-5	Inclement Weather Response Plan	2	1	Severe Winter Storm, Thunderstorm, Hurricane	Moderate	Town of Cary, Town of Cary Public Works	$100,000 - $1 Million (depending on number and type)	General Fund	Ongoing – Next 5 Years	In-Progress – Carry Forward	Cary commits significant Town-wide resource allocations and operational commitment to ensure all aspects of Adverse Weather events are planned, executed, and reviewed to maximize positive recovery outcomes for its citizens. The Town has similar structure and programs in place to address thunderstorm or wind events.
Public Education and Awareness											
PEA-1	Environmental Education "green infrastructure" signage on Dry Avenue Properties that were bought out due to flooding. Signs to be installed early 2019	1	1	Flood	Low	Cary Stormwater and Sustainability	$11,000	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Updated/expanded from 2019
PEA-2	Citizen volunteers make up the Community Emergency Response Team (CERT). CERT training is a Citizens Corps program designed to enable citizens to care for themselves and their neighbors during the first three days following a disaster event. Participants are educated about disaster preparedness, CERT organization, light search and rescue, medical care, fire extinguisher use and disaster psychology.	1	2	All	Moderate	Cary Police Department and Fire Department	$1,000/year	Donations	Ongoing - Next 5 Years	In-Progress – Carry Forward	Fire and Police have staff that perform education for citizens and businesses in Town.

E. TOWN OF FUQUAY-VARINA

E.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Fuquay-Varina. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Fuquay-Varina. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

E.1.1 CRITICAL FACILITIES

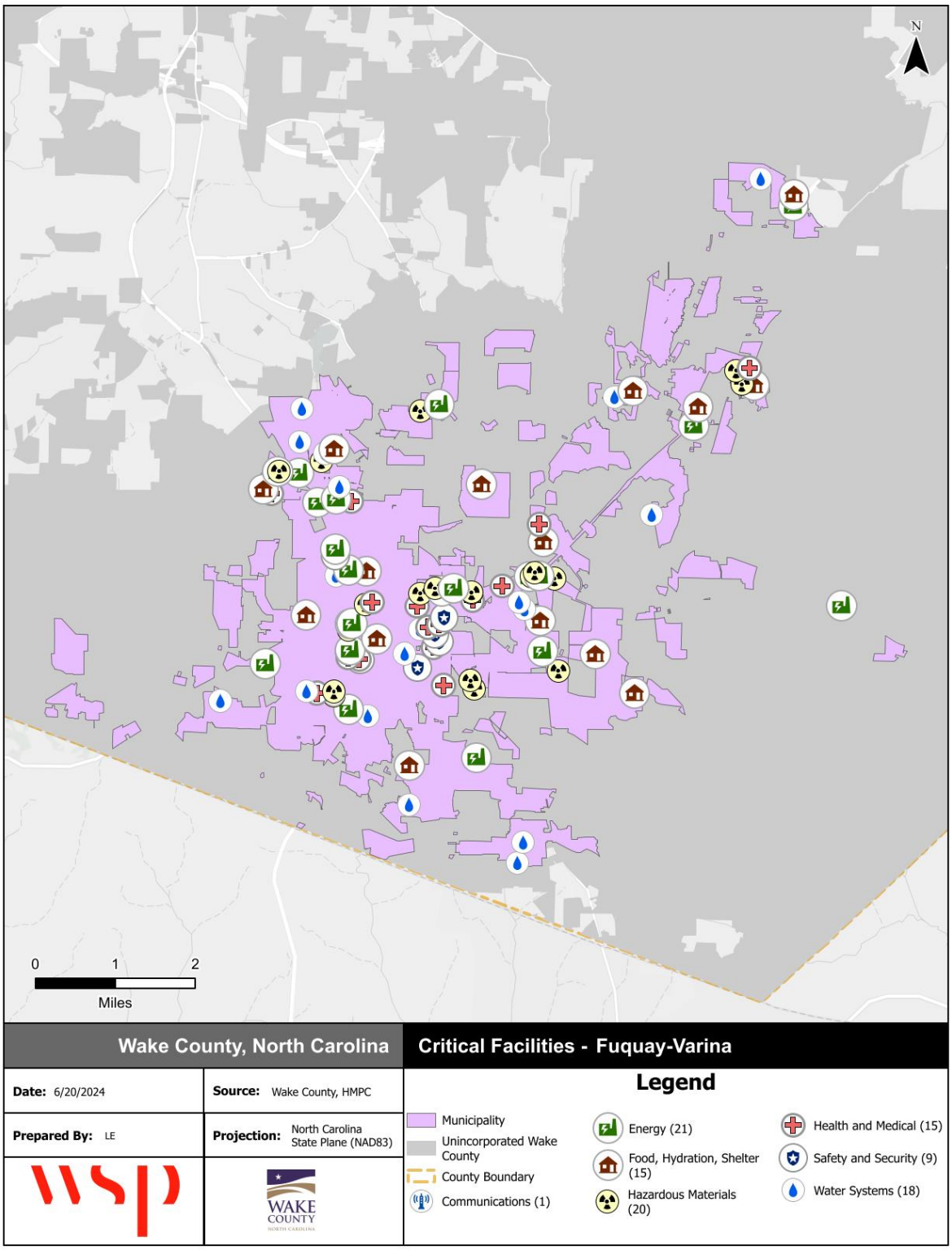
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table E.1 provides a count of critical facilities by FEMA lifeline category within the Town of Fuquay-Varina. Figure E.1 shows the locations of all critical facilities within the Town of Fuquay-Varina.

Table E.1 – Critical Facilities by Type, Town of Fuquay-Varina

Facility Type	Count of Facility Type	Structure Value
Communications	1	$0
Energy	26	$15,241,505
Food, Hydration, Shelter	7	$40,510,553
Hazardous Materials	37	$91,091,657
Health and Medical	16	$24,876,463
Safety and Security	11	$108,384,409
Transportation	0	$0
Water Systems	45	$15,979,741
Total	**143**	**$296,084,328**

Source: Wake County, HMPC

Figure E.1 – Town of Fuquay-Varina Critical Facilities

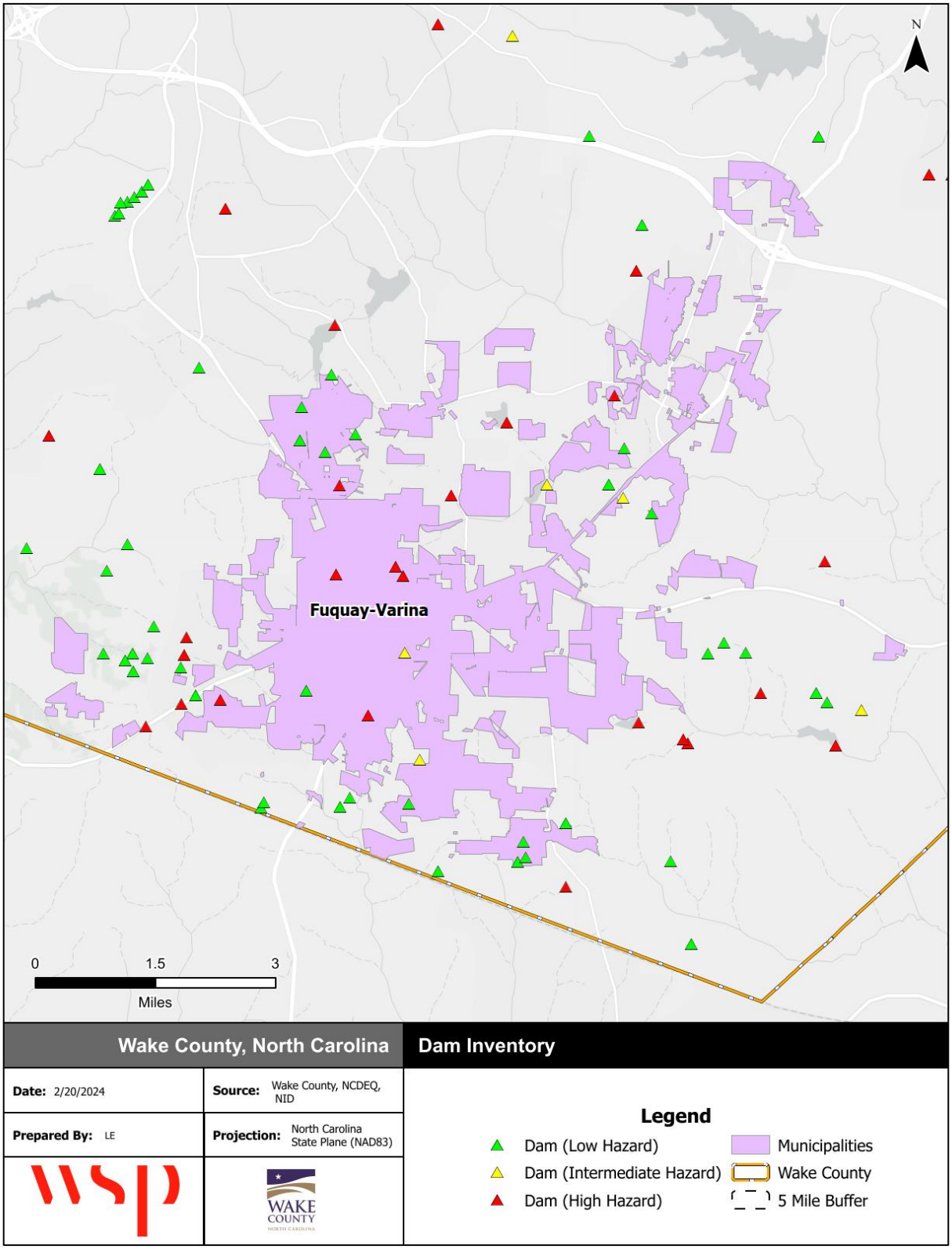


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

E.1.2 DAM FAILURE

Currently, the Town of Fuquay-Varina has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure E.2 shows the location of all dams in the Town of Fuquay-Varina.

Figure E.2 – Dam Inventory, Town of Fuquay-Varina



Source: North Carolina Dam Inventory, February 2024

E.1.3 FLOOD

Table E.1 details the acreage of the Town of Fuquay-Varina by flood zone on the effective DFIRM. Per this assessment, over 4 percent of the Town of Fuquay-Varina falls within the mapped 1%-annual-chance floodplains.

Table E.2 – Flood Zone Acreage in the Town of Fuquay-Varina

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	516.9	4.2
Zone X (500-year)	25.9	0.2
Zone X Unshaded	11,895.3	95.6
Total	**12,438.0**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure E.3 reflects the effective mapped flood hazard zones for the Town of Fuquay-Varina, and Figure E.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table E.3 provides building counts and values for critical facilities by flood zone in the Town of Fuquay-Varina.

Table E.3 – Critical Facilities Exposed to Flood, Town of Fuquay-Varina

Flood Zone	Critical Facility Count	Structure Value
AE	15	$54,433,513
X	128	$241,650,815
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0	$0
Total	**143**	**$296,084,328**

Source: FEMA Effective DFIRM

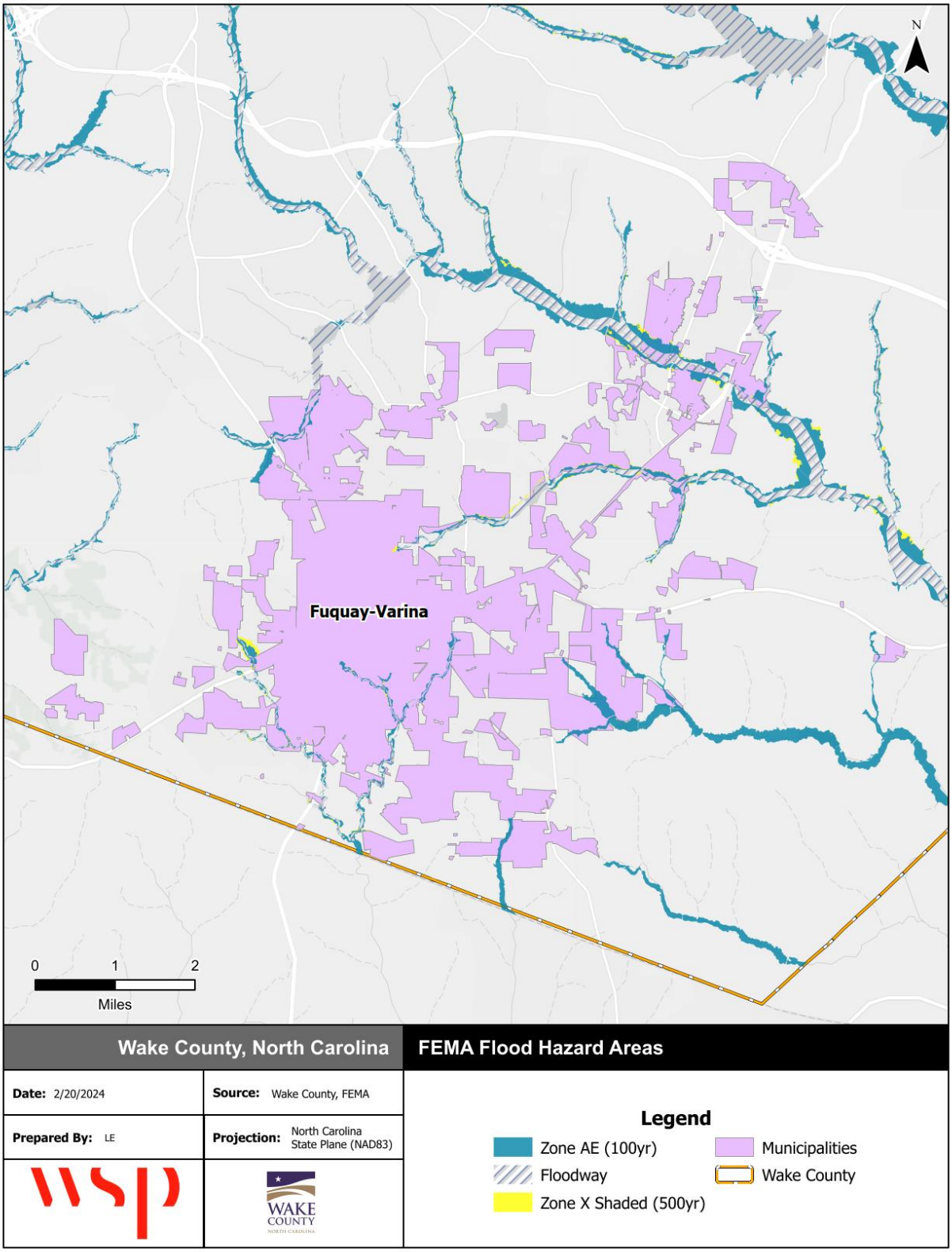
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $10.9 million in building related damages. The results of the Hazus loss estimate are summarized in Table E.4.

Table E.4 – HAZUS 100-Year Flood Results, Town of Fuquay-Varina

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	4	$342,000	$23,000	$104,000	$127,000	37%
Commercial	20	$3,887,000	$284,000	$957,000	$1,241,000	32%
Educational	0	$0	$0	$0	$0	0%
Government	2	$1,384,000	$20,000	$134,000	$154,000	11%
Industrial	16	$4,494,000	$908,000	$2,702,000	$3,610,000	80%
Religious	4	$461,000	$24,000	$177,000	$201,000	44%
Residential	80	$7,143,000	$3,663,000	$1,934,000	$5,597,000	78%
Total	**126**	**$17,711,000**	**$4,922,000**	**$6,008,000**	**$10,930,000**	**62%**

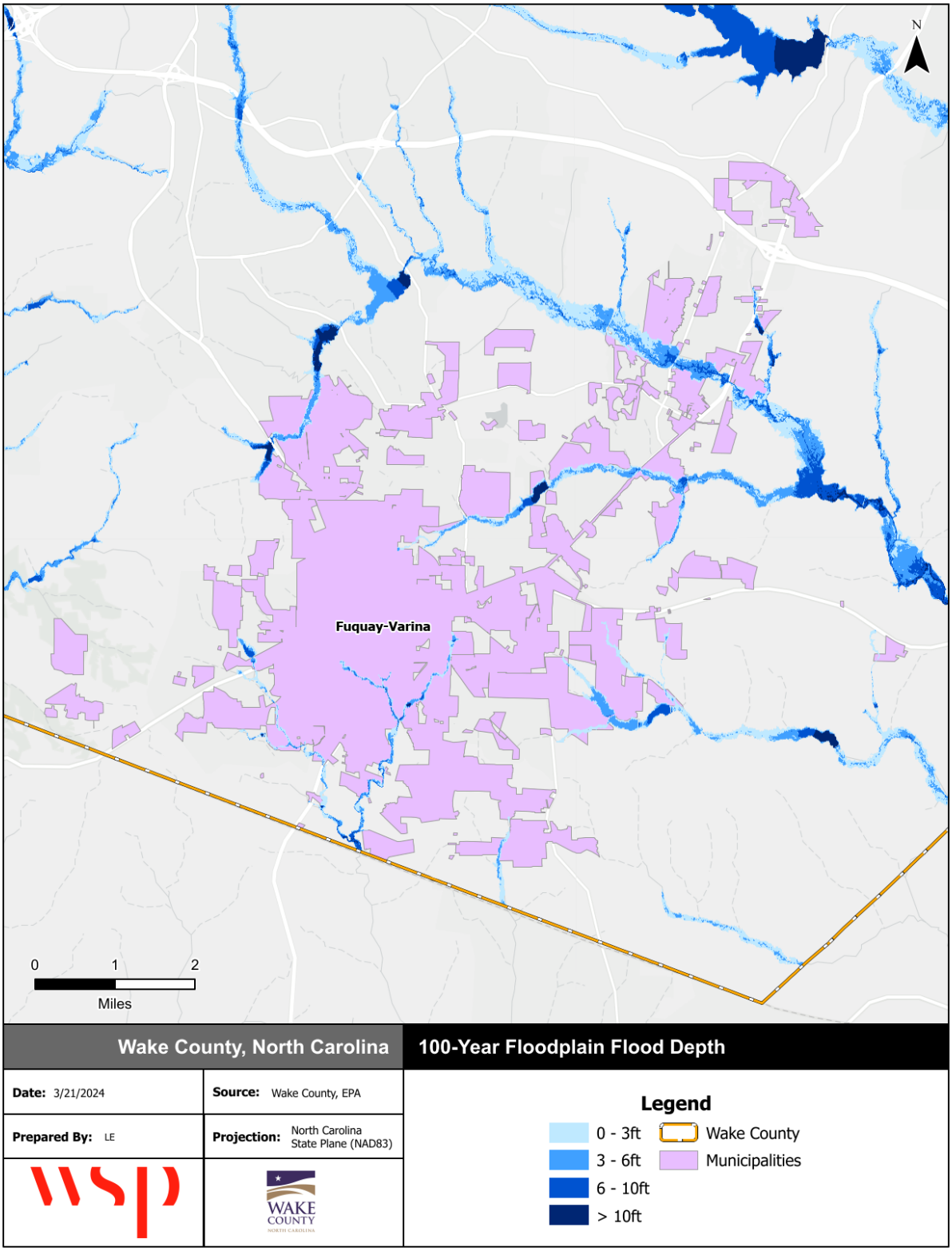
Source: FEMA Natural Hazards Risk Assessment Program

Figure E.3 – FEMA Flood Hazard Areas, Town of Fuquay-Varina



Source: FEMA Effective DFIRM

Figure E.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Fuquay-Varina



Source: FEMA Effective DFIRM

E.1.4 WILDFIRE

Table E.5 summarizes the acreage in the Town of Fuquay-Varina that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 8 percent of the Town of Fuquay-Varina is not included in the WUI.

Table E.5 – Wildland Urban Interface Acreage, Town of Fuquay-Varina

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	1,035.47	8.3%
	LT 1hs/40ac	858.18	6.9%
	1hs/40ac to 1hs/20ac	789.01	6.3%
	1hs/20ac to 1hs/10ac	1,040.70	8.4%
	1hs/10ac to 1hs/5ac	1,440.62	11.6%
	1hs/5ac to 1hs/2ac	2,483.29	20.0%
	1hs/2ac to 3hs/1ac	4,589.89	36.9%
	GT 3hs/1ac	200.83	1.6%
	Total	**12,437.99**	**100%**

Source: Southern Wildfire Risk Assessment

Figure E.5 depicts the WUI the Town of Fuquay-Varina. Figure E.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure E.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in central Fuquay-Varina as well as some areas in the southwest and northeast. These areas are generally within the WUI, but in the central area, there is a lower burn probability. The southern and eastern regions of the Town have moderate burn probabilities, and some areas within these regions have relatively high potential fire intensity and fall within the WUI, putting some development potentially at risk.

Table E.6 provides the count and estimated value of all structures that intersect with areas of the Town of Fuquay-Varina that are rated moderate to high on the WUI Risk Index.

Table E.6 – Structures at Risk to Moderate-High WUI Risk Index, Town of Fuquay-Varina

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	79	$17,071,326	$17,071,326	$34,142,652
Commercial	431	$479,212,592	$479,212,592	$958,425,184
Education	25	$113,512,605	$113,512,605	$227,025,210
Government	70	$54,288,572	$54,288,572	$108,577,144
Industrial	132	$235,120,072	$352,680,108	$587,800,180
Religious	73	$123,517,740	$123,517,740	$247,035,480
Residential	16789	$5,999,001,536	$2,999,500,768	$8,998,502,304
Total	**17,599**	**$7,021,724,443**	**$4,139,783,711**	**$11,161,508,154**

Source: Southern Wildfire Risk Assessment

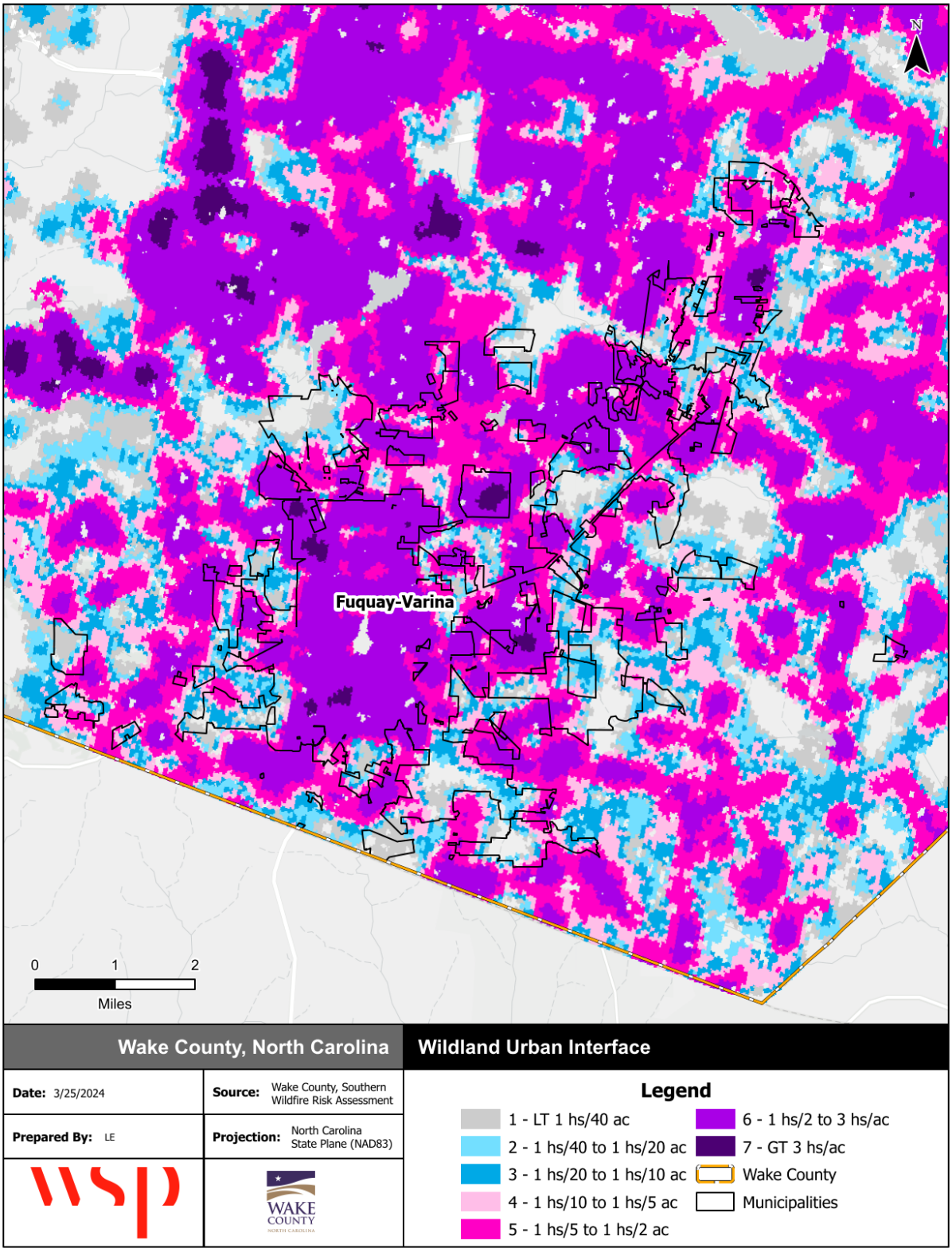
Table E.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table E.7 – Critical Facilities Exposed to Wildfire, Town of Fuquay-Varina

Type	Critical Facility Count	Structure Value
Communications	1	$0
Energy	23	$13,307,891
Food, Hydration, Shelter	7	$40,510,553
Hazardous Materials	29	$85,485,017
Health and Medical	15	$21,668,671
Safety and Security	10	$106,123,234
Transportation	0	$0
Water Systems	38	$15,786,253
Total	**123**	**$282,881,619**

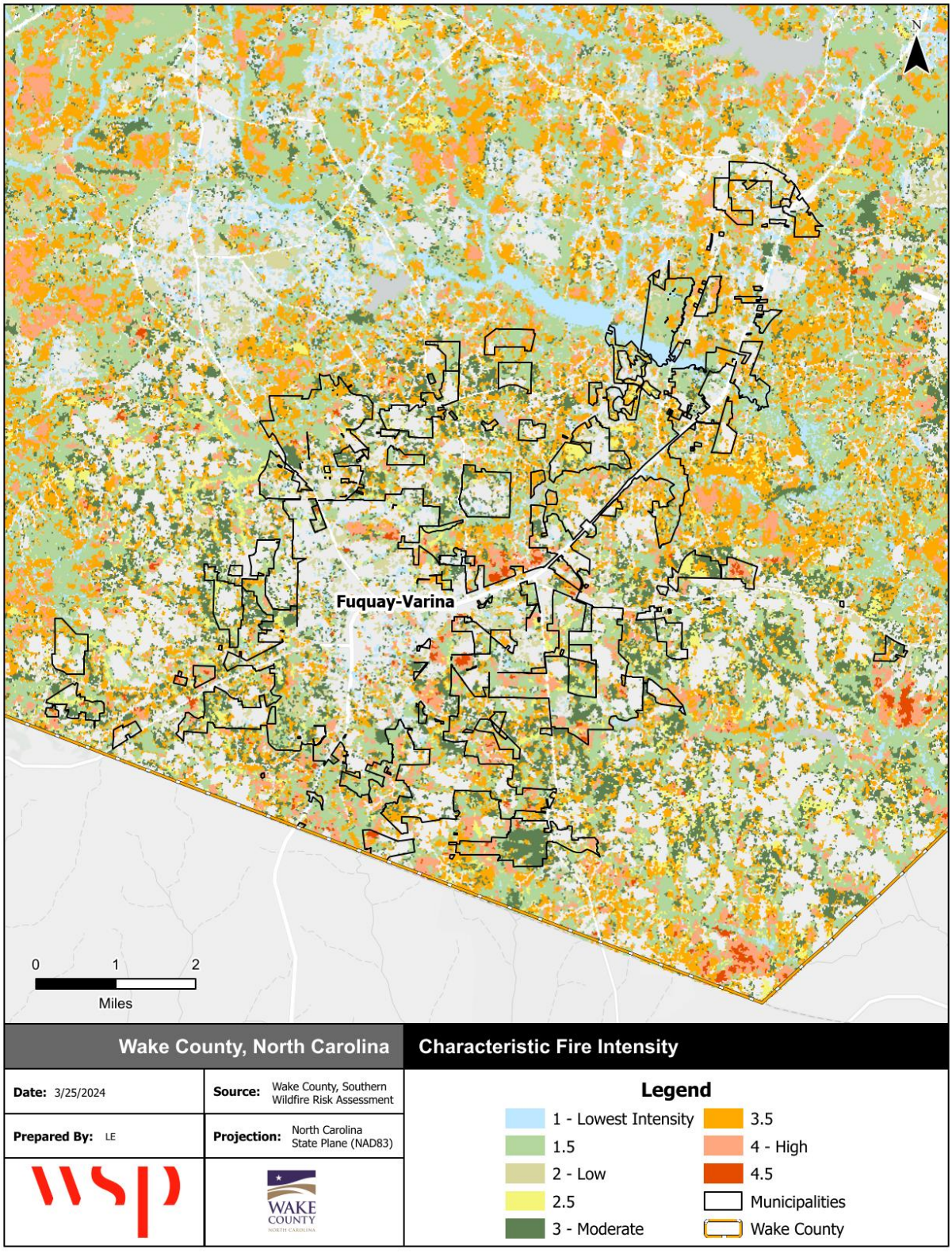
Source: Southern Wildfire Risk Assessment

Figure E.5 – Wildland Urban Interface, Fuquay-Varina



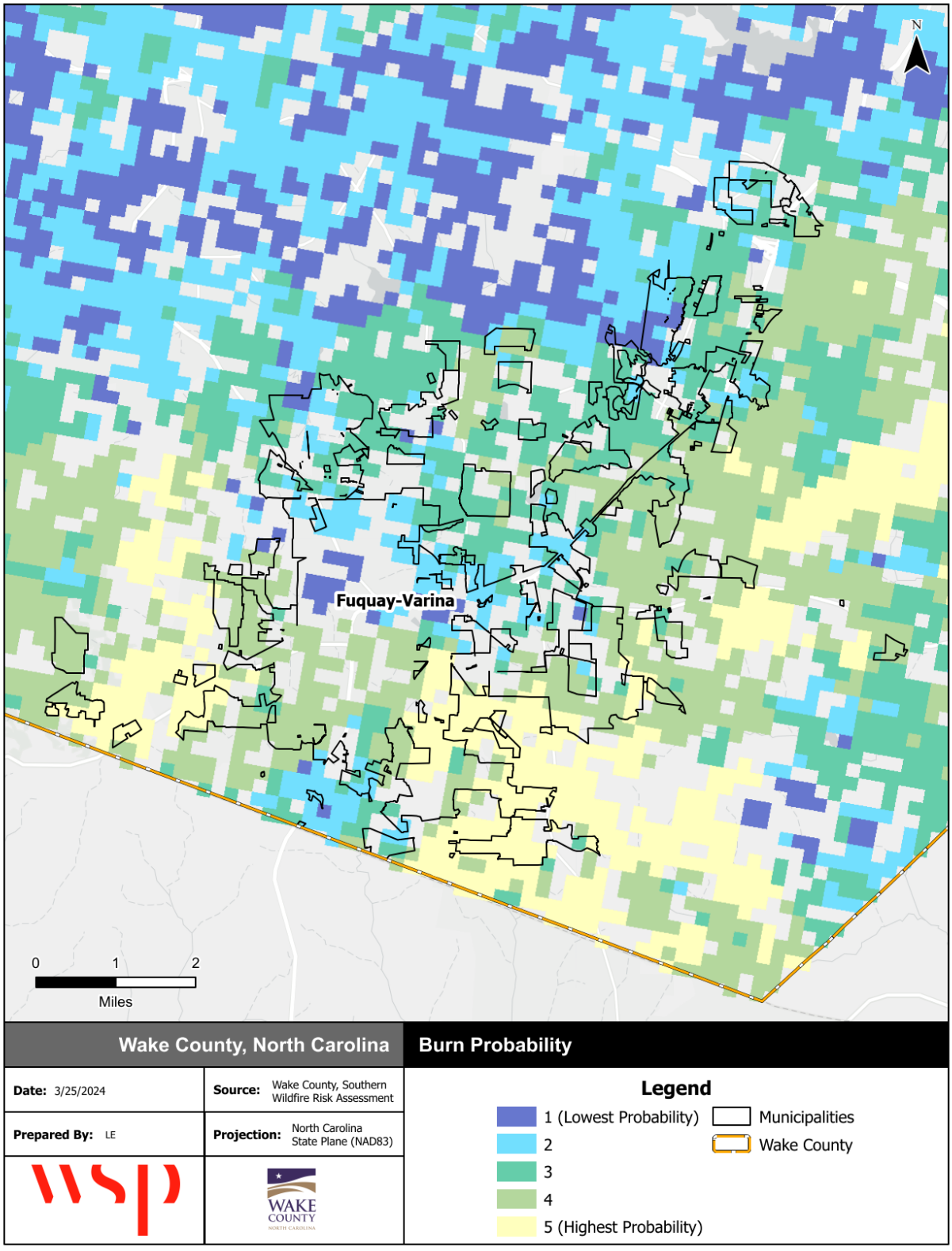
Source: Southern Wildfire Risk Assessment

Figure E.6 – Fire Intensity Scale, Fuquay Varina



Source: Southern Wildfire Risk Assessment

Figure E.7 – Burn Probability, Fuquay Varina



Source: Southern Wildfire Risk Assessment

E.2 MITIGATION STRATEGY

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Require pre and post construction certification for residential lot development within 10 feet of Wake County Flood Hazard Soils.	4	1	Flood	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of permit review process
P-2	Annually calculate acreage of flood prone property preserved as open space.	2	2	Flood, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of an annual report
P-3	Map storm water drainage system as part of Phase II Stormwater Management Plan.	2	2	Flood	High	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of infrastructure acceptance / ongoing project to work on historical data inclusion. More staff time needed to complete.
P-4	Provide for public dissemination building inspections brochures regarding high winds, water damage prevention, and tie downs for accessory structures.	1	1	Flood, Tornado, Hurricane, Severe Weather	Moderate	Fuquay-Varina Inspections	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Brochures continuously made available to public at Town Hall
P-5	Review and update of drought policy for water conservation	2	2	Drought	High	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	3-5 years	In-Progress – Carry Forward	Plan is updated every five years, originally adopted Feb 2024
P-6	Neuse River Buffer Rules Implementation	3	1	Flooding	High	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
Property Protection											
PP-1	Continue to enforce the Flood Damage Prevention Ordinance for all new construction or substantial building rehabilitations.	4	1	Flood, Hurricane	High	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
PP-2	Require minimum finished floor elevation in known FEMA flood hazard zones be minimum 2' above base flood elevation.	4	1	Flood, Hurricane	High	Fuquay-Varina Planning and Inspections	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
PP-3	Identify and inventory buildings that are located in FEMA flood zones to determine which structures may be prone to flooding (possible relocation and/or elevation).	3	1	Flood, Hurricane	High	Fuquay-Varina Planning and Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	We reference the Dept of Public Safety's report. More staff time needed, change in FEMA mapping added more structures.
PP-4	Decommissioning Brighton Forest Wastewater Treatment Plant	3	2	Flood, Hurricane & Tropical Storm, Severe Weather	High	Municipal Administration	To be Determined	FEMA HHDPR, BRIC, Local Funding	5 Years	In-Progress - Carry Forward	To apply for FEMA BRIC implementation funding, the Town of Fuquay-Varina adopted this mitigation action as part of an amendment to the 2019 Wake County HMP. Applied for funding in 2023.

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Natural Resource Protection											
NRP-1	Work with the U.S. Army Corps of Engineers on wetland protection.	4	1	Flood, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
NRP-2	Use Open Space Ordinance to protect wildlife habitat.	4	1	All	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
NRP-3	Notify Wake County of any illegal stream dumping instances	3	1	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Planning and Public Utilities	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
NRP-4	Enforce standards for tree protection and control of clear cutting (Town has received legislative authority to enact tree protection and control of clearcutting standards.)	4	1	Flood, Wildfire, Landslide	High	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
NRP-5	Town Spill Response Plan			Hazardous Materials	High	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
NRP-6	Brighton Forest Wastewater Treatment Plant Decommissioning			Hazardous Materials	High	Fuquay-Varina Public Utilities	Budgeted Staff Time	BRIC	Ongoing - Next 5 Years	New	N/A
Structural Projects											
S-1	Geotechnical investigation to establish data for risk analysis and development of engineering designs/solutions	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-2	Implementing engineered design solutions to improve performance/safety of existing dam	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-3	Property Acquisition in inundation area(s) below dam	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-4	Raise crest of dam to increase storage capacity	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-5	Add additional spillways, widen or lower existing spillways to increase discharge capacity	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-6	Warning systems to alert downstream areas of potential dam failure	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-7	Improve flow path below dam to increase conveyance capacity	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-8	Encourage conservation or re-forestation of upstream land to reduce runoff	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-9	Development of community Stormwater Management Plans for upstream communities	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-10	Complete an Emergency Action Plan in conjunction with NCDEQ for all High Hazard Dams in the county	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-11	Permanently breach hazardous dams, or modify risers such that dam can no longer impound water, but may still provide attenuation of peak flooding by acting as a stormwater retention feature	3	3	Dam Failure	Moderate	Town of Fuquay-Varina Engineering Department	To Be Determined	Local Funds, State Funds, Federal Funds, Other Sources	2-5 Years	Carry Forward	The Town of Fuquay-Varina wishes to make modifications to the Crooked Creek Dam which was identified as a high hazard dam by NCDEQ. To pursue grant funding under FEMA BRIC this action was included as an amendment to the 2019 Wake County HMP.
S-12	New Fire Station cameras & generator	2	1	All	High	All Departments	To Be Determined	Annual Budget	1 year	New	N/A
S-13	New Waterline from Sanford	3	1	Flood, Wildfire, Terrorism, Drought	High	Fuquay-Varina Public Utilities	To Be Determined	Annual Budget	Ongoing - Next 5 Years	New	N/A
Emergency Services											
ES-1	Maintain current warning system with local sirens on elevated platforms and use of the Emergency Broadcast System.	1	2	All	High	Fuquay-Varina Planning, Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-2	Coordinate an incident command course for all Town employees, related to Emergency Operations Plan and Disaster Operations Plan for the Town.	2	1	All	Moderate	Fuquay-Varina Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Lack of staffing has prevented implementation
ES-3	Conduct a scenario-based training exercise, related to Emergency Operations Plan and Disaster Operations Plan for the Town.	2	1	All	Moderate	Fuquay-Varina Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Lack of staffing has prevented implementation

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-4	Assist Wake County Emergency Management with updating list of local hazardous materials sites.	2	1	Hazardous Materials Incident, Radiological Emergency	Moderate	Fuquay-Varina Fire and Wake County Emergency Management	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-5	Continue Pre-Fire Incident Plan program for all commercial facilities within the Town limits.	3	2	All	High	Fuquay-Varina Fire	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-6	Address securing and cleaning up affected hazardous areas when revising Disaster Operations Plan.	4	2	All	High	Fuquay-Varina Planning, Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-7	Continue to evaluate and improve response and recovery methods following each hazard event.	2	2	All	High	Fuquay-Varina Fire and Police	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
ES-9	Wake County Everbridge Text Alert Implementation	1	2	All	Moderate	Fuquay-Varina Fire	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
Public Education and Awareness											
PEA-1	Maintain floodplain maps for public use and produce other maps as needed.	1	1	Flood, Hurricane	Moderate	Fuquay-Varina Planning and Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-2	Develop and maintain a hazard mitigation section on the Town website that is updated every 5 years as the plan is updated.	1	1	All	High	Fuquay-Varina Public Information and Information Technology	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-3	Collect educational materials on disaster preparedness and display at public library and local government offices.	1	1	All	High	Fuquay-Varina Planning, Inspections, Police, and Fire	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Lack of staffing has prevented implementation
PEA-4	Educate public on importance of channel maintenance as part of Phase II Stormwater Management Plan.	1	1	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Engineering	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-5	Work with local real estate agents to ensure that potential buyers are aware of properties that are exposed to potential flood damage.	1	1	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Continued function of normal operation
PEA-6	Require delineation of Wake County Flood Hazard Soils, FEMA flood zones, and wetlands on final plats.	3	2	Flood, Dam Failure, Hurricane	Moderate	Fuquay-Varina Planning	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	In-Progress – Carry Forward	Part of development and permit review process
PEA-7	Annual participation in Severe Weather Preparedness Week (March 3-9) via Weather Channel (social media campaign, newsletter, published materials)	1	1	All	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A

Town of Fuquay-Varina											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PEA-8	Annual participation in National Preparedness Month (September) Ready.gov (social media campaign, newsletter, published materials)	1	1	All	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-9	Annual participation in Hurricane Prep Week (May 13-19) ReadyNC.gov (social media campaign, newsletter, published materials)	1	1	Flood, Landslide, Hurricane	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-10	Annual participation in Earthquake Awareness Month and National Earthquake Drill (February & October) Ready.gov (social media campaign, newsletter, published materials)	1	1	Earthquake	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-11	Annual participation in National Dam Safety Awareness Day (May 31) Ready.gov (social media campaign, newsletter, published materials)	1	1	Dam Failure	High	Fuquay Varina Planning and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A
PEA-12	Structured public education through social media, brochures, and flyers in critical facilities	1	1	All	High	Fuquay Varina Planning, Fire & Police, and Public Information	Budgeted Staff Time	Annual Budget	Ongoing - Next 5 Years	New	N/A

F. TOWN OF GARNER

F.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Garner. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Garner. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

F.1.1 CRITICAL FACILITIES

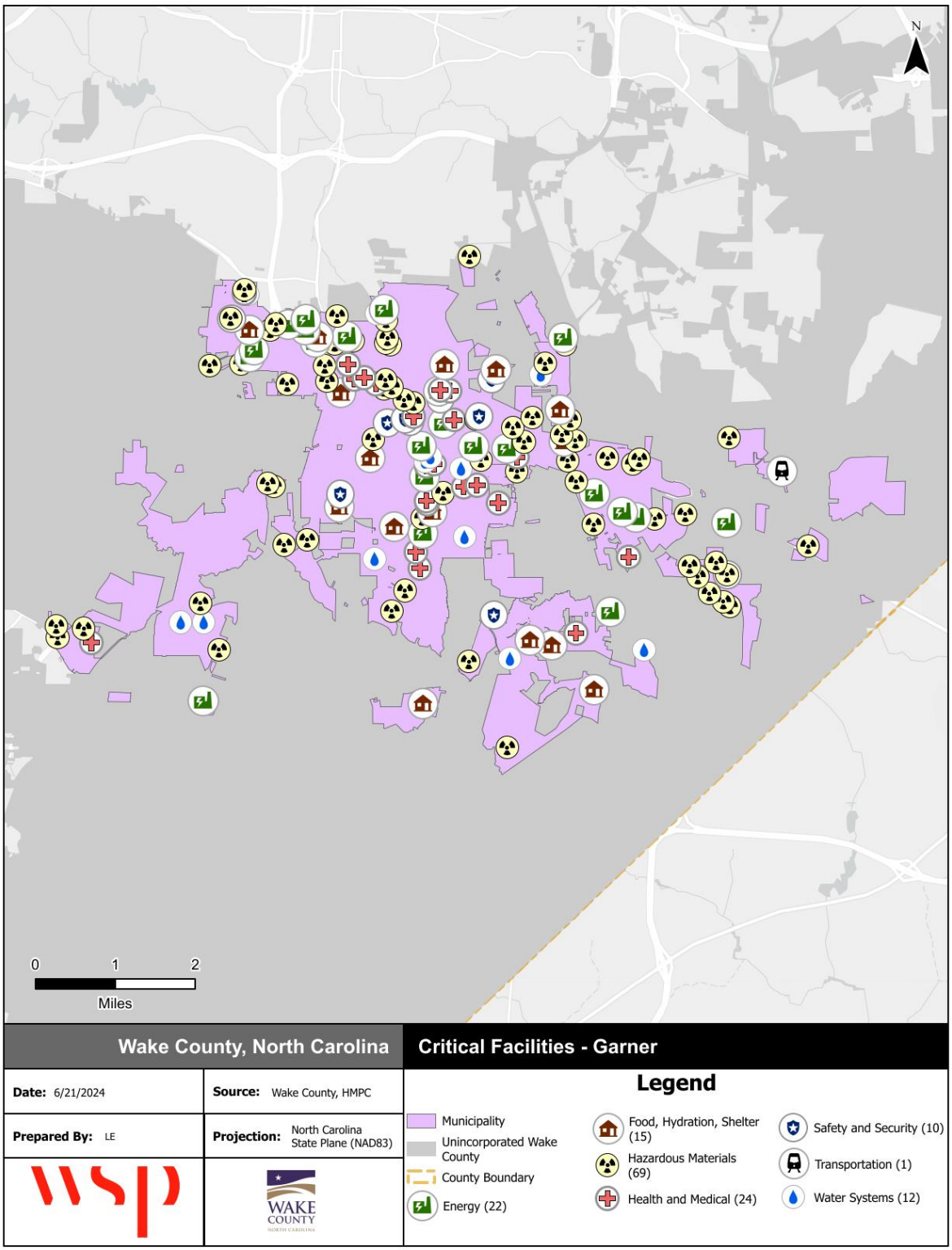
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table F.1 provides a count of critical facilities by FEMA lifeline category within the Town of Garner. Figure F.1 shows the locations of all critical facilities within the Town of Garner.

Table F.1 – Critical Facilities by Type, Town of Garner

Facility Type	Count of Facility Type	Structure Value
Communications	3	$10,340
Energy	31	$89,641,098
Food, Hydration, Shelter	8	$6,591,903
Hazardous Materials	98	$380,773,832
Health and Medical	24	$100,072,977
Safety and Security	10	$40,447,847
Transportation	2	$20,292,117
Water Systems	18	$61,523,803
Total	**194**	**$699,353,917**

Source: Wake County, HMPC

Figure F.1 – Town of Garner Critical Facilities



Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

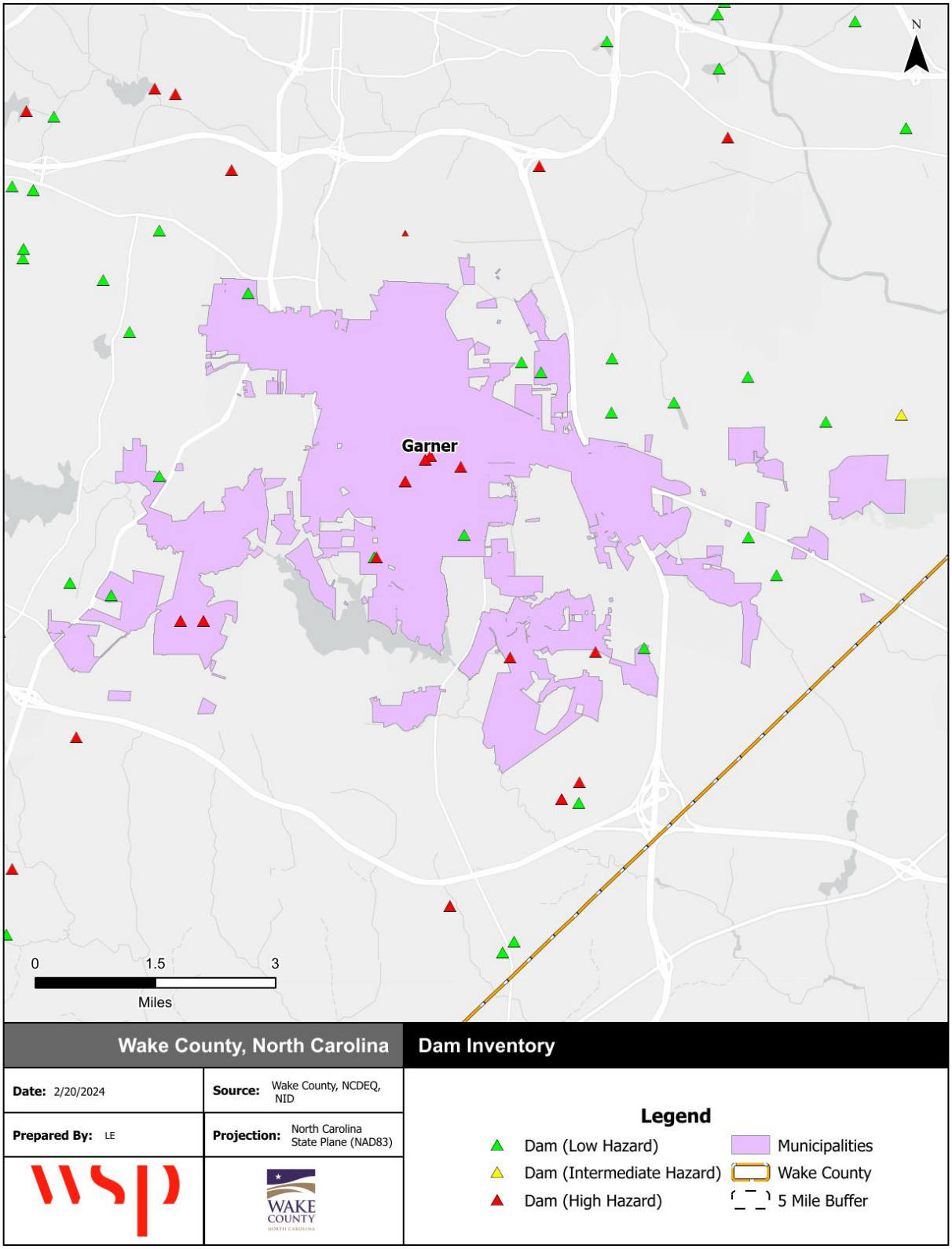
F.1.2 DAM FAILURE

Table F.2 lists all high hazard dams located in the Town of Garner that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure F.2 shows the location of all dams in the Town of Garner.

Table F.2 – High Hazard Dams in the Town of Garner with Condition Assessment of "Poor"

Dam Name	NID ID	Inspection Date	Nearest Downstream City & Distance (mi.)	EAP in Place
Peacock Dam	NC04614	01/01/2025	Garner (0 mi.)	No
Weston #1 Dam	NC05235	07/06/2023	Garner (0 mi.)	No
Weston #2 Dam	NC05236	07/06/2023	Garner (0 mi.)	No
Massengill Dam	NC04626	02/01/2023	Garner (4 mi.)	No

Figure F.2 – Dam Inventory, Town of Garner



Source: North Carolina Dam Inventory, February 2024

F.1.3 FLOOD

Table F.3 details the acreage of the Town of Garner by flood zone on the effective DFIRM. Per this assessment, over 6 percent of Garner falls within the mapped 1%-annual-chance floodplains.

Table F.3 – Flood Zone Acreage in the Town of Garner

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	771.8	6.1
Zone X (500-year)	10.6	0.1
Zone X Unshaded	11,790.3	93.8%
Total	**12,572.7**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure F.3 reflects the effective mapped flood hazard zones for the Town of Garner, and Figure F.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table F.4 provides building counts and values for critical facilities by flood zone in the Town of Garner.

Table F.4 – Critical Facilities Exposed to Flooding, Town of Garner

Flood Zone	Critical Facility Count	Structure Value
AE	35	$99,397,727
X	159	$599,956,190
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0	$0
Total	**194**	**$699,353,917**

Source: FEMA Effective DFIRM

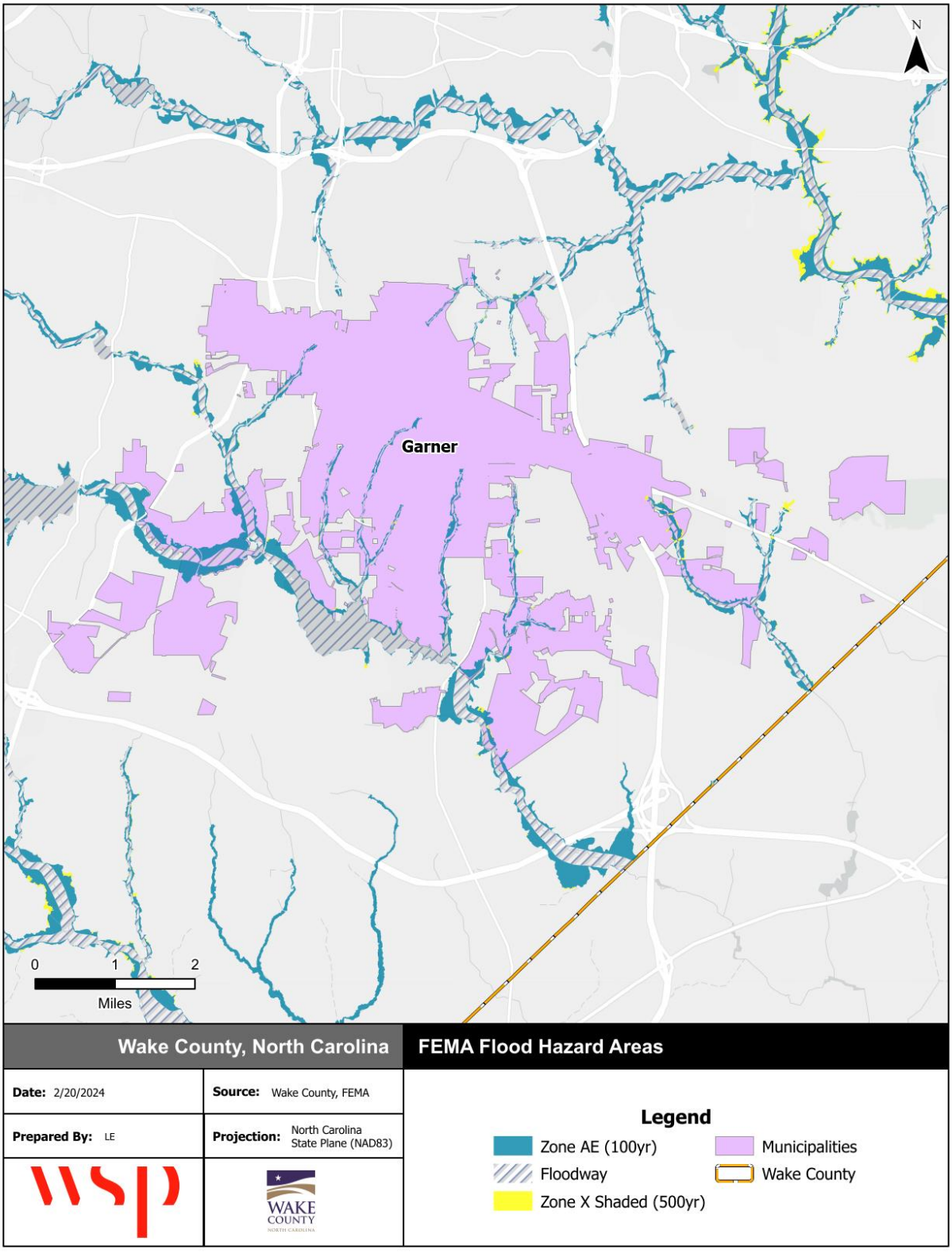
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $12.3 million in building related damages. The results of the Hazus loss estimate are summarized in Table F.5.

Table F.5 – HAZUS 100-Year Flood Results, Town of Garner

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	6	$748,000	$97,000	$241,000	$338,000	45%
Commercial	35	$10,183,000	$768,000	$2,631,000	$3,399,000	33%
Educational	4	$849,000	$21,000	$141,000	$162,000	19%
Government	0	$0	$0	$0	$0	0%
Industrial	19	$1,184,000	$323,000	$710,000	$1,033,000	87%
Religious	3	$107,000	$5,000	$43,000	$48,000	45%
Residential	107	$10,090,000	$4,706,000	$2,619,000	$7,325,000	73%
Total	**174**	**$23,161,000**	**$5,920,000**	**$6,385,000**	**$12,305,000**	**53%**

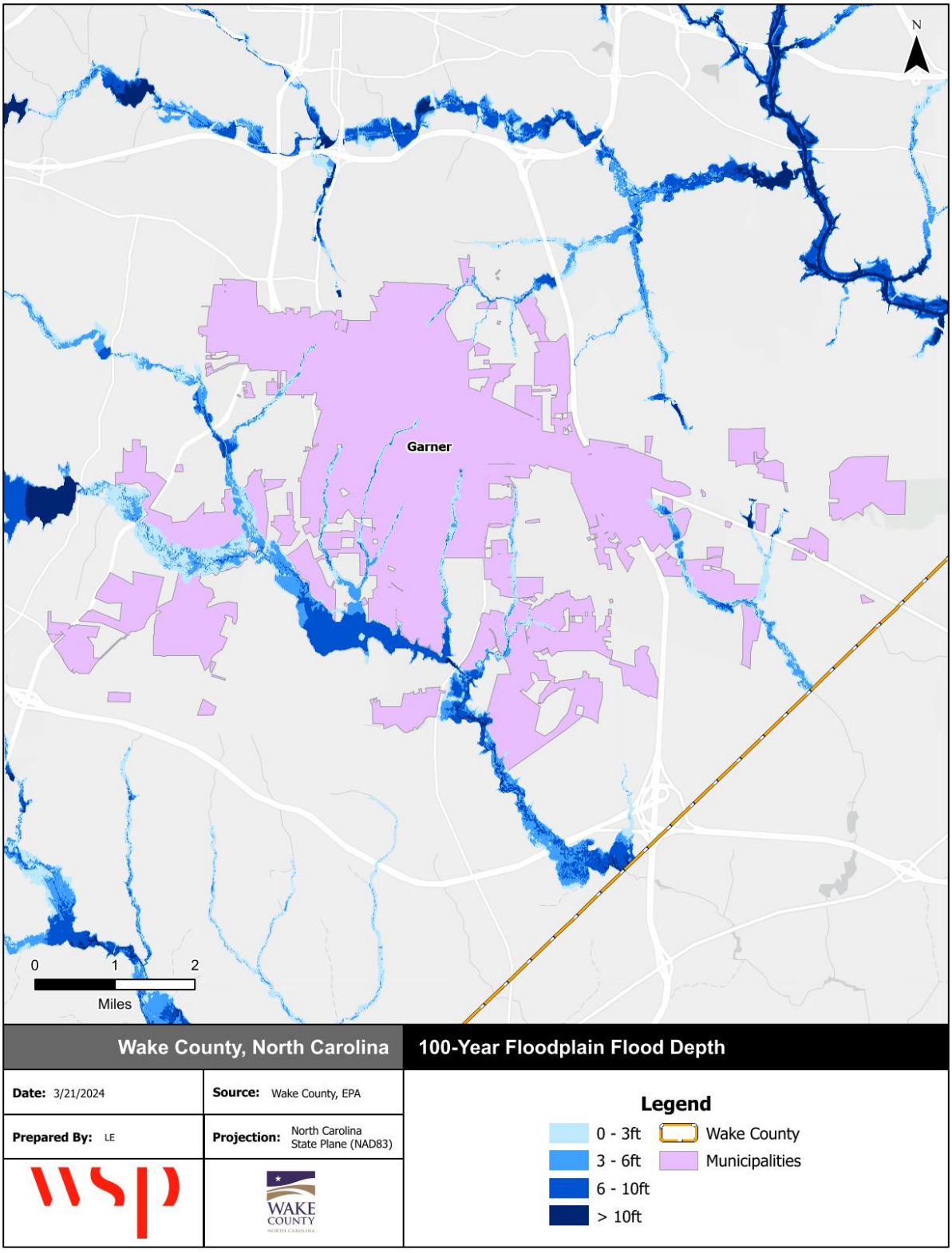
Source: FEMA Natural Hazards Risk Assessment Program

Figure F.3 – FEMA Flood Hazard Areas, Town of Garner



Source: FEMA Effective DFIRM

Figure F.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Garner



Source: FEMA Effective DFIRM

F.1.4 WILDFIRE

Table F.6 summarizes the acreage in the Town of Garner that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 11 percent of the Town of Garner is not included in the WUI.

Table F.6 – Wildland Urban Interface Acreage, Town of Garner

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	1,438.59	11.4%
	LT 1hs/40ac	898.78	7.1%
	1hs/40ac to 1hs/20ac	675.69	5.4%
	1hs/20ac to 1hs/10ac	755.49	6.0%
	1hs/10ac to 1hs/5ac	990.76	7.9%
	1hs/5ac to 1hs/2ac	1,504.99	12.0%
	1hs/2ac to 3hs/1ac	6,103.24	48.5%
	GT 3hs/1ac	205.12	1.6%
	Total	**24,966.8**	**100%**

Source: Southern Wildfire Risk Assessment

Figure F.5 depicts the WUI for the Town of Garner. Figure F.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure F.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in southwest and east Garner. Some of these areas do fall within the WUI but have a lower burn probability. The area of greatest risk in are in the central-eastern region where WUI overlays with moderate burn probability and moderate to high potential fire intensity levels.

Table F.7 provides the count and estimated value of all structures that intersect with areas of the Town of Garner that are rated moderate to high on the WUI Risk Index.

Table F.7 – Structures at Risk to Moderate-High WUI Risk Index, Town of Garner

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	39	$13,368,749	$13,368,749	$26,737,498
Commercial	461	$614,678,860	$614,678,860	$1,229,357,720
Education	42	$287,289,509	$287,289,509	$574,579,018
Government	86	$497,196,017	$497,196,017	$994,392,034
Industrial	202	$422,103,619	$633,155,429	$1,055,259,048
Religious	99	$133,261,115	$133,261,115	$266,522,230
Residential	12002	$3,619,908,850	$1,809,954,425	$5,429,863,275
Total	**12,931**	**$5,587,806,719**	**$3,988,904,104**	**$9,576,710,823**

Source: Southern Wildfire Risk Assessment

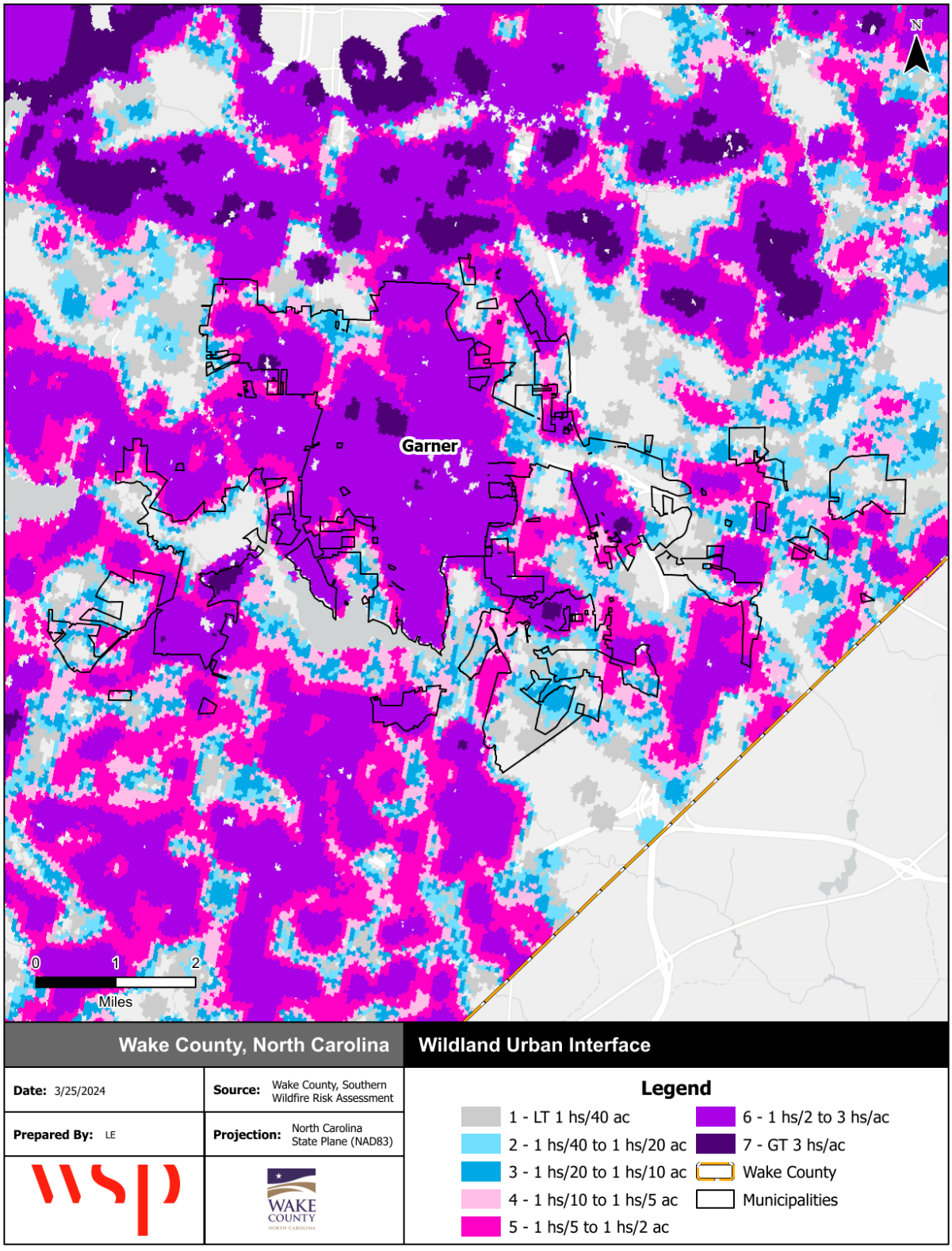
Table F.8 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table F.8 – Critical Facilities Exposed to Wildfire, Town of Garner

Type	Critical Facility Count	Structure Value
Communications	2	$10,340
Energy	24	$84,406,550
Food, Hydration, Shelter	6	$6,462,484
Hazardous Materials	63	$272,267,213
Health and Medical	20	$97,460,786
Safety and Security	10	$40,447,847
Transportation	2	$20,292,117
Water Systems	17	$60,886,629
Total	**144**	**$582,233,966**

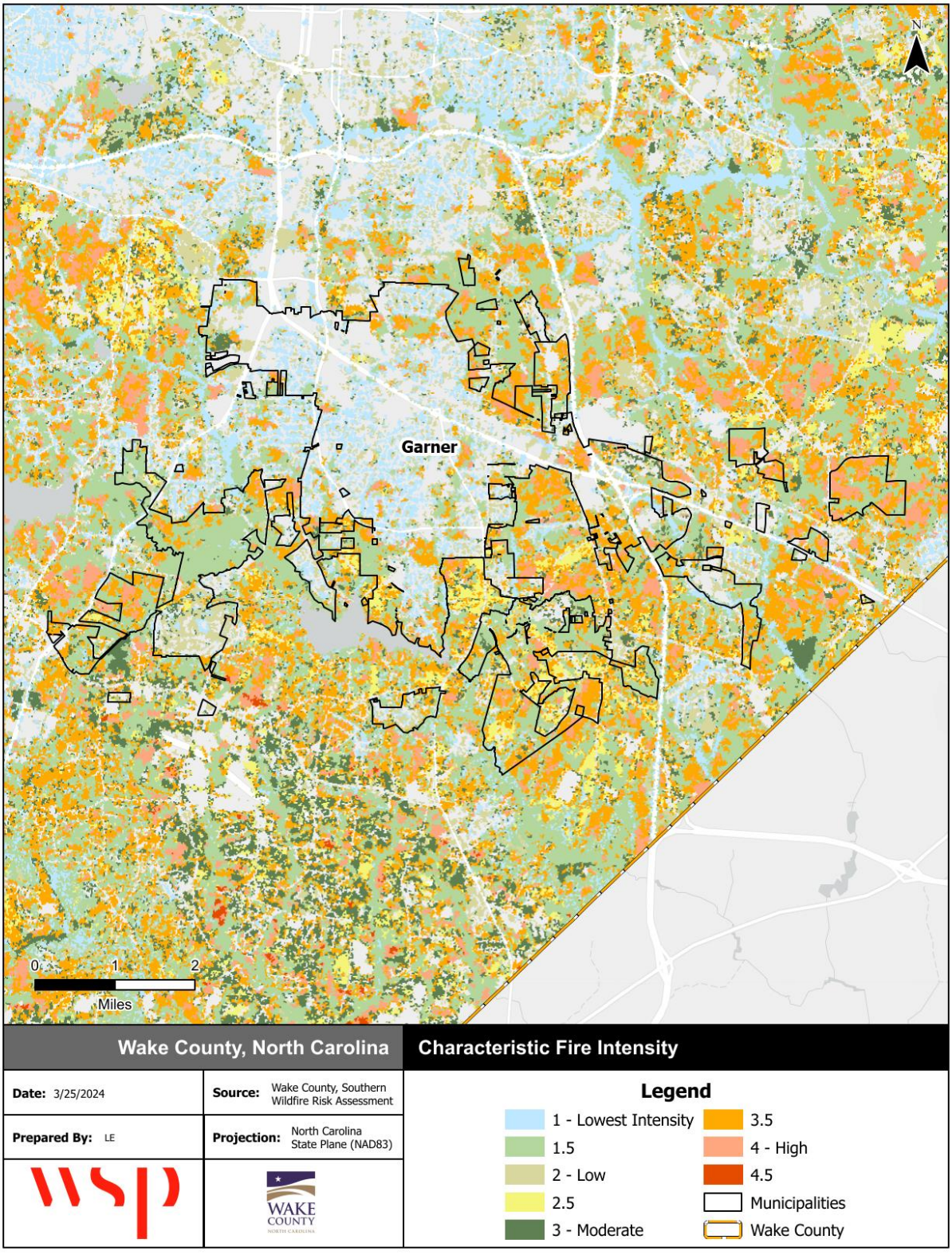
Source: Southern Wildfire Risk Assessment

Figure F.5 – Wildland Urban Interface, Town of Garner



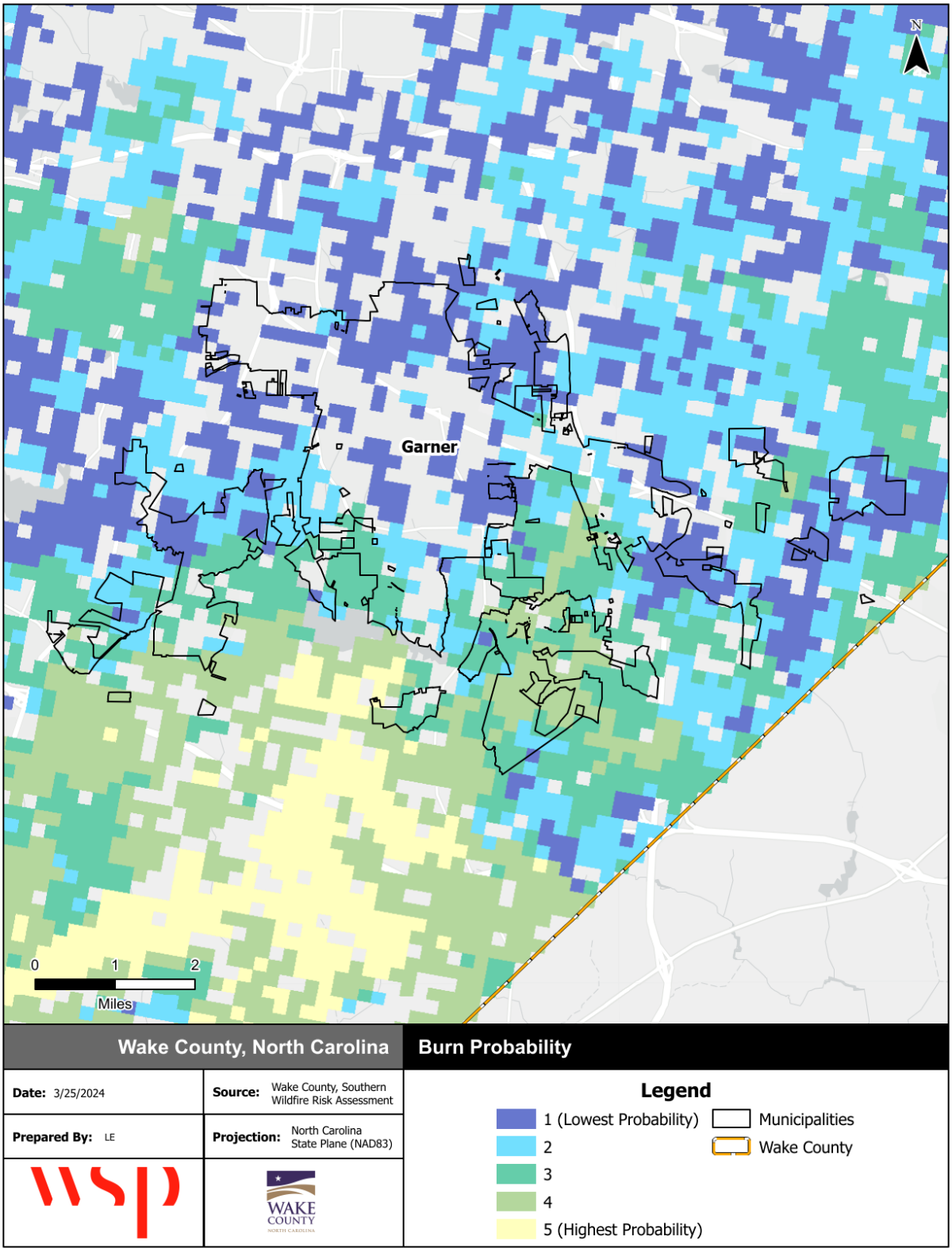
Source: Southern Wildfire Risk Assessment

Figure F.6 – Fire Intensity Scale, Town of Garner



Source: Southern Wildfire Risk Assessment

Figure F.7 – Burn Probability, Town of Garner



Source: Southern Wildfire Risk Assessment

F.2 MITIGATION STRATEGY

Town of Garner											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Evaluate the need for regulations to encourage use of low impact development site planning principles to help control stormwater volume impacts.	4	1	Flood, Dam Failure, Hurricane	Moderate	Garner Engineering and Planning	Staff time	Local	2-3 years (2026)	In-Progress – Carry Forward	The current UDO does not contain specific language to require or encourage low impact development; therefore, it is encouraged in practice rather than by regulation. With the expected addition of stormwater staff in the coming years, this will be incorporated into our overall stormwater program.
P-2	Provide adequate water supply through storage and interconnection with other public water systems.	3	2	Drought	Moderate	City of Raleigh and Garner Engineering	TBD	Local	2-3 years (2026)	In-Progress – Carry Forward	Ongoing collaboration with the City of Raleigh and support of efforts to better the water supply system and search for regional supply solutions. The Town also participates in the Wake County One Water effort to address regional water supply.
P-3	Garner Transportation Plan – Continue to address disaster preparedness (evacuation) through road interconnectivity, paved roads, and widening of roads.	4	2	Flood, Dam Failure, Earthquake, Hurricane, Severe Weather, Severe Winter Weather, Tornado, Hazardous Materials Incident, Radiological Emergency, Terrorism	Moderate	Garner Planning and Public Works	Improvement costs TBD on case-by-case basis	Local, State, Federal	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town's emergency preparedness plan follows the Wake County for routes. The Town's 2018 Transportation Plan does encourage and promote interconnectivity.
P-4	The Town will inventory all its structures located within or immediately adjacent to known flood hazard areas.	2	2	Flood	Moderate	Garner Planning and Engineering	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Town has inventory of all structures in regulatory floodplains per the newest flood maps. Will continue expand inventory to contain structures in non-regulatory flood prone areas.
Property Protection											
PP-1	The Town has a service to respond to requests and questions from citizens regarding actions they may take to improve drainage, halt erosion, and to relocate, renovate or retrofit structures being flooded.	1	1	Flood	Moderate	Garner Engineering	Staff time	Local, Private	Ongoing - Next 5 Years	In-Progress – Carry Forward	Staff time should continue to be allocated to maintain this activity as part of normal Town operations.

Town of Garner											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Structural Projects											
SP-1	Pursue stream restoration projects	3	2	Flood	High	Garner Engineering	TBD	Local, Regional, State, Federal	2-3 Years (2027)	Not Started – Carry Forward	The Town expects to seek new funding mechanisms for stormwater capital and an expanded stormwater program in the next 1-2 years. With this effort, stream restoration projects can become a capital project category under "stormwater" as problem areas are identified.
Emergency Services											
ES-1	Develop a Business Continuity Plan that is the primary document housing all disaster related plans and procedures including Hazard Mitigation Plan, Debris Management Plan, Multi-Hazard Plan as well as disaster response plans for all Town departments.	2	2	All Hazards	High	Garner Police, Public Works, and Administration	$25,000-$50,000	Local	2-3 Years	In-Progress – Carry Forward	Target 2028
Public Education and Awareness											
PEA-1	Town website will be updated with public access to information pertaining to evacuation routes, emergency contact numbers, and detailed weather reports in case of emergency.	1	2	Flood, Hurricane, Earthquake, Severe Weather, Tornado, Severe Winter Storm, Wildfire, Hazardous Materials Incident, Radiological Emergency	Moderate	Police & Fire Departments, Garner Communications	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Target 2028
PEA-2	Develop and maintain a hazard mitigation section on the Town website.	1	1	All Hazards	Moderate	Garner Communications, and Garner IT	Staff time	Local	2-3 Years	Not Started – Carry Forward	Target 2028

G. TOWN OF HOLLY SPRINGS

G.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Holly Springs. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Holly Springs. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

G.1.1 CRITICAL FACILITIES

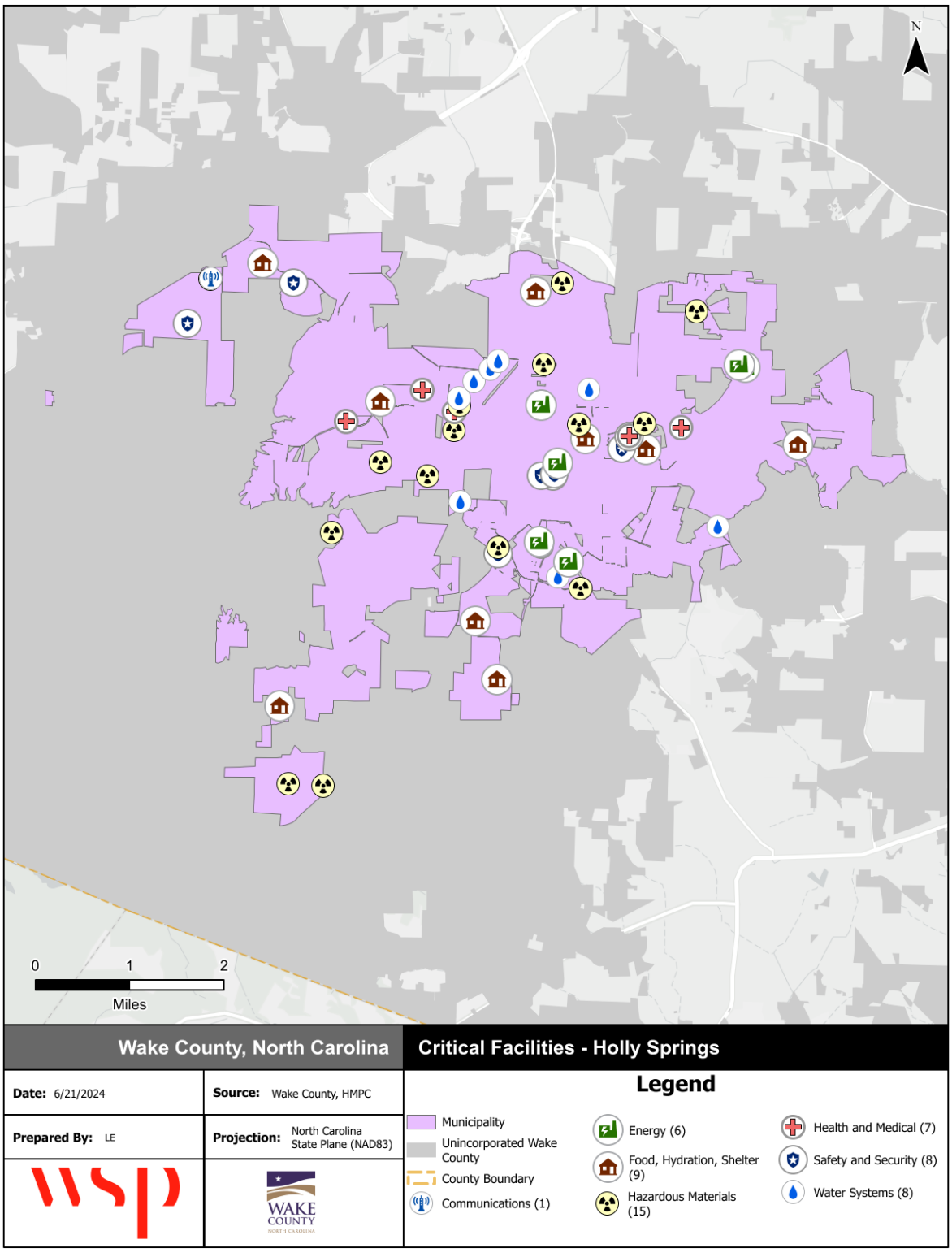
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table G.1 provides a count of critical facilities by FEMA lifeline category within the Town of Holly Springs. Figure G.1 shows the locations of all critical facilities within the Town of Holly Springs.

Table G.1 – Critical Facilities by Type, Town of Holly Springs

Facility Type	Count of Facility Type	Structure Value
Communications	2	$89,844
Energy	13	$18,427,923
Food, Hydration, Shelter	4	$13,297,116
Hazardous Materials	24	$550,391,901
Health and Medical	7	$15,009,324
Safety and Security	10	$29,772,530
Transportation	0	$0
Water Systems	14	$70,529,234
Total	**74**	**$697,517,872**

Source: Wake County, HMPC

Figure G.1 – Town of Holly Springs Critical Facilities

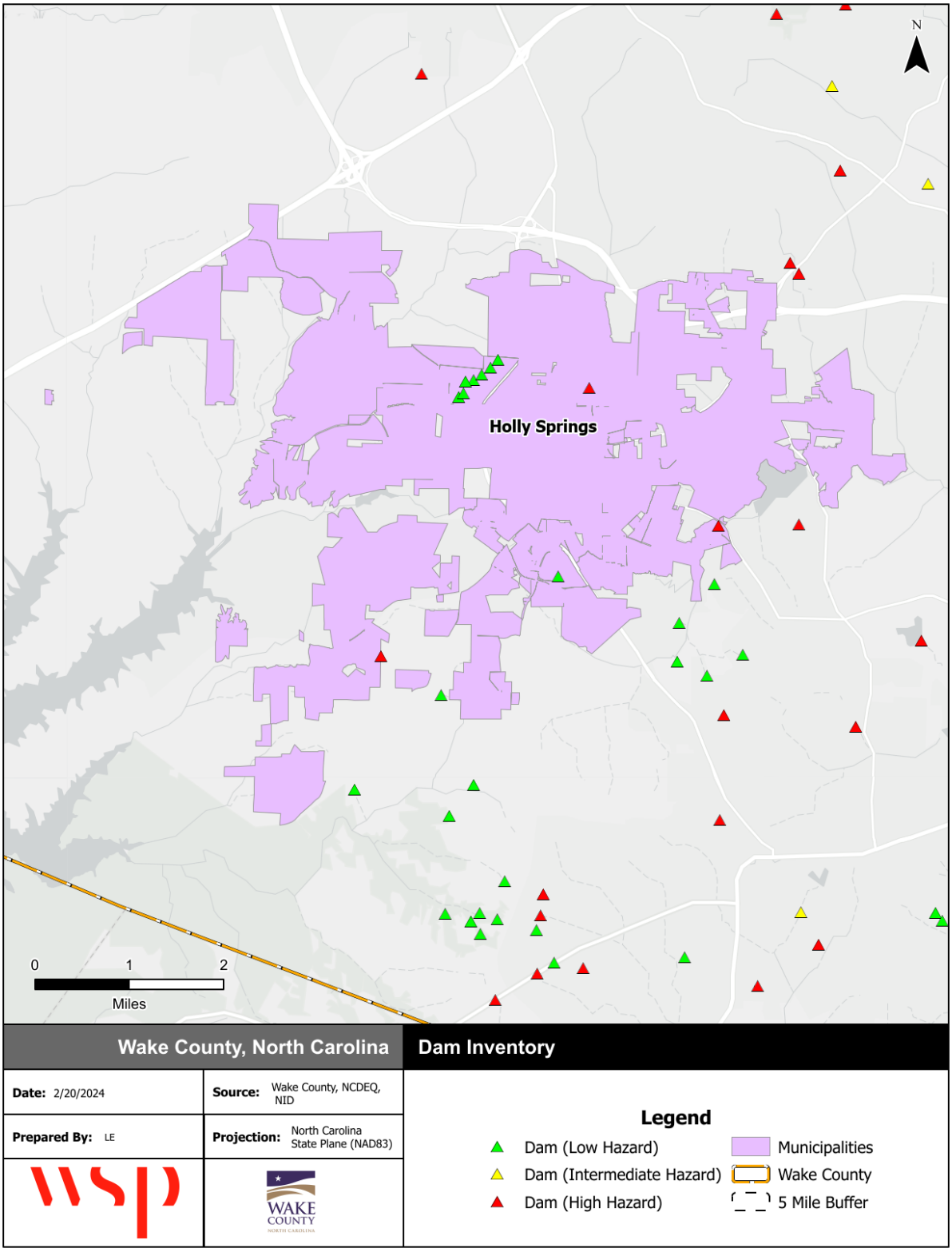


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

G.1.2 DAM FAILURE

Currently, the Town of Holly Springs has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure G.2 shows the location of all dams in the Town of Holly Springs.

Figure G.2 – Dam Inventory, Town of Holly Springs



Source: North Carolina Dam Inventory, February 2024

G.1.3 FLOOD

Table G.2 details the acreage of the Town of Holly Springs by flood zone on the effective DFIRM. Per this assessment, over 5 percent of Holly Springs falls within the mapped 1%-annual-chance floodplains.

Table G.2 – Flood Zone Acreage in the Town of Holly Springs

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	700	5.6
Zone X (500-year)	0.2	0.001
Zone X Unshaded	11,782.3	94.4
Total	**12,482.6**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure G.3 reflects the effective mapped flood hazard zones for the Town of Holly Springs, and Table G.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table G.3 provides building counts and values for critical facilities by flood zone in the Town of Holly Springs.

Table G.3 – Critical Facilities Exposed to Flooding, Town of Holly Springs

Flood Zone	Critical Facility Count	Structure Value
AE	13	$536,998,394
X	60	$160,519,478
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	1	$0
Total	**74**	**$697,517,872**

Source: FEMA Effective DFIRM

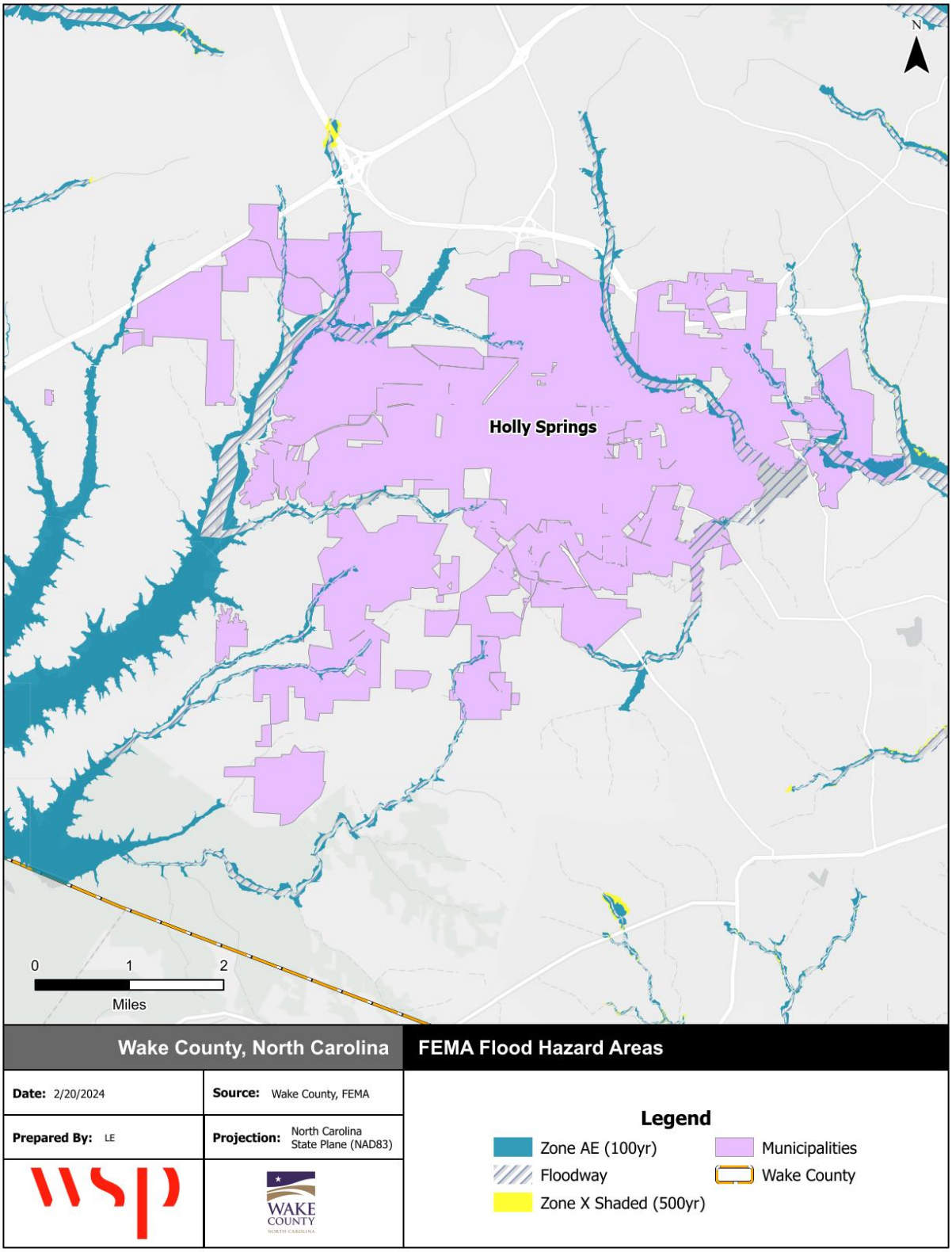
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $5.7 million in building related damages. The results of the Hazus loss estimate are summarized in Table G.4.

Table G.4 – HAZUS 100-Year Flood Results, Town of Holly Springs

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	0	$0	$0	$0	$0	0%
Commercial	6	$360,000	$16,000	$67,000	$83,000	23%
Educational	1	$156,000	$6,000	$38,000	$44,000	28%
Government	0	$0	$0	$0	$0	0%
Industrial	4	$1,318,000	$331,000	$812,000	$1,143,000	87%
Religious	1	$19,000	$1,000	$8,000	$9,000	47%
Residential	36	$5,486,000	$2,929,000	$1,551,000	$4,480,000	82%
Total	**48**	**$7,339,000**	**$3,283,000**	**$2,476,000**	**$5,759,000**	**78%**

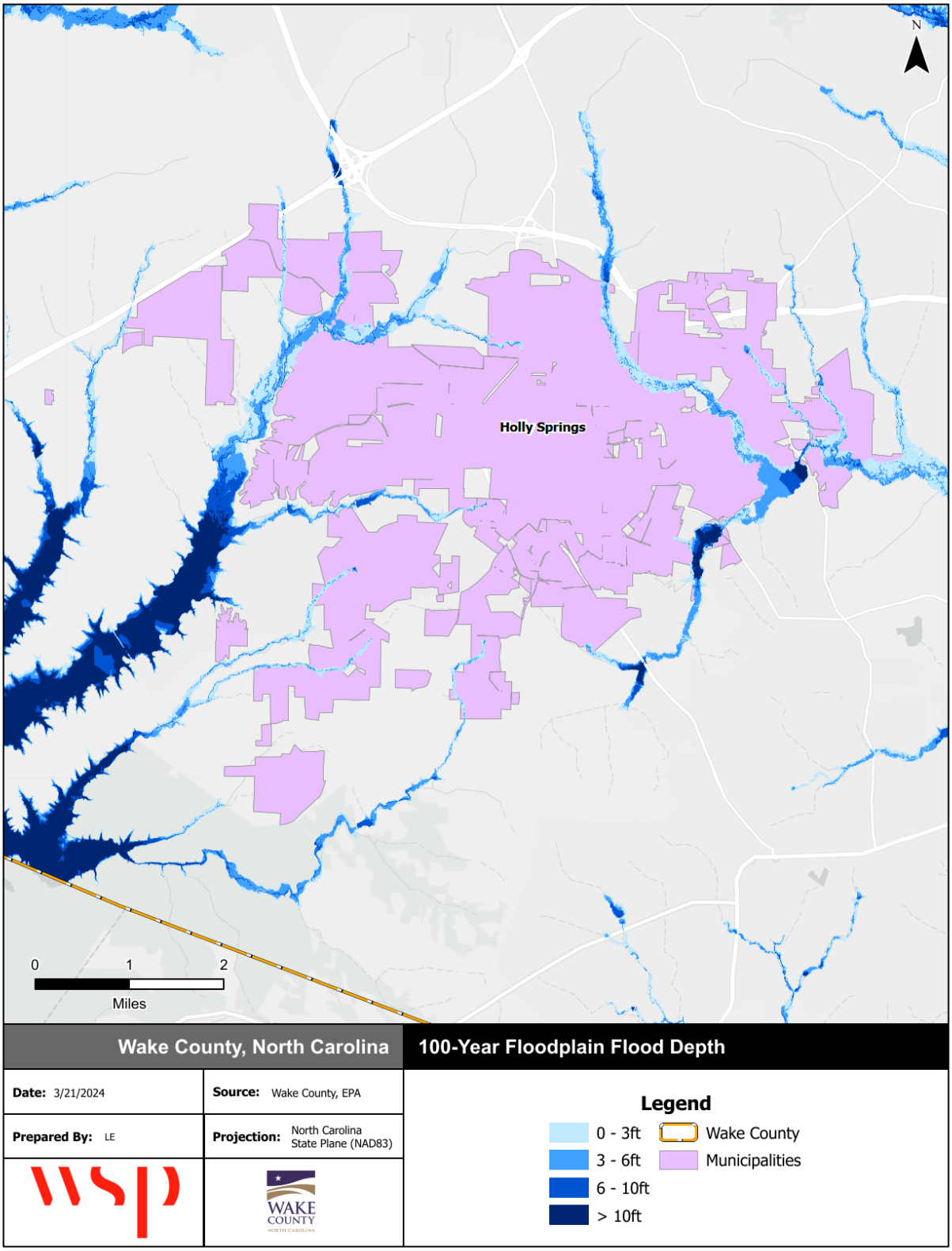
Source: FEMA Natural Hazards Risk Assessment Program

Figure G.3 – FEMA Flood Hazard Areas, Town of Holly Springs



Source: FEMA Effective DFIRM

Figure G.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Holly Springs



Source: FEMA Effective DFIRM

G.1.4 WILDFIRE

Table G.5 summarizes the acreage in the Town of Holly Springs that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 24 percent of the Town of Holly Springs is not included in the WUI.

Table G.5 – Wildland Urban Interface Acreage, Town of Holly Springs

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	2,997.71	24.0%
	LT 1hs/40ac	1,403.53	11.2%
	1hs/40ac to 1hs/20ac	908.95	7.3%
	1hs/20ac to 1hs/10ac	725.86	5.8%
	1hs/10ac to 1hs/5ac	699.77	5.6%
	1hs/5ac to 1hs/2ac	1,026.31	8.2%
	1hs/2ac to 3hs/1ac	3,968.37	31.8%
	GT 3hs/1ac	752.06	6.0%
	Total	**12,482.55**	**100%**

Source: Southern Wildfire Risk Assessment

Figure G.5 depicts the WUI for the Town of Holly Springs. Figure G.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure G.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in northwest and west Holly Springs. These areas are largely outside of the WUI and have low burn probability. Southeast Holly Springs has a moderate burn probability, however potential fire intensity is relatively low in most of the area.

Table G.6 provides the count and estimated value of all structures that intersect with areas of the Town of Holly Springs that are rated moderate to high on the WUI Risk Index.

Table G.6 - Structures at Risk to Moderate-High WUI Risk Index, Town of Holly Springs

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	23	$6,875,103	$6,875,103	$13,750,206
Commercial	213	$1,058,529,220	$1,058,529,220	$2,117,058,440
Education	9	$99,813,515	$99,813,515	$199,627,030
Government	32	$168,711,598	$168,711,598	$337,423,196
Industrial	30	$22,946,785	$34,420,178	$57,366,963
Religious	21	$22,009,307	$22,009,307	$44,018,614
Residential	10521	$4,335,904,980	$2,167,952,490	$6,503,857,470
Total	**10,849**	**$5,714,790,508**	**$3,558,311,411**	**$9,273,101,919**

Source: Southern Wildfire Risk Assessment

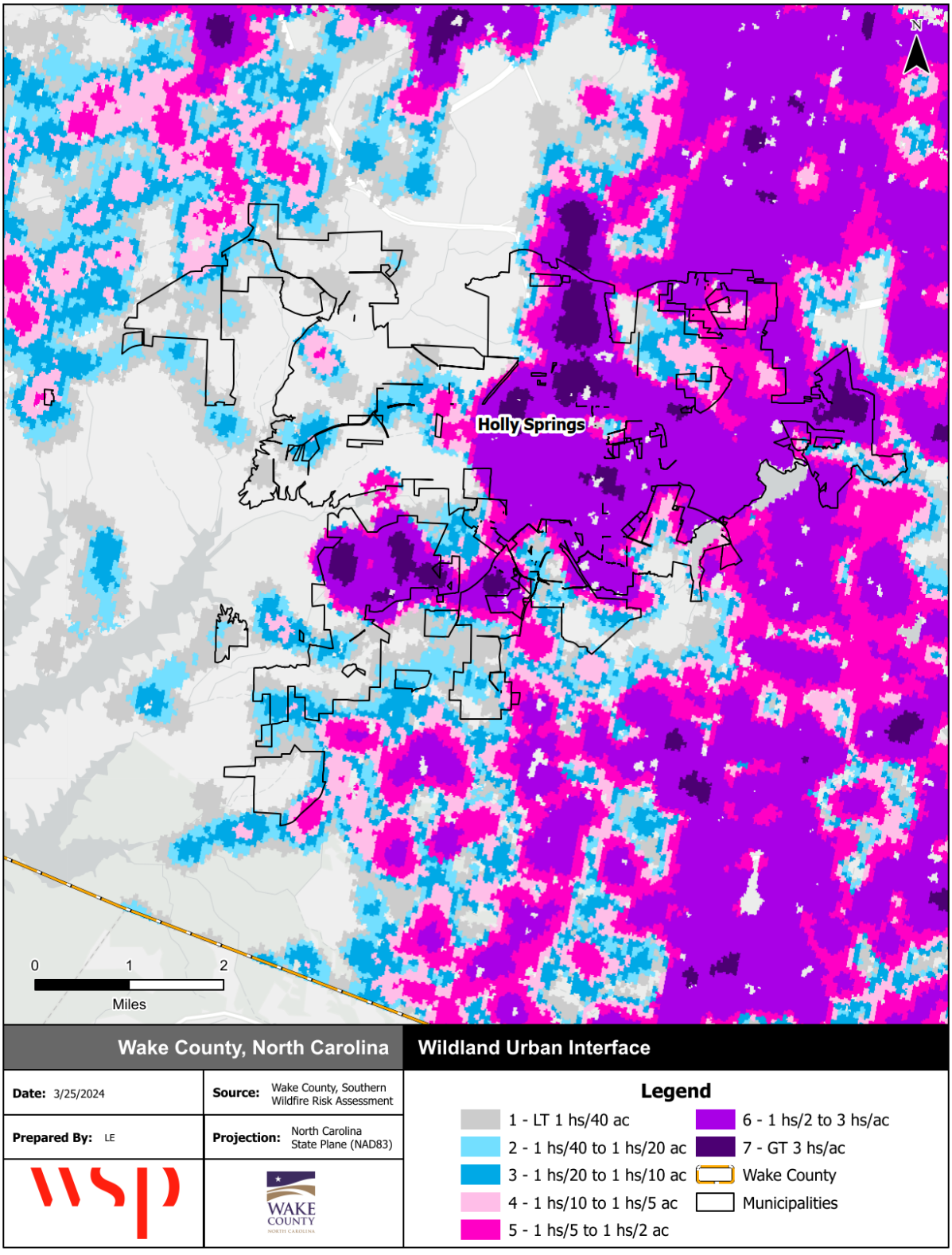
Table G.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table G.7 – Critical Facilities Exposed to Wildfire, Town of Holly Springs

Type	Critical Facility Count	Structure Value
Communications	0	$0
Energy	8	$5,121,781
Food, Hydration, Shelter	2	$13,297,116
Hazardous Materials	14	$535,404,797
Health and Medical	3	$9,603,459
Safety and Security	6	$24,082,271
Transportation	0	$0
Water Systems	10	$69,868,667
Total	**43**	**$657,378,091**

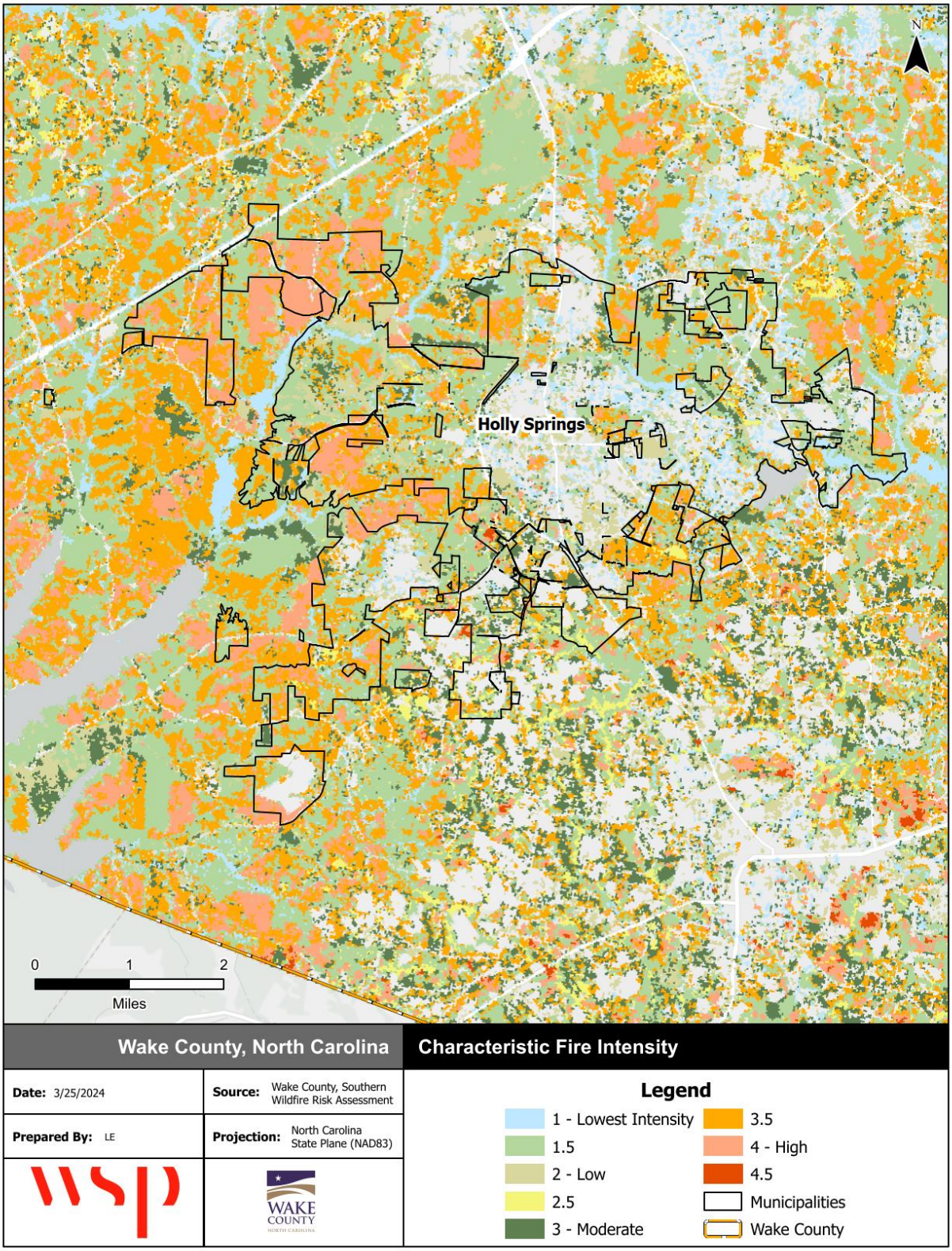
Source: Southern Wildfire Risk Assessment

Figure G.5 – Wildland Urban Interface, Town of Holly Spring



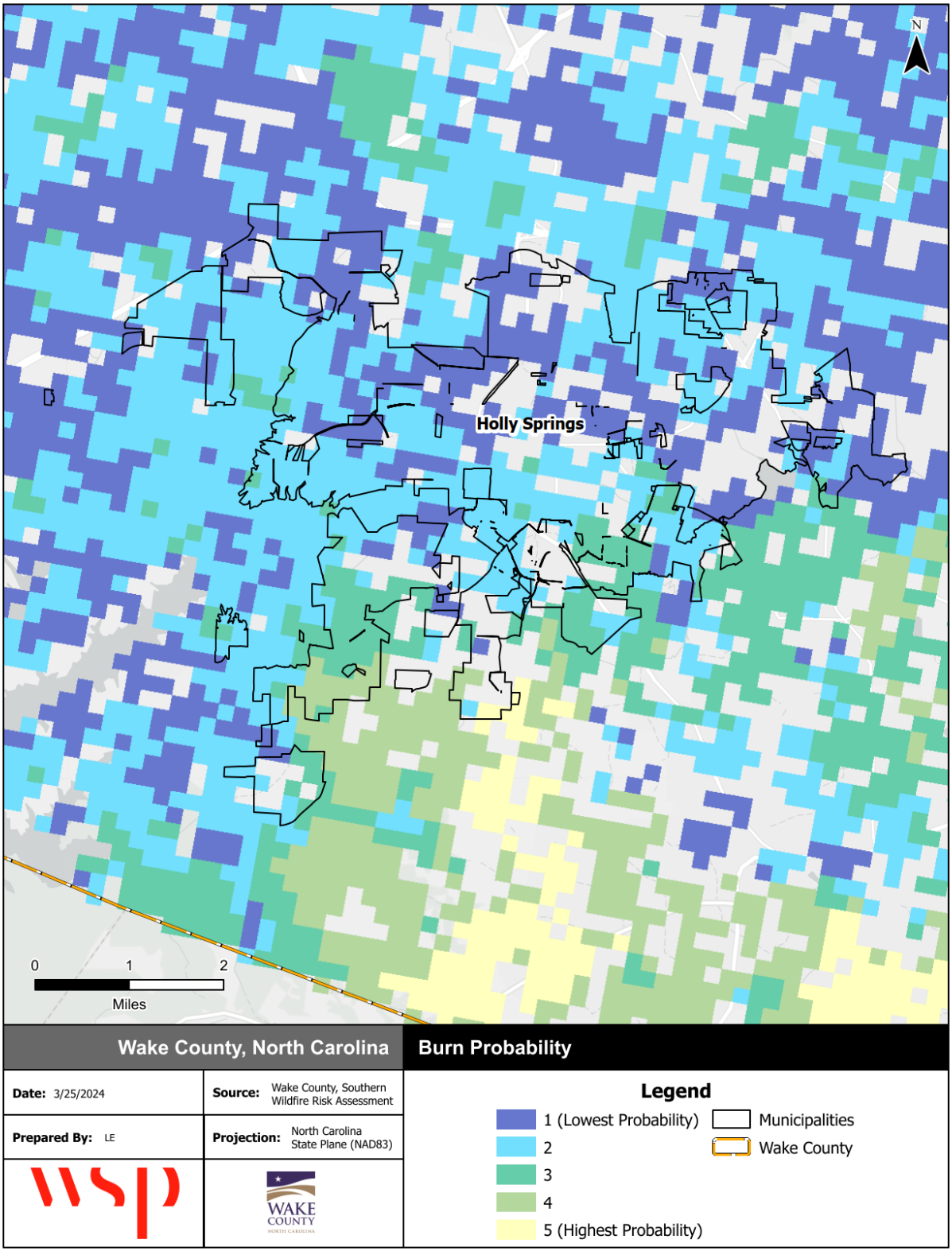
Source: Southern Wildfire Risk Assessment

Figure G.6 – Fire Intensity Scale, Town of Holly Springs



Source: Southern Wildfire Risk Assessment

Figure G.7 – Burn Probability, Town of Holly Springs



Source: Southern Wildfire Risk Assessment

G.2 MITIGATION STRATEGY

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Vision Holly Springs Comprehensive Plan - The Town has an existing Comprehensive Plan which includes Land Use, Parks and Recreation, Public Safety, Economic Development, Transportation, Public Utilities and Environment. This plan includes past and current conditions and sets goals for future needs of the Town. The Hazard Mitigation Plan will be incorporated as an additional component of the CGP at plan update.	4	2	All	Moderate	Holly Springs Planning & Zoning	To be determined	Local	1 year	In-Progress – Carry Forward	Last update occurred in 2021. The Holly Springs Comprehensive Plan is a fluid plan that will be updated and changed continually.
P-2	Implement Floodplain Development Regulations related to participating in the National Flood Insurance Program	4	1	Flood	High	Holly Springs Engineering	Staff time	Local	2-3 years	Not Started – Carry Forward	On-going process that will need to be changed as circumstances and regulations change.
P-3	Water Emergency Response Plan - Develop Water Emergency Response Plan in accordance with EPA mandate with wastewater emergency plan developed voluntarily.	3	2	All	High	Holly Springs Public Utilities, Engineering	To be determined	Local	3-5 years	In-Progress – Carry Forward	With the development of the wastewater filtration facility expansion, current plans need reviews and revisions to include Sanford facility. Will be deleted on next update.
Property Protection											
PP-1	Building Acquisition and Clearance - The Town is willing to develop a plan designed to utilize Federal grant resources to assist private property owners in purchasing properties located in flood hazard zones.	3	2	Flood	Low	Holly Springs Code Enforcement	Staff time; acquisition costs TBD on case by case basis	Local, State, Federal	2-3 years	Not Started – Carry Forward	Target for development of plan to enable this activity is now 5-10 year implementation. Carry forward until funding needs are met.
PP-2	Building Relocation - The Town is willing to develop a plan designed to utilize Federal grant resources to assist private property owners in relocating existing structures out of flood hazard zones.	3	2	Flood	Low	Holly Springs Code Enforcement	Staff time; relocation costs TBD on case by case basis	Local, State, Federal	2-3 years	Not Started – Carry Forward	Target for development of plan to enable this activity is now 5-10 year implementation. Carry forward until funding needs are met.
PP-3	Building Retrofit - The Town is willing to develop a plan to utilize Federal grant resources to assist private property owners in renovating and retrofitting existing structures in flood hazard zones to reduce vulnerability to flooding damage.	3	2	Flood	Low	Holly Springs Code Enforcement	Staff time; retrofitting costs TBD on case by case basis	Local, State, Federal	2-3 years	Not Started – Carry Forward	Target for development of plan to enable this activity is now 5-10 year implementation. Carry forward until funding needs are met.

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
PP-4	Purchase of Open Space, Parks and Greenways – As part of new residential development, the Town collects dedicated open space and parkland, or fees-in-lieu of dedication to then purchase land in accordance with Town of Ordinance requirements and Comprehensive Planning documents. The Town also works with Wake County and other agencies to find other funding for open space acquisition. Once funds are obtained the Town will acquire land consistent with Land Use and Master Open Space Plans.	4	2	Flood	Moderate	Holly Springs Parks and Recreation	Land Cost	County & State Agencies	More than 5 years	In-Progress – Carry Forward	This is an ongoing goal to create open space, parks, and greenways in pace with the growth of the community
PP-5	Backup Power to Fire and Police Stations – The Town provides backup power to all fire and police stations. Fire Station 1 – backup power provided by a grant; backup power to Fire Station 2 and Fire Station 3 and Police Station provided by local funds.	3	1	All	High	Holly Springs Public Safety	Requires new facility. Cost unknown at this time.	Local, Federal	3-5 Years	In-Progress – Carry Forward	The new station is under construction, and we are finalizing contract with generator specifications. Will be completed by next update.
PP-6	Emergency Generator for Public Works Building	3	1	All	Moderate	Holly Springs Public Works	To be determined	Local	3-5 Years	In-Progress – Carry Forward	The Town currently has an emergency generator to provide power to the Front Office of the Public Works Building during emergencies. The building personnel are getting relocated to a new facility. That facility is slated to be built in the next few years. Still in the planning phase and this new facility will include a generator.
PP-7	Install additional Generators	3	1	All	High	Holly Springs Public Utilities	To be determined	Local	1 year	In-Progress – Carry Forward	We have 3 new lift stations with 1 at a new fire station that are not built yet and do not have generators. Carry forward until stations are complete with generators. Will be deleted on next update.
PP-8	Build a Regional Pump Station to alleviate capacity concerns, reduce flood damages, and avoid infrastructure investments in older existing pump stations that are located in moderate and high flood risk areas.	3	2	All	High	Holly Springs Utilities and Infrastructure	$8 million	Local, Federal	5 years	New	One existing pump station located in the SFHA is incompatible with newer lines and repeatedly failing, causing the release of wastewater into the floodplain and requiring costly response and cleanup. Construction of this Regional Pump Station will reduce wastewater flowing to this station and two others that flow to it, alleviating capacity concerns, reducing future flood damages, and reducing infrastructure upgrades in flood prone areas.
Natural Resource Protection											
NRP-1	Restore bank stability and floodplain on Middle Creek.	3	2	Flood	High	Holly Springs Utilities and Infrastructure	$250,000	Grant, Local	2-3 years	New	The Town is pursuing a Water Resources Development (WRD) grant to implement this project.
Structural Projects											
S-1	The Town is in the process of pursuing options to improve the existing spillway or create a secondary spillway. Per an agreement with NC Dam Safety, this will be completed within the next 5 years.	3	2	Flood, Dam Failure	High	Holly Springs Engineering, Parks & Recreation	Over $100,000	Local	3-5 years	In-Progress – Carry Forward	This project is in design, it was delayed due to dispute between FEMA/Dam safety

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-2	Reservoirs/Retention/Detention Basins - The Town does not currently maintain any retention or detention basins. The Town does maintain Bass Lake Dam. The Town regularly provides maintenance of vegetation and minor erosion while providing visual inspections of the dam. If larger repairs are required, the Town will find appropriate means to resolve the problem. The Town also has a few small ponds located on existing parks. The Town maintains these ponds consistent with measures taken to maintain the Bass Lake Dam.	3	1	Flood	Moderate	Holly Springs Parks & Recreation	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	Consistently and correctly maintains all ponds and dams. Ongoing project.
S-3	Geotechnical investigation to establish data for risk analysis and development of engineering designs/solutions	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-4	Build upstream dam to reduce load on existing dam	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-5	Property Acquisition in inundation area(s) below dam	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-6	Raise crest of dam to increase storage capacity	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-7	Add additional spillways, widen or lower existing spillways to increase discharge capacity	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-8	Warning systems to alert downstream areas of potential dam failure	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
S-9	Improve flow path below dam to increase conveyance capacity	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-10	Encourage conservation or re-forestation of upstream land to reduce runoff	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-11	Development of community Stormwater Management Plans for upstream communities	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-12	Complete an Emergency Action Plan in conjunction with NCDEQ for all High Hazard Dams in the county	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-13	Permanently breach hazardous dams, or modify risers such that dam can no longer impound water, but may still provide attenuation of peak flooding by acting as a stormwater retention feature	3	3	Dam Failure	Moderate	Town of Holly Springs	To be determined	Local, State, Federal	5 years	Carry Forward	The Town of Holly Springs plans to make modifications to the Bass Lake Dam which was identified as a high hazard dam by NCDEQ. To pursue potential funding under the FEMA High Hazard Dam Repair Program this action was included as an amendment to the 2019 Wake County HMP.
S-14	New Water Filtration Facility Expansion Project	1	1	Drought	High	Holly Springs Utilities & Infrastructure	Over $65 Million	Local, Grants, Bonds	2-5 Years	New	In order to meet current and future water needs due to the growth in population, Holly Springs has partnered with Pittsboro and Fuquay-Varina to expand the Sanford water treatment facility along a 14 mile conveyance line.
Emergency Services											
ES-1	Technical Rescue Capabilities - Provide and enhance technical rescue capabilities more equitably throughout the Town.	2	2	All	High	Holly Springs Public Safety	No cost	Local, Federal	3-5 Years	In-Progress – Carry Forward	We have done training for confined spaces but do not have any training capabilities for swift water rescue.
ES-2	Tabletop Exercise Program - Continue to conduct disaster tabletop exercise program with Wake County	2	2	All	High	Holly Springs Public Safety	Staff time	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	As the county went through a reorganization and population growth, the needs for training/exercises have increased throughout all jurisdictions. Carry forward until staffing is adequate with county resources.
ES-3	Counseling – Police psychologist and Critical Incident Stress Debriefing Team training to provide debriefing sessions for personnel.	2	1	All	High	Holly Springs Police Department	Staff time	Local	5 years	In-Progress – Carry Forward	Currently the Town police department has a contract for services. The need will be continuous as mental health services and peer support expand with various sensitive incidents. Will be deleted on next update.

Town of Holly Springs											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
ES-4	Development of Town Emergency Operations Plan and Continuity of Operations Plan	2	2	All	High	Holly Springs Public Safety	Staff Time	Local	1-2 Years	New	Currently under the Wake County EOP. Partially completed draft of the Town's own Emergency Operations Plan. Open for departments revisions. On-going process still awaiting implementation. COOP to follow.
Public Education and Awareness											
PEA-1	Environmental Education	1	1	Flood, Drought	High	Holly Springs Engineering	Staff time and O&M costs	Local	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town currently has a program which includes environmental education for the public through Town festivals (Holly Fest), public meetings, brochures and preconstruction meetings. The Town operates the Bass Lake Retreat Center which will allow for space to hold additional environmental education activities. The Town will also expand its current education activities to meet NPDES Phase II requirements. The Town's Environmental Education focuses on flooding, drainage, the National Flood Insurance Program, NPDES Phase II, Erosion & Sedimentation Control, Habitat Preservation, etc.

H. TOWN OF KNIGHTDALE

H.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Knightdale. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Knightdale. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

H.1.1 CRITICAL FACILITIES

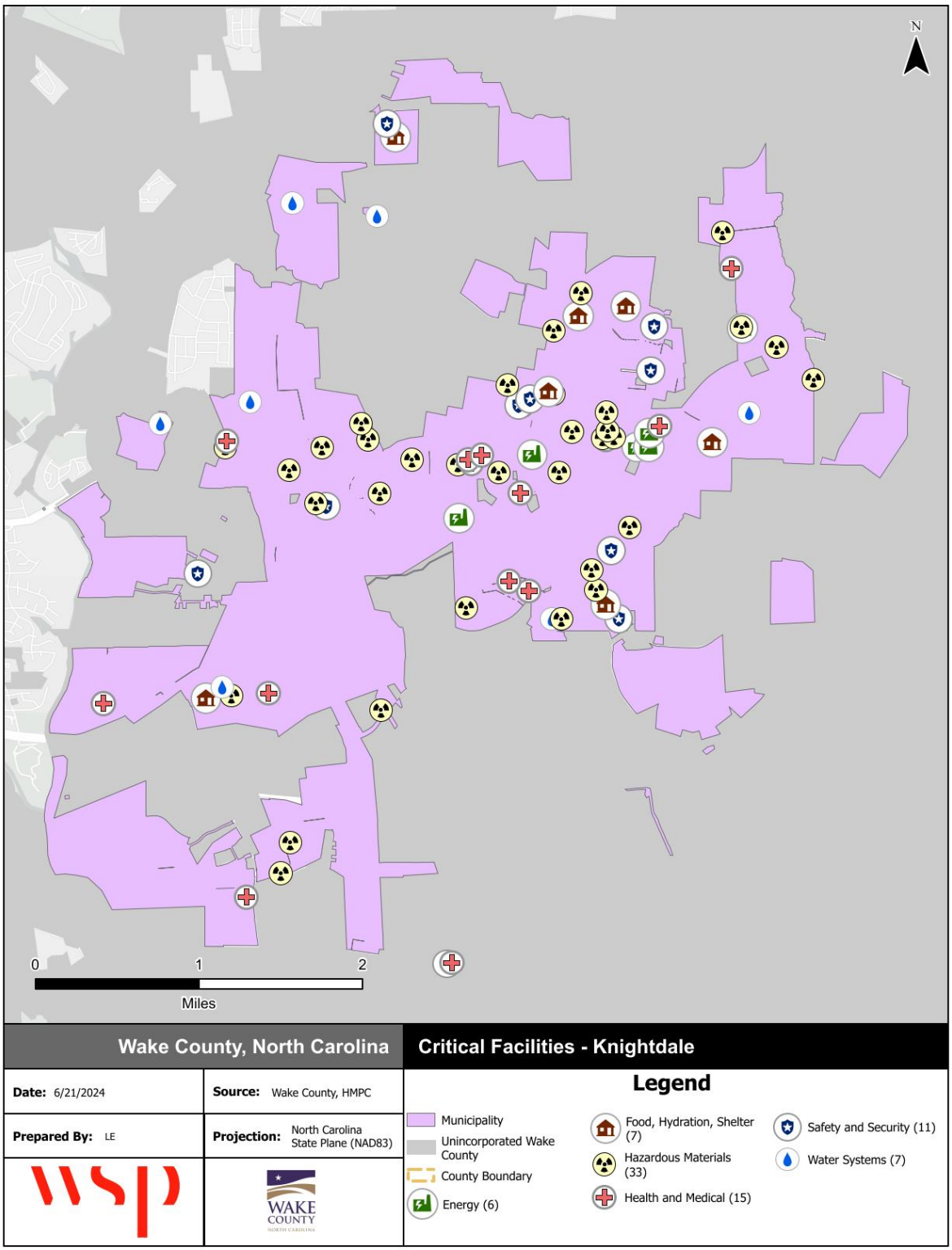
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table H.1 provides a count of critical facilities by FEMA lifeline category within the Town of Knightdale. Figure H.1 shows the locations of all critical facilities within the Town of Knightdale.

Table H.1 – Critical Facilities by Type, Town of Knightdale

Facility Type	Count of Facility Type	Structure Value
Communications	0	$0
Energy	11	$6,907,662
Food, Hydration, Shelter	8	$18,103,555
Hazardous Materials	52	$180,345,147
Health and Medical	17	$16,277,939
Safety and Security	12	$120,613,192
Transportation	0	$0
Water Systems	14	$4,135,817
Total	**114**	**$346,383,312**

Source: Wake County, HMPC

Figure H.1 – Town of Knightdale Critical Facilities

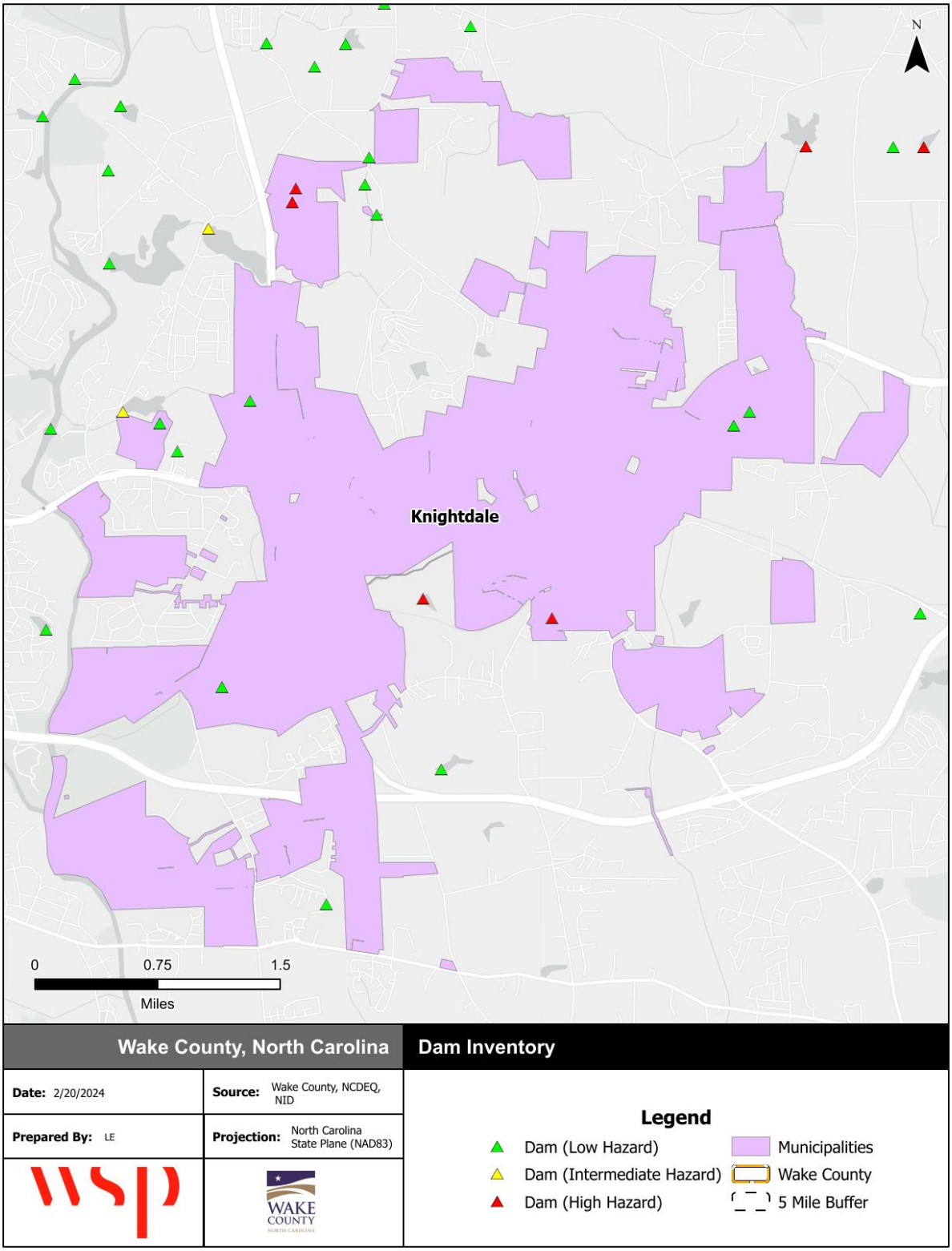


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

H.1.2 DAM FAILURE

Currently, the Town of Knightdale has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure H.2 shows the location of all dams in the Town of Knightdale.

Figure H.2 – Dam Inventory, Town of Knightdale



Source: North Carolina Dam Inventory, February 2024

H.1.3 FLOOD

Table H.2 details the acreage of the Town of Knightdale by flood zone on the effective DFIRM. Per this assessment, over 5 percent of the Town of Knightdale falls within the mapped 1%-annual-chance floodplains.

Table H.2 – FEMA Flood Hazard Areas, Town of Knightdale

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	332.5	5.4
Zone X (500-year)	26.2	0.4
Zone X Unshaded	5,780.2	94.2
Total	**6,138.9**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure H.3 reflects the effective mapped flood hazard zones for the Town of Knightdale, and Figure H.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table H.3 provides building counts and values for critical facilities by flood zone in the Town of Knightdale.

Table H.3 – Critical Facilities Exposed to Flooding, Town of Knightdale

Flood Zone	Critical Facility Count	Structure Value
AE	11	$96,884,156
X	100	$218,577,181
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	3	$30,921,975
Total	**114**	**$346,383,312**

Source: FEMA Effective DFIRM

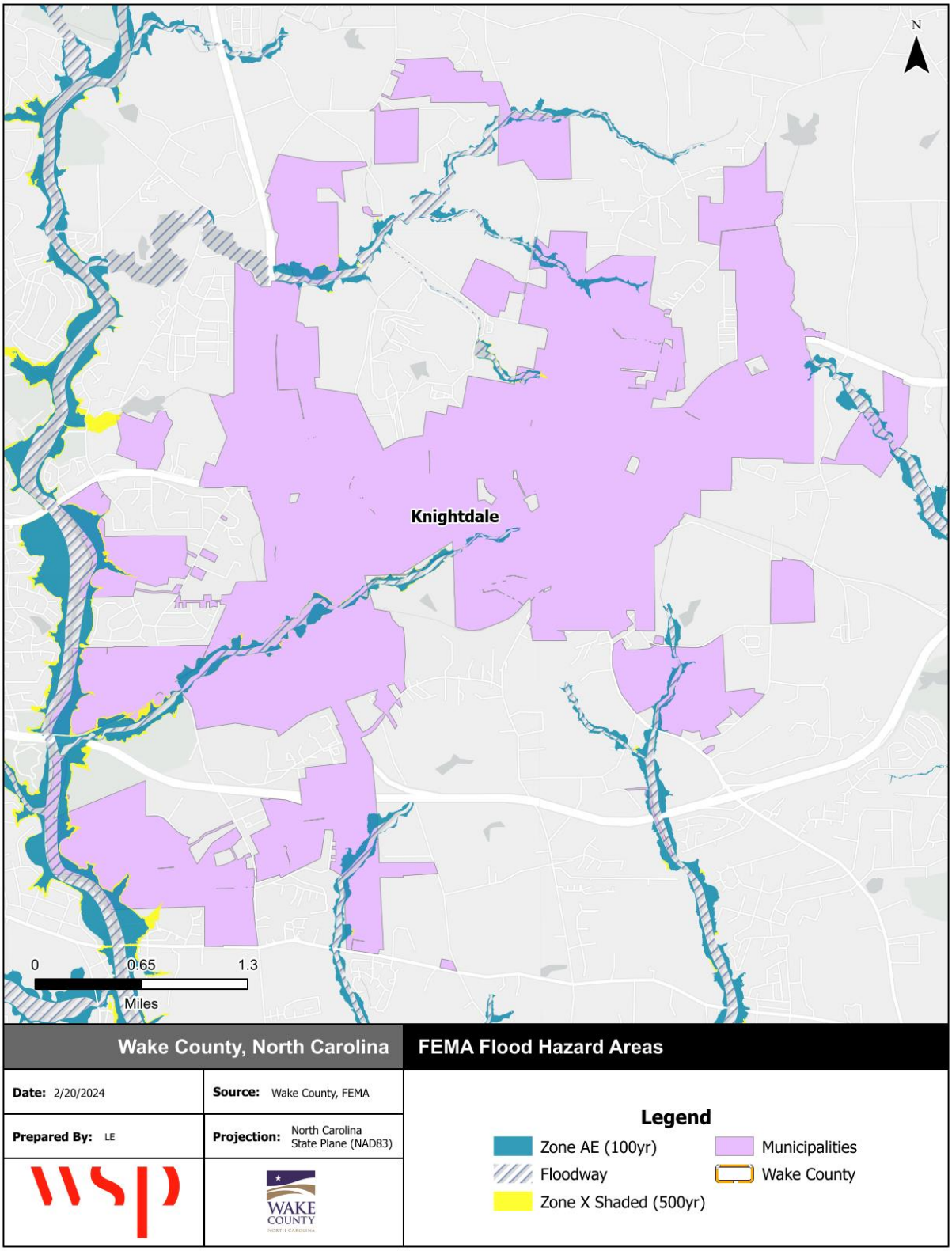
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $3.9 million in building related damages. The results of the Hazus loss estimate are summarized in Table H.4.

Table H.4 – HAZUS 100-Year Flood Results, Town of Knightdale

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	4	$316,000	$34,000	$107,000	$141,000	45%
Commercial	12	$1,484,000	$95,000	$311,000	$406,000	27%
Educational	1	$56,000	$2,000	$15,000	$17,000	30%
Government	0	$0	$0	$0	$0	0%
Industrial	8	$230,000	$42,000	$139,000	$181,000	79%
Religious	3	$186,000	$11,000	$86,000	$97,000	52%
Residential	33	$3,983,000	$2,075,000	$1,077,000	$3,152,000	79%
Total	**61**	**$6,255,000**	**$2,259,000**	**$1,735,000**	**$3,994,000**	**64%**

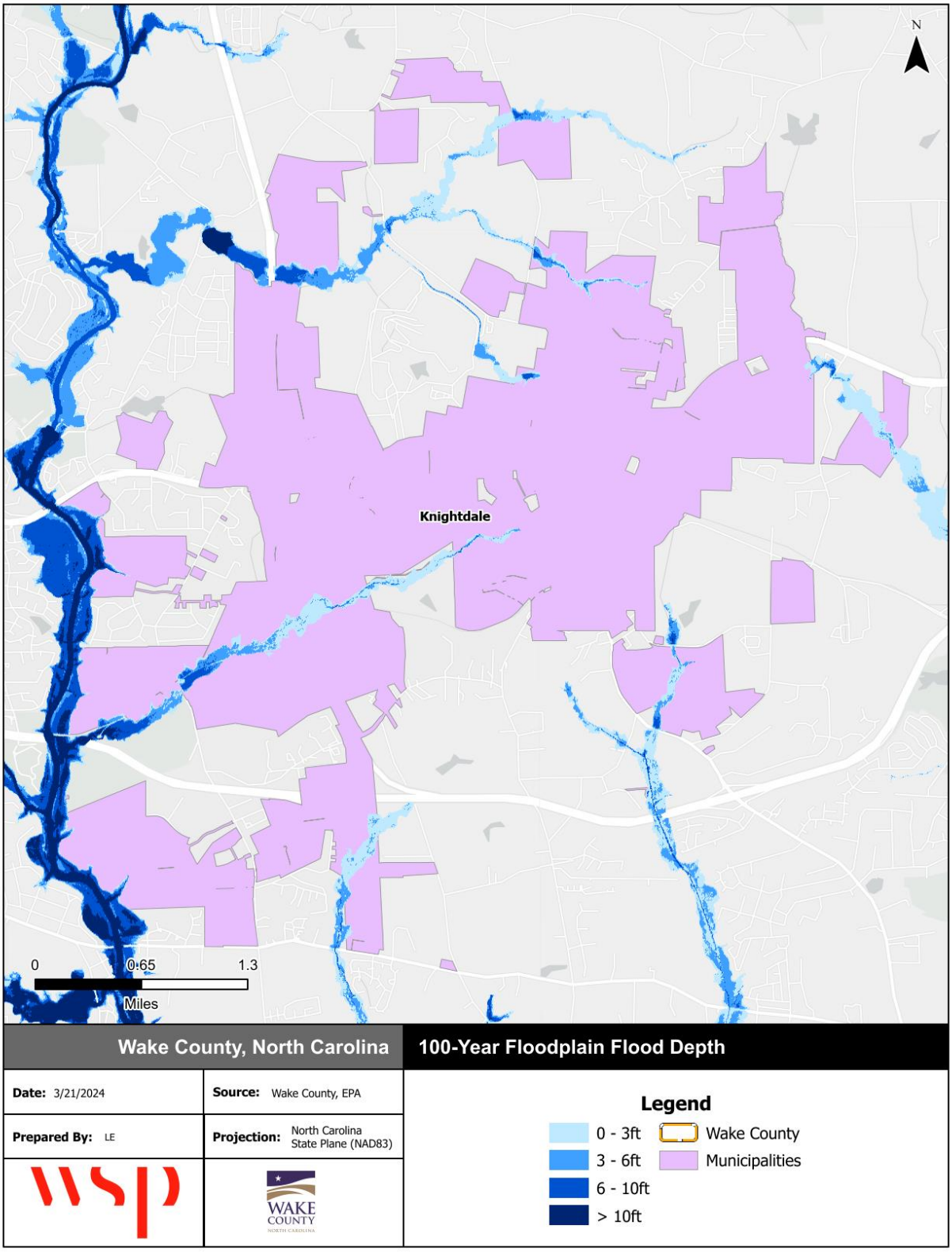
Source: FEMA Natural Hazards Risk Assessment Program

Figure H.3 – FEMA Flood Hazard Areas, Town of Knightdale



Source: FEMA Effective DFIRM

Figure H.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Knightdale



Source: FEMA Effective DFIRM

H.1.4 WILDFIRE

Table H.5 summarizes the acreage in the Town of Knightdale that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 14 percent of the Town of Knightdale is not included in the WUI.

Table H.5 – Wildland Urban Interface Acreage, Town of Knightdale

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	915.29	14.9%
	LT 1hs/40ac	524.44	8.5%
	1hs/40ac to 1hs/20ac	374.63	6.1%
	1hs/20ac to 1hs/10ac	493.67	8.0%
	1hs/10ac to 1hs/5ac	574.03	9.4%
	1hs/5ac to 1hs/2ac	918.28	15.0%
	1hs/2ac to 3hs/1ac	1,992.67	32.5%
	GT 3hs/1ac	345.91	5.6%
	Total	**6,138.91**	**100%**

Source: Southern Wildfire Risk Assessment

Figure H.5 depicts the WUI for the Town of Knightdale. Figure H.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure H.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Areas of high potential fire intensity are scattered throughout the outer regions of Knightdale and overlap with areas of the WUI in the southern and northeaster portions of the town. However, burn probability is predominately low throughout the town, meaning development in these areas is at low to no risk. However, the burn probability in the southeast region is moderately high and intersects with the WUI.

Table H.6 provides the count and estimated value of all structures that intersect with areas of the Town of Knightdale that are rated moderate to high on the WUI Risk Index.

Table H.6 – Structures at Risk to Moderate-High WUI Risk Index, Town of Knightdale

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	51	$6,756,565	$6,756,565	$13,513,130
Commercial	185	$255,016,188	$255,016,188	$510,032,376
Education	16	$106,522,236	$106,522,236	$213,044,472
Government	26	$41,320,804	$41,320,804	$82,641,608
Industrial	46	$240,188,893	$360,283,340	$600,472,233
Religious	16	$30,168,738	$30,168,738	$60,337,476
Residential	6975	$2,197,092,000	$1,098,546,000	$3,295,638,000
Total	**7,315**	**$2,877,065,424**	**$1,898,613,871**	**$4,775,679,295**

Source: Southern Wildfire Risk Assessment

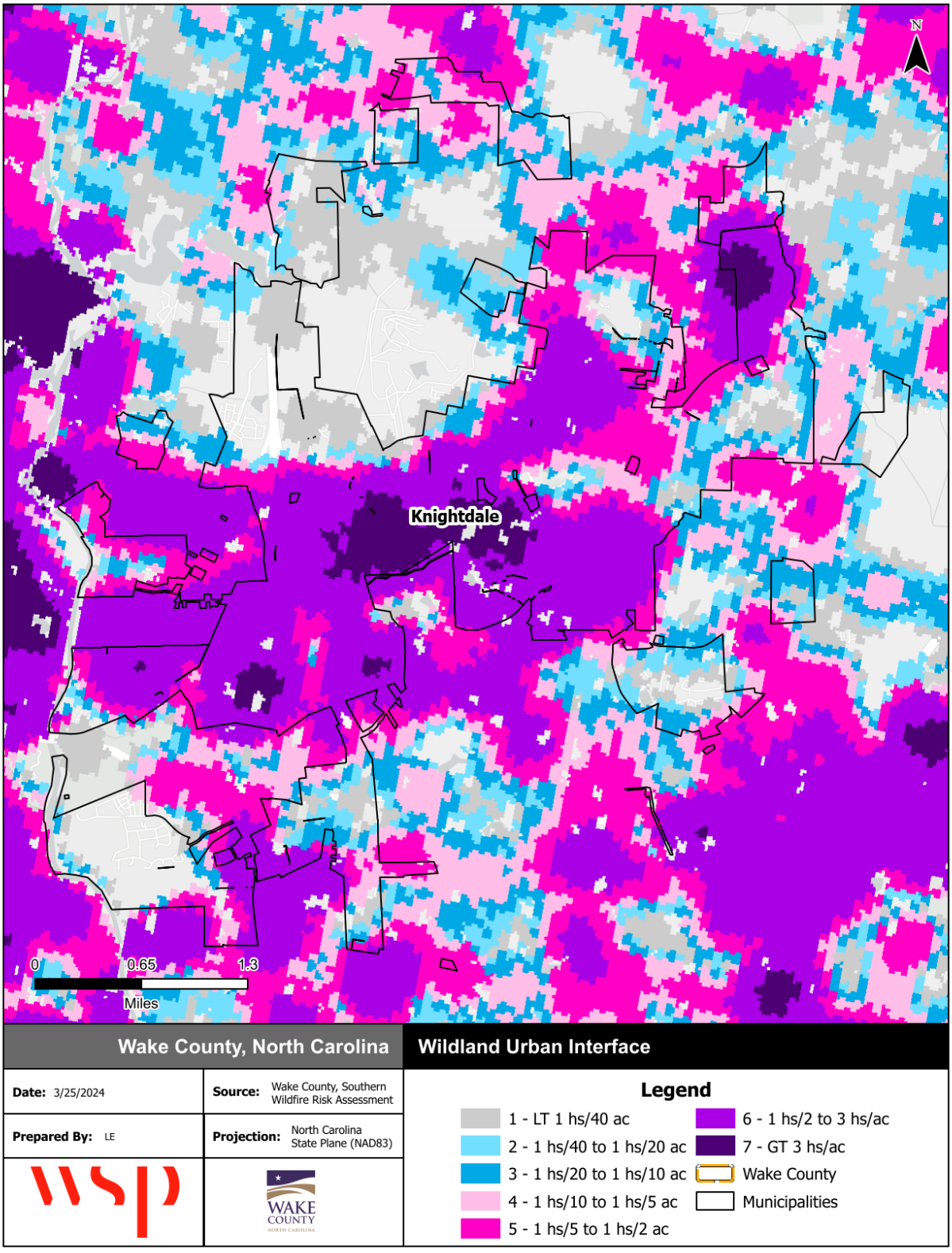
Table H.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table H.7 – Critical Facilities Exposed to Wildfire, Town of Knightdale

Type	Critical Facility Count	Structure Value
Communications	0	$0
Energy	8	$5,812,381
Food, Hydration, Shelter	7	$8,408,752
Hazardous Materials	33	$141,727,975
Health and Medical	17	$16,277,939
Safety and Security	11	$120,600,482
Transportation	0	$0
Water Systems	8	$3,173,563
Total	**84**	**$296,001,092**

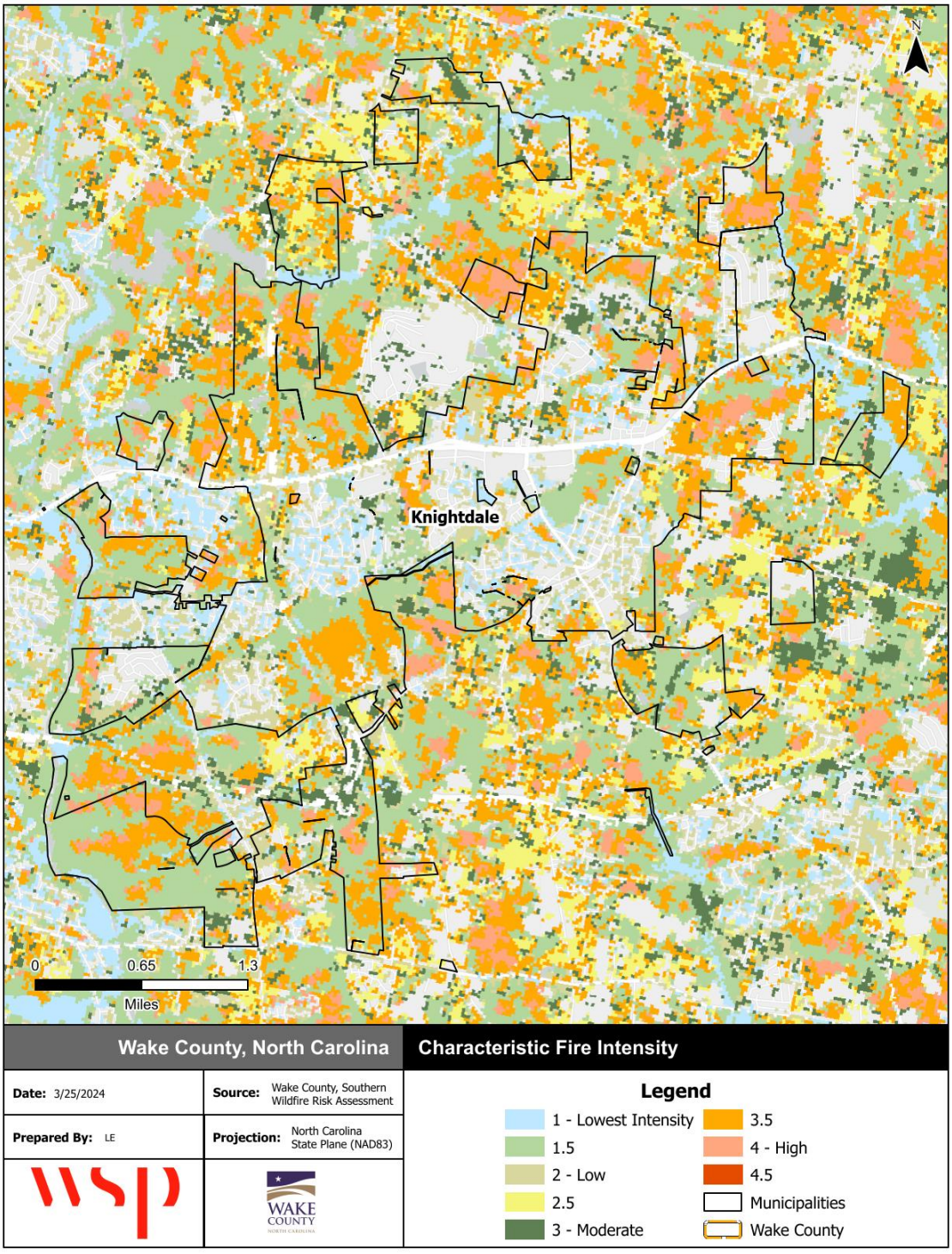
Source: Southern Wildfire Risk Assessment

Figure H.5 – Wildland Urban Interface, Town of Knightdale



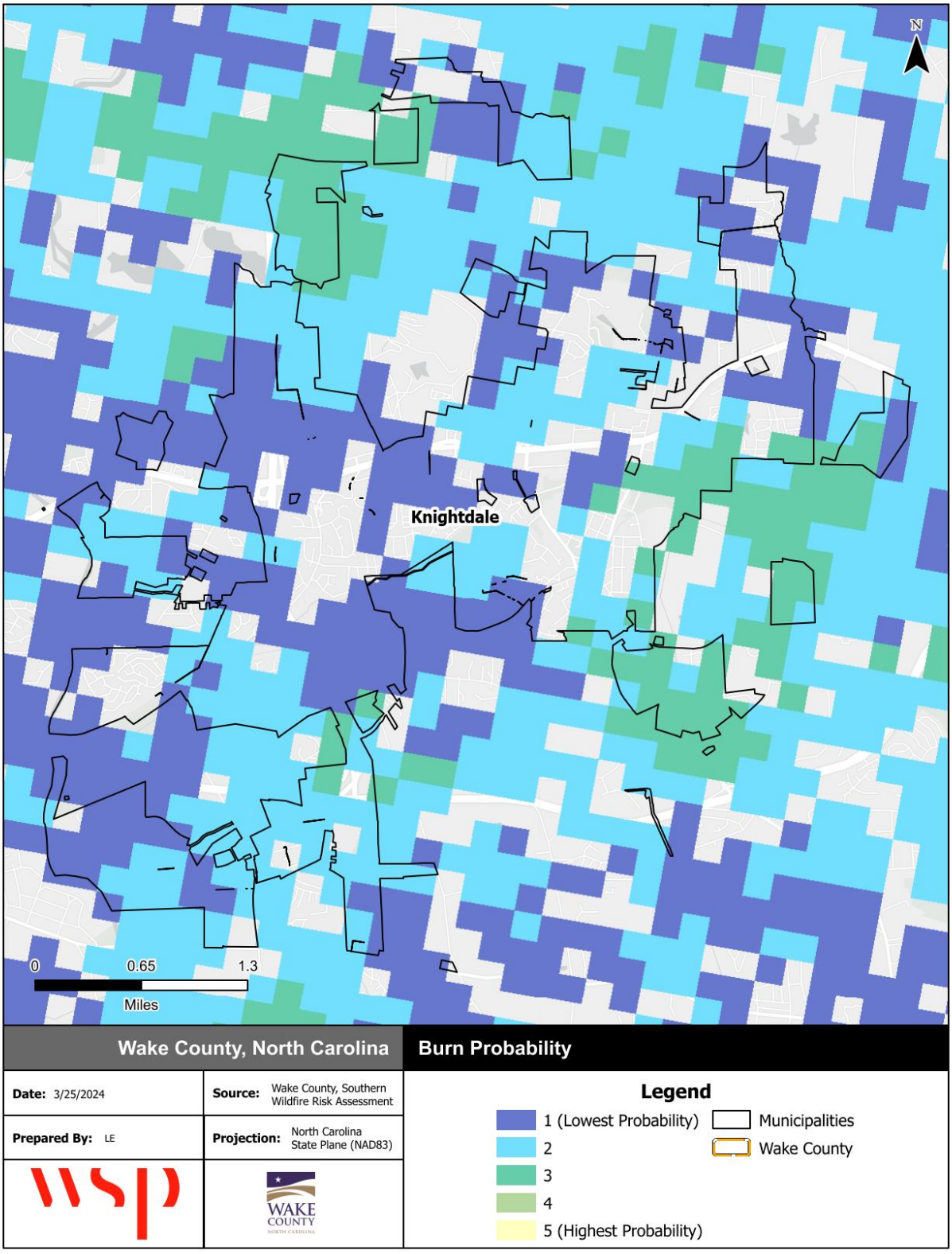
Source: Southern Wildfire Risk Assessment

Figure H.6 – Fire Intensity Scale, Town of Knightdale



Source: Southern Wildfire Risk Assessment

Figure H.7 – Burn Probability, Town of Knightdale



Source: Southern Wildfire Risk Assessment

H.2 MITIGATION STRATEGY

Town of Knightdale											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Pursue Grants to Acquire, Elevate and or Relocate Flood Prone Structures and Property.	3	1	Flood, Dam Failure, Hurricane & Tropical Storm	High	Knightdale Planning	Over $1m	Local, State, Federal	Ongoing - Next 5 Years	Not Started – Carry Forward	This has not been necessary since there have been no affected structures and/or property. The Town will evaluate opportunities to purchase property for future events.
P-2	Establish post-disaster clean-up procedures.	2	1	All	High	Knightdale Public Works	$250,000	Internal	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town will continuously evaluate post-disaster clean-up procedures.
P-3	Prepare debris removal and disposal plan.	2	1	Dam Failure, Earthquake, Hurricane & Tropical Storm, Landslide, Severe Weather, Severe Winter Storm, Tornado	Moderate	Knightdale Public Works	Over $1m	Internal, FEMA, NCEM	Ongoing - Next 5 Years	In-Progress – Carry Forward	The Town will continuously evaluate debris removal and disposal plan
P-4	Protect and Obtain Land for the Little River Reservoir.	3	1	Drought	Moderate	City of Raleigh Public Utilities	Over $1m	Internal, City of Raleigh	Ongoing - Next 5 Years	In-Progress – Carry Forward	City of Raleigh is responsible for implementation
Structural Projects											
SP-1	Poplar Street Drainage & Stormwater Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$450,000	Local, federal	Ongoing - Next 5 Years	New	Construction of a dry detention basin to help alleviate drainage issues downstream; addition of a swale to aid in conveyance of runoff to the dry detention basin to maximize the capture of offsite drainage
SP-2	Park Avenue Stormwater & Drainage Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$650,000	Local, federal	Ongoing - Next 5 Years	New	Redirection of stormwater drainage to alleviate flooding within a section of downtown; installation of curb and gutter and new storm system
SP-3	Forest Dr Stormwater Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$225,000	Local, federal	Ongoing - Next 5 Years	New	Capture and mitigate flash flood rain events to alleviate flooding and erosion in down stream residential area.
SP-4	Maplewood/Pebblebrook Stormwater & Drainage Improvements	3	2	Flood	Moderate	Knightdale Administration, Knightdale Public Works	$700,000	Local, federal	Ongoing - Next 5 Years	New	installation of stormwater infrastructure to alleviate flooding in residential neighborhood

Town of Knightdale											
Emergency Services											
ES-1	Construct Fire Station #1 - 7477 Forestville Rd	3	2	All Hazards	Moderate	Knightdale Fire	$6.8 million	Internal	2-3 Years	New	Anticipated completion August 2024
ES-2	Construct Fire Station #4 - 1325 Hodge Road	3	2	All Hazards	Moderate	Knightdale Fire	$5.4 million	Internal	2-3 Years	New	Operational as of March 2024
ES-3	Construct new Law Enforcement Center - 967 Steeple Square Ct.	3	2	All Hazards	Moderate	Knightdale Administration	$13.5 million	Internal	2-3 Years	New	Anticipated completion December 2025
ES-4	Renovation of Fire Station #3 - 4828 Clifton Rd	3	2	All Hazards	Moderate	Knightdale Fire	$2.1 million	Internal	2-3 Years	New	Completed February 2024
ES-5	Purchase new fire apparatus	3	2	All Hazards	Moderate	Knightdale Fire	$2.5 million	Internal	2-3 Years	New	Two new fire pumpers have arrived and are in service. Two more are apparatus (ladder truck and pumper) are expected in late 2026.
Public Education and Awareness											
PEA-1	Develop a policy for the installation of warning signs concerning lightning, hail and thunderstorms at outdoor public facilities and begin retro-fitting existing spaces.	1	2	Severe Weather, Tornado	Moderate	Knightdale Parks & Recreation	Over $1m	Internal	2-3 years	Not Started – Carry Forward	Due to staff turnover and lack of funding this project has not been completed. This project is still a valuable tool that will be studied for future implementation
PEA-2	Expand the Town's existing fire/smoke alarm program for retro-fitting older structures to include CO alarms.	1	2	Earthquake, Severe Weather, Tornado, Hazardous Materials Incident	Low	Knightdale Fire	about $200,000	Internal, Grants	2-3 years	In-Progress – Carry Forward	The Knightdale Fire Department routinely visits residences to ensure smoke detectors are working properly and participates in the annual fire alarm canvas program.
PEA-3	Have a Town staff member that is a Certified Floodplain Manager.	2	1	Flood, Dam Failure, Hurricane & Tropical Storm	Moderate	Knightdale Engineering/Public Works	$40,000	Internal	2-3 years	In-Progress – Carry Forward	Town staff is working toward Floodplain Manager certification.
PEA-4	Issue an annual local proclamation for Severe Weather Awareness Week and conduct associated promotional activities.	1	1	All	Moderate	Knightdale Fire, Knightdale Community Relations	Staff time	Internal	Ongoing - Next 5 years	Not Started – Carry Forward	Due to staff turnover this item has not been started.
PEA-5	Incentivize the use of cool roofing products through the Town's Water Allocation Policy point system.	4	1	Extreme Heat	Low	Knightdale Planning	Staff time	Internal	3-5 years	Not Started – Carry Forward	During the update to the Town's Water Allocation Policy, this will be evaluated for inclusion.
PEA-6	Implement GovDelivery - email and SMS notification system for real time alerts on traffic advisories and closures, emergencies, etc.	1	2	All	Moderate	Knightdale Community Relations	Staff time, under $10,000	Internal	1 year	New	Launched January 2024

I. TOWN OF MORRISVILLE

I.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Morrisville. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Morrisville. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

I.1.1 CRITICAL FACILITIES

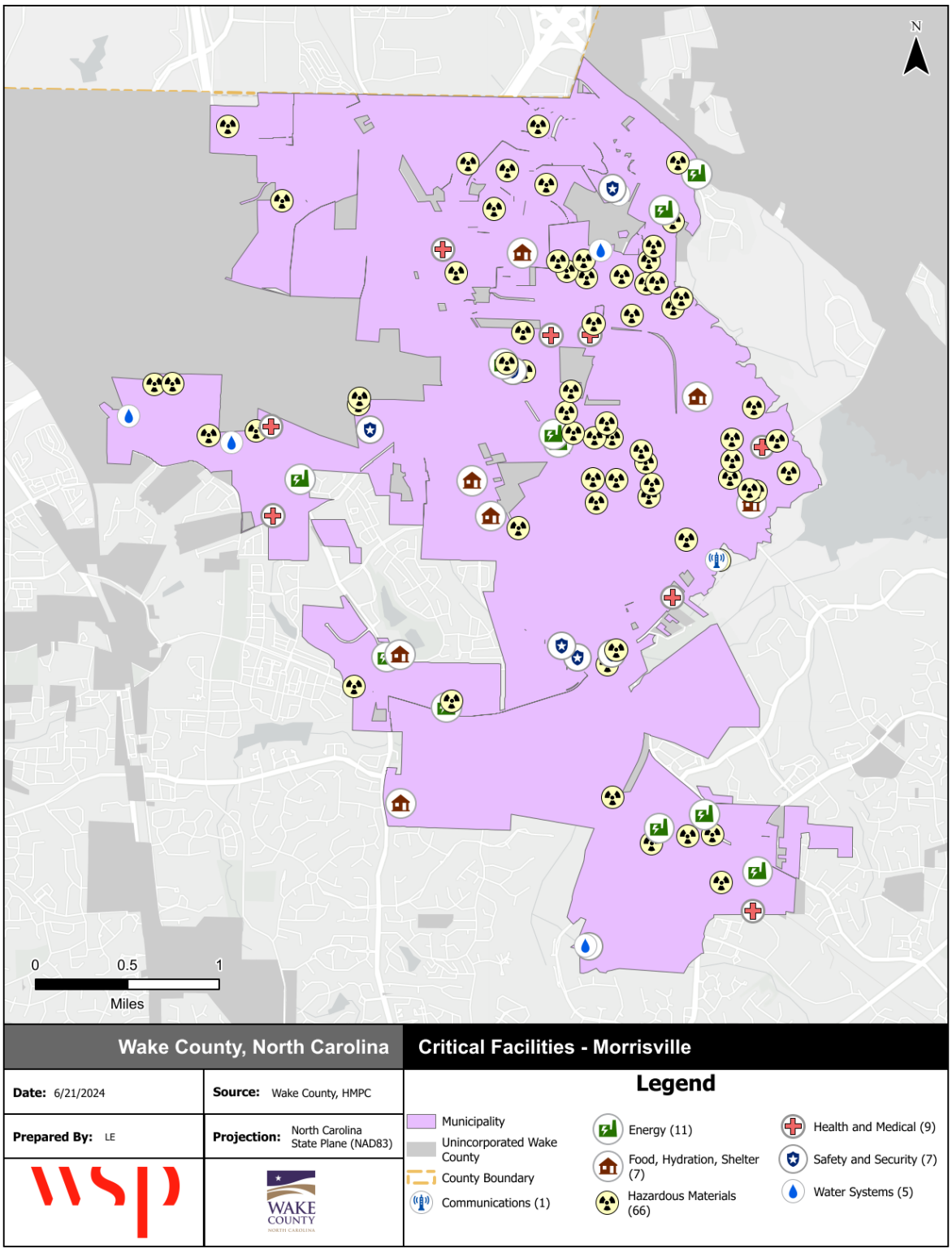
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table I.1 provides a count of critical facilities by FEMA lifeline category within the Town of Morrisville. Figure I.1 shows the locations of all critical facilities within the Town of Morrisville.

Table I.1 – Critical Facilities by Type, Town of Morrisville

Facility Type	Count of Facility Type	Structure Value
Communications	1	$894,505
Energy	11	$12,224,590
Food, Hydration, Shelter	5	$102,160,639
Hazardous Materials	66	$975,913,667
Health and Medical	9	$47,629,329
Safety and Security	7	$11,547,926
Transportation	0	$0
Water Systems	5	$0
Total	**104**	**$1,150,370,656**

Source: Wake County, HMPC

Figure I.1 – Town of Morrisville Critical Facilities

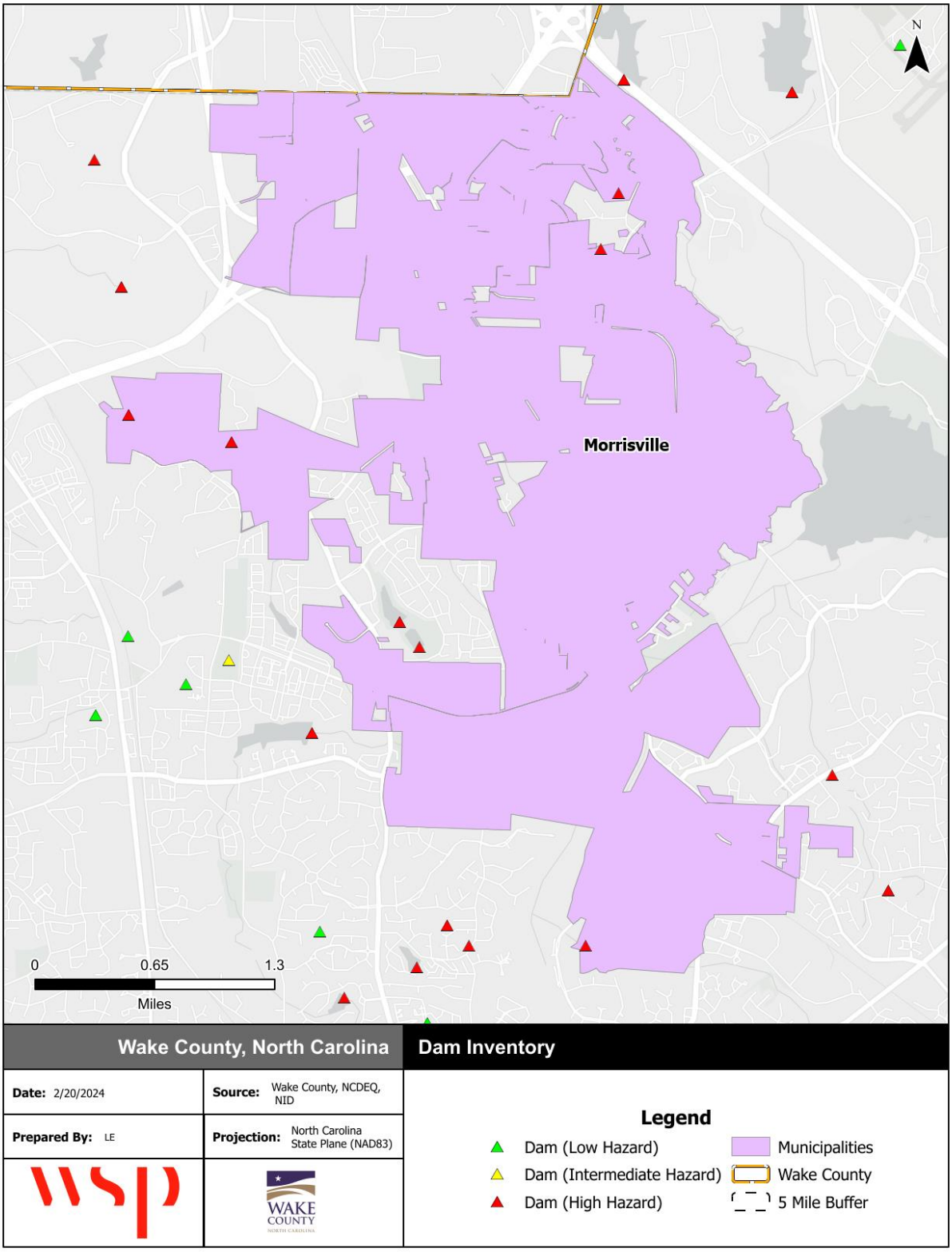


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

I.1.2 DAM FAILURE

Currently, the Town of Morrisville has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure I.2 shows the location of all dams in the Town of Morrisville.

Figure I.2 – Dam Inventory, Town of Morrisville



Source: North Carolina Dam Inventory, February 2024

I.1.3 FLOOD

Table I.2 details the acreage of the Town of Morrisville by flood zone on the effective DFIRM. Per this assessment, over 7 percent of Morrisville falls within the mapped 1%-annual-chance floodplains.

Table I.2 – Flood Zone Acreage, Town of Morrisville

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	434.4	7.4
Zone X (500-year)	79.5	1.4
Zone X Unshaded	5,328.5	91.2
Total	**5,842.4**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure I.3 reflects the effective mapped flood hazard zones for Town of Morrisville, and Figure I.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table I.3 provides building counts and values for critical facilities by flood zone in the Town of Morrisville.

Table I.3 – Critical Facilities Exposed to Flooding, Town of Morrisville

Flood Zone	Critical Facility Count	Structure Value
AE	18	$381,393,991
X	85	$763,292,550
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	1	$5,684,115
Total	**104**	**$1,150,370,656**

Source: FEMA Effective DFIRM

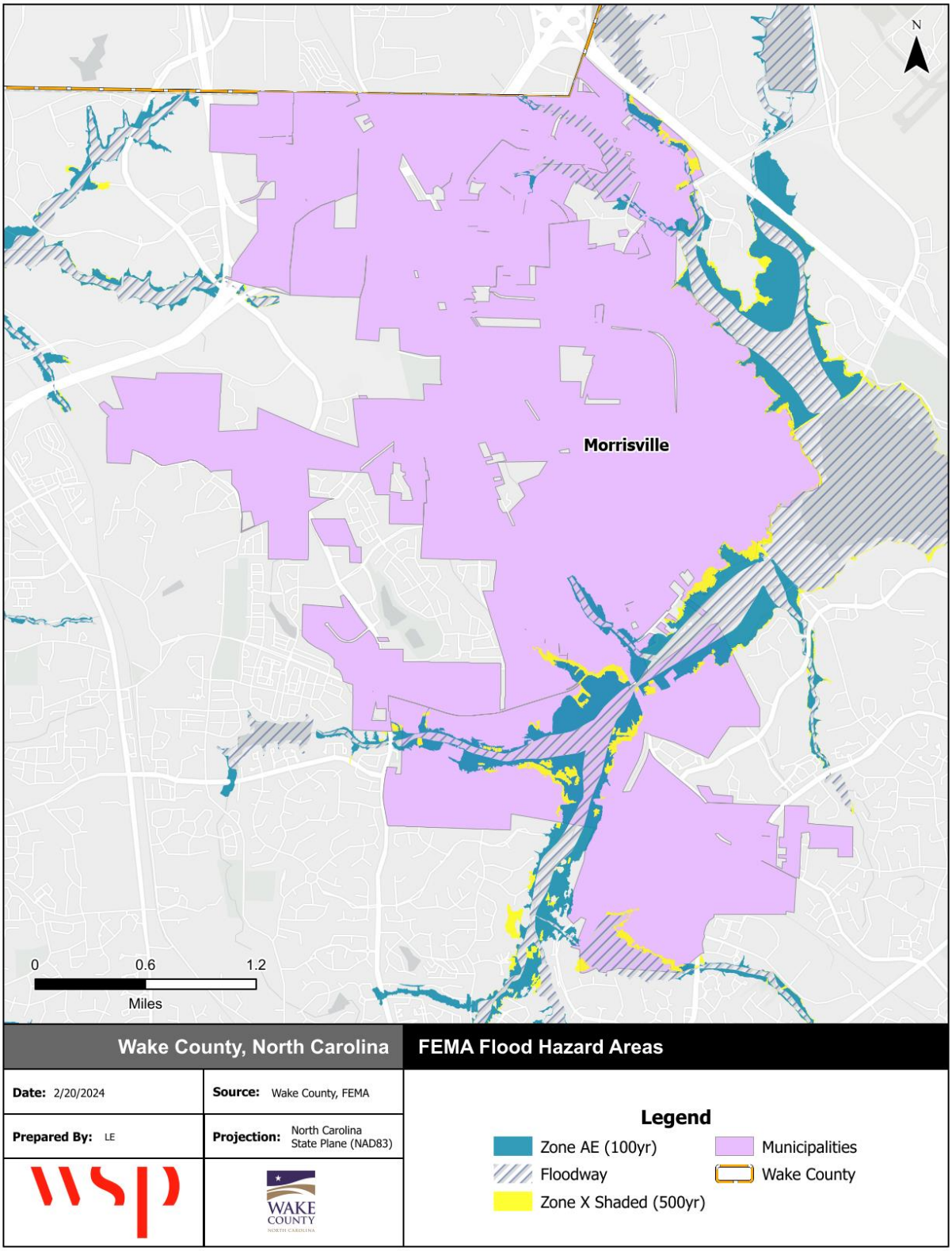
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $47.6 million in building related damages. The results of the Hazus loss estimate are summarized in Table I.4.

Table I.4 – HAZUS 100-Year Flood Results, Town of Morrisville

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	1	$46,000	$4,000	$16,000	$20,000	43%
Commercial	11	$7,127,000	$499,000	$1,449,000	$1,948,000	27%
Educational	2	$201,694,000	$4,313,000	$35,564,000	$39,877,000	20%
Government	1	$214,000	$3,000	$26,000	$29,000	14%
Industrial	4	$487,000	$78,000	$264,000	$342,000	70%
Religious	4	$195,000	$11,000	$81,000	$92,000	47%
Residential	14	$8,289,000	$3,390,000	$1,971,000	$5,361,000	65%
Total	**37**	**$218,052,000**	**$8,298,000**	**$39,371,000**	**$47,669,000**	**22%**

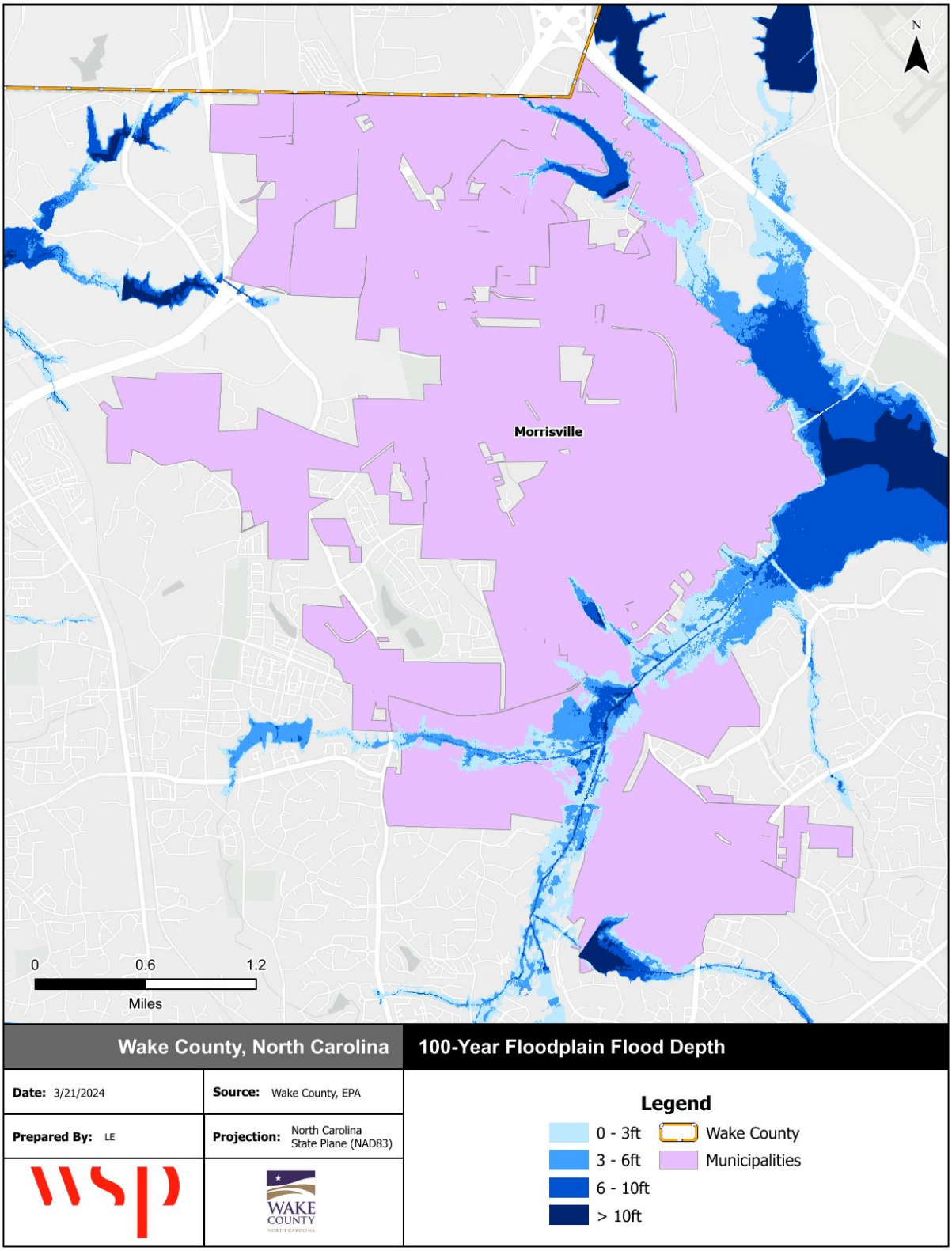
Source: FEMA Natural Hazards Risk Assessment Program

Figure I.3 – FEMA Flood Hazard Areas, Town of Morrisville



Source: FEMA Effective DFIRM

Figure I.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Morrisville



Source: FEMA Effective DFIRM

I.1.4 WILDFIRE

Table I.5 summarizes the acreage in the Town of Morrisville that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 14 percent of the Town of Morrisville is not included in the WUI.

Table I.5 – Wildland Urban Interface Acreage, Town of Morrisville

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	868.22	14.9%
	LT 1hs/40ac	551.64	9.4%
	1hs/40ac to 1hs/20ac	330.18	5.7%
	1hs/20ac to 1hs/10ac	219.60	3.8%
	1hs/10ac to 1hs/5ac	400.32	6.9%
	1hs/5ac to 1hs/2ac	619.66	10.6%
	1hs/2ac to 3hs/1ac	2,032.18	34.8%
	GT 3hs/1ac	800.64	13.7%
	Total	**5,822.46**	**100%**

Source: Southern Wildfire Risk Assessment

Figure I.5 depicts the WUI for the Town of Morrisville. Figure I.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure I.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

North and east Morrisville have the highest potential fire intensity in two concentrated pockets. These pockets, however, are largely outside of the WUI. The town has a relatively low burn probability, as well.

Table I.6 provides the count and estimated value of all structures that intersect with areas of the Town of Morrisville that are rated moderate to high on the WUI Risk Index.

Table I.6 - Structures at Risk to Moderate-High WUI Risk Index, Town of Morrisville

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	2	$255,215	$255,215	$510,430
Commercial	156	$549,567,079	$549,567,079	$1,099,134,158
Education	12	$105,342,887	$105,342,887	$210,685,774
Government	25	$21,052,725	$21,052,725	$42,105,450
Industrial	56	$105,410,497	$158,115,746	$263,526,243
Religious	19	$21,399,613	$21,399,613	$42,799,226
Residential	6501	$3,603,185,791	$1,801,592,896	$5,404,778,687
Total	**6,771**	**$4,406,213,807**	**$2,657,326,160**	**$7,063,539,967**

Source: Southern Wildfire Risk Assessment

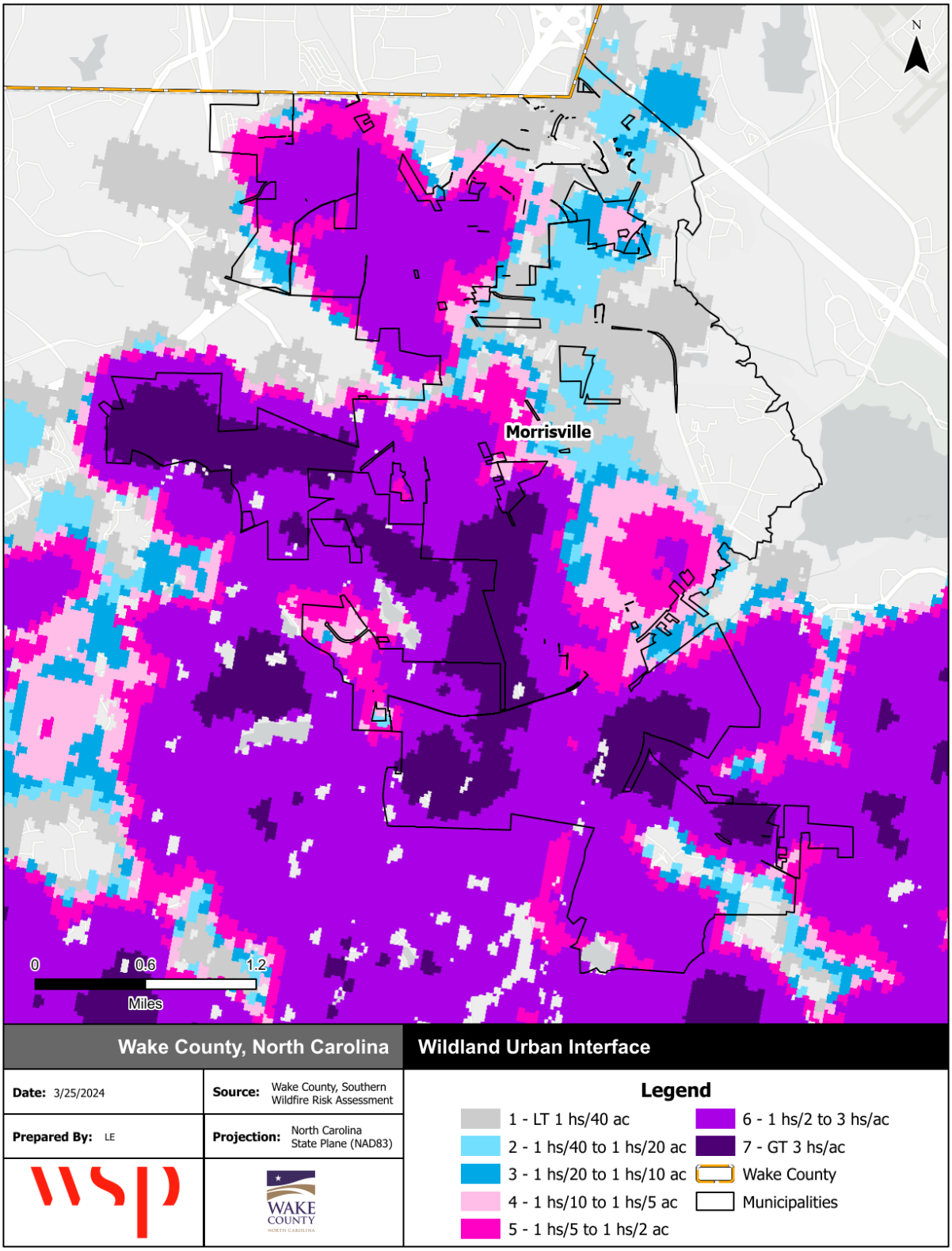
Table I.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table I.7 – Critical Facilities Exposed to Wildfire, Town of Morrisville

Type	Critical Facility Count	Structure Value
Communications	1	$894,505
Energy	4	$3,225,144
Food, Hydration, Shelter	3	$72,554,444
Hazardous Materials	24	$461,564,699
Health and Medical	5	$6,040,790
Safety and Security	6	$11,547,926
Transportation	0	$0
Water Systems	3	$0
Total	**46**	**$555,827,508**

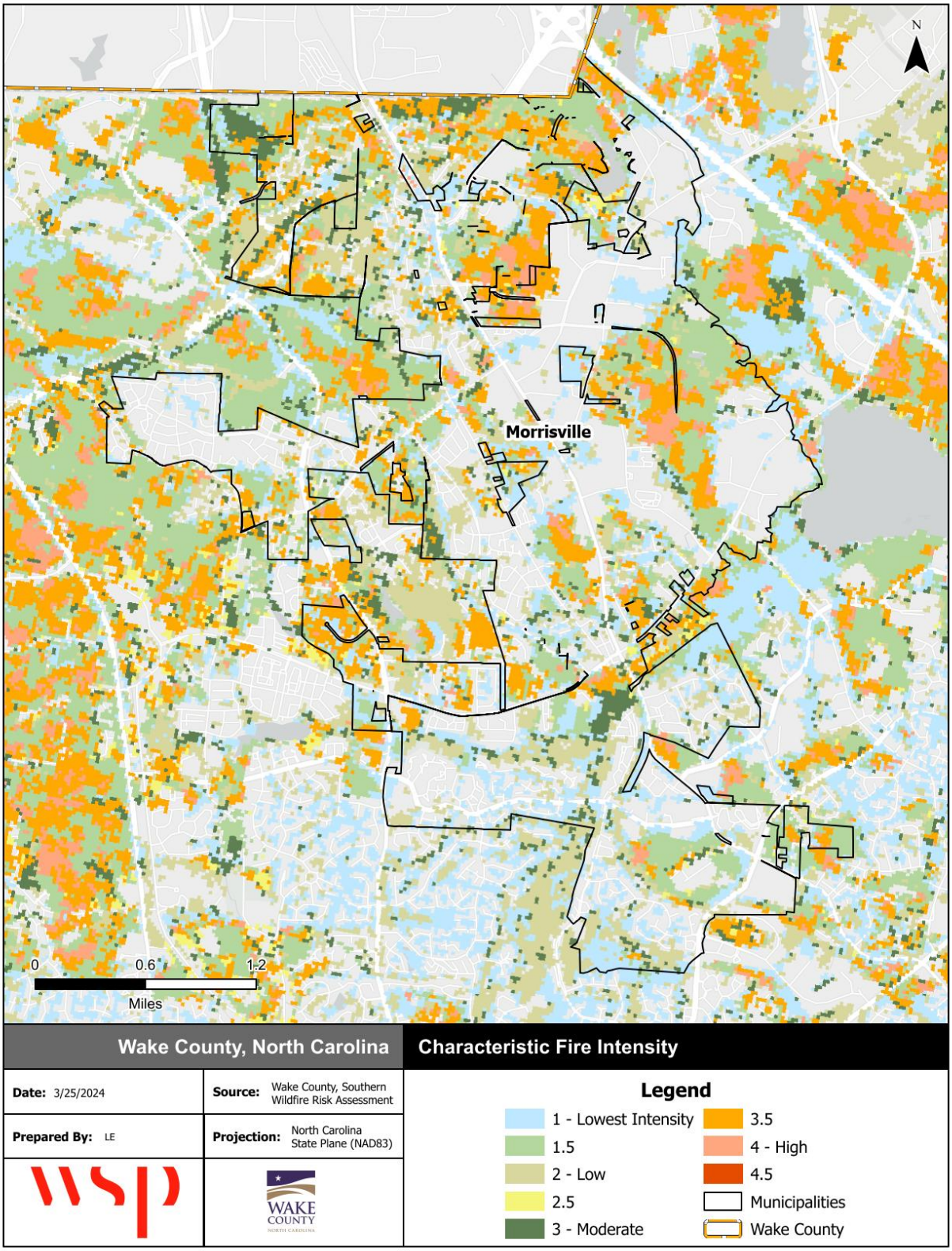
Source: Southern Wildfire Risk Assessment

Figure I.5 – Wildland Urban Interface, Town of Morrisville



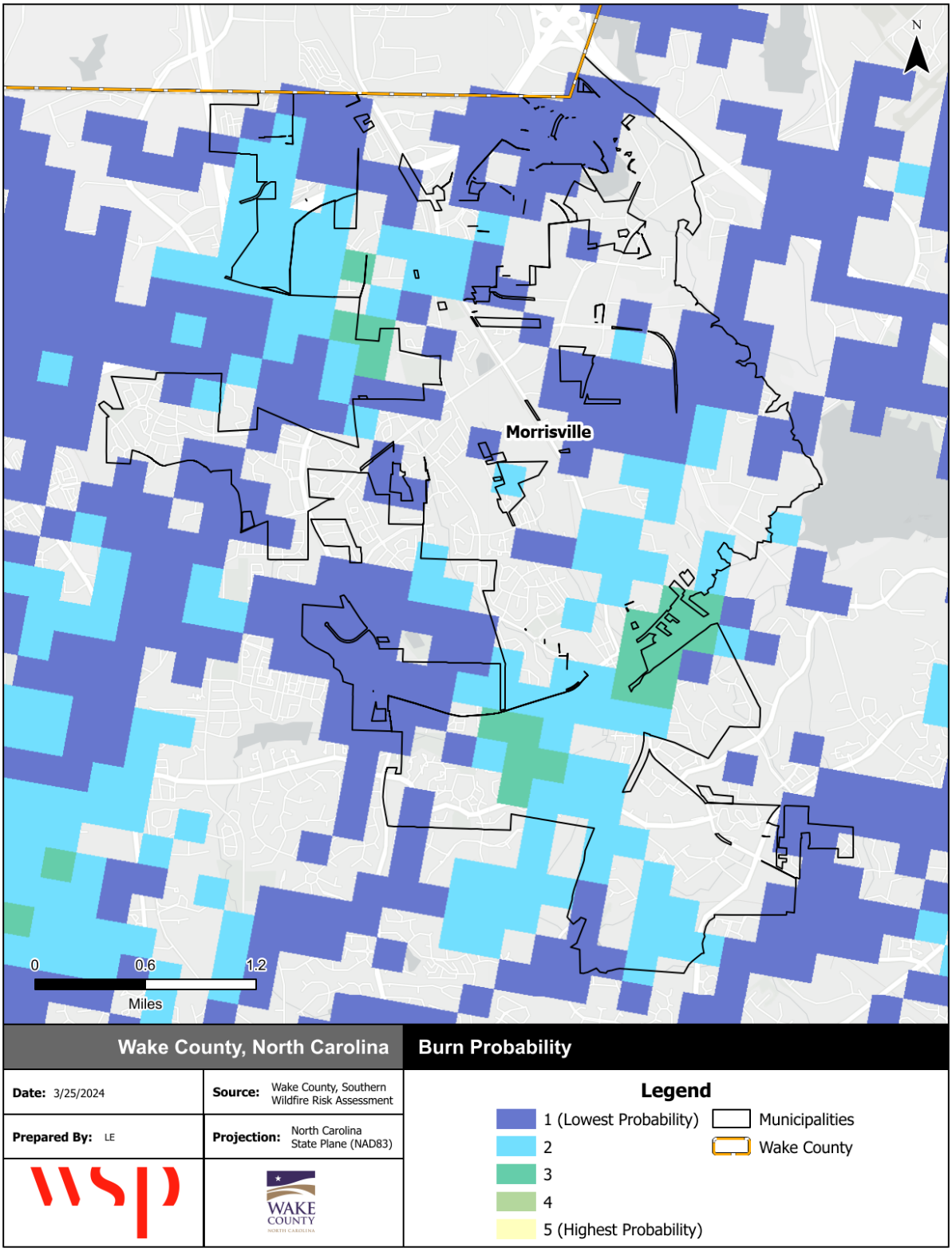
Source: Southern Wildfire Risk Assessment

Figure I.6 – Fire Intensity Scale, Town of Morrisville



Source: Southern Wildfire Risk Assessment

Figure I.7 – Burn Probability, Town of Morrisville



Source: Southern Wildfire Risk Assessment

I.2 MITIGATION STRATEGY

Town of Morrisville											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Reduce vulnerability of cyber-attack by transitioning Town staff to encrypted laptops.	3	1	Terrorism	Moderate	Town of Morrisville	$9,000 annually	Town of Morrisville	Ongoing - Next 5 years	In-Progress – Carry Forward	Still working on finalizing all computers. Still a priority for the Town.
P-2	Garden Square Lane Culvert and Greenway is Located approximately 150 feet west of the intersection of Garden Square Lane and Councilman Court and includes stormwater infrastructure within the town-maintained ROW and Garden Square Lane and the town-maintained easement along Indian Creek Greenway. Replacing and upgrading existing pipe and culvert infrastructure will mitigate road overtopping and flooding to adjacent residential structures.	3	2	Flood, Hurricane, Dam Failure	Moderate	Town of Morrisville	$1 Million	Town of Morrisville	5 years	New	N/A
P-3	Savannah Subdivision and Morrisville Carpenter Road Culvert Upsizing and replacement of existing pipe infrastructure to mitigate road overtopping and flooding to adjust residential structures. The project is located within the NCDOT-maintained right-of-way of Morrisville Carpenter Rd and with the town-maintained right-of-way of Star Magnolia Drive and Lowside of Morrisville Carpenter.	3	2	Flood, Hurricane, Dam Failure	Moderate	Town of Morrisville	$1.7 Million	NCDOT/Town of Morrisville	5 years	New	N/A
Property Protection											
PP-1	Reduce vulnerability of important data by transitioning IT Department's routine data backup to cloud storage.	3	1	Tornado, Earthquake, Severe Winter Storm, Severe Weather, Hurricane, Terrorism	High	Town of Morrisville	$42,000 annually	Town of Morrisville	Ongoing - Next 5 years	In-Progress – Carry Forward	N/A
Structural Projects											
SP-1	Construct new public works facility, which will increase Town's capacity to respond to hazards and other safety concerns.	2	1	All	Moderate	Town of Morrisville	$8,500,000	Town of Morrisville	3-5 years	In-Progress – Carry Forward	Project still required due to Aviation Pkwy widening. Design is in progress in conjunction with Wake County Solid Waste Convenience Center, Construction anticipated to begin 2026
Public Education and Awareness											
PEA-1	Purchase and implement new online civic engagement platform to be used in part to inform citizens on disaster preparation, emergency response training opportunities, and evacuation information.	1	1	All	Moderate	Town of Morrisville	$10,000	Town of Morrisville	1 year	In-Progress – Carry Forward	Capacity issue with staff. Still needs to be completed.

J. TOWN OF ROLESVILLE

J.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Rolesville. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Rolesville. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

J.1.1 CRITICAL FACILITIES

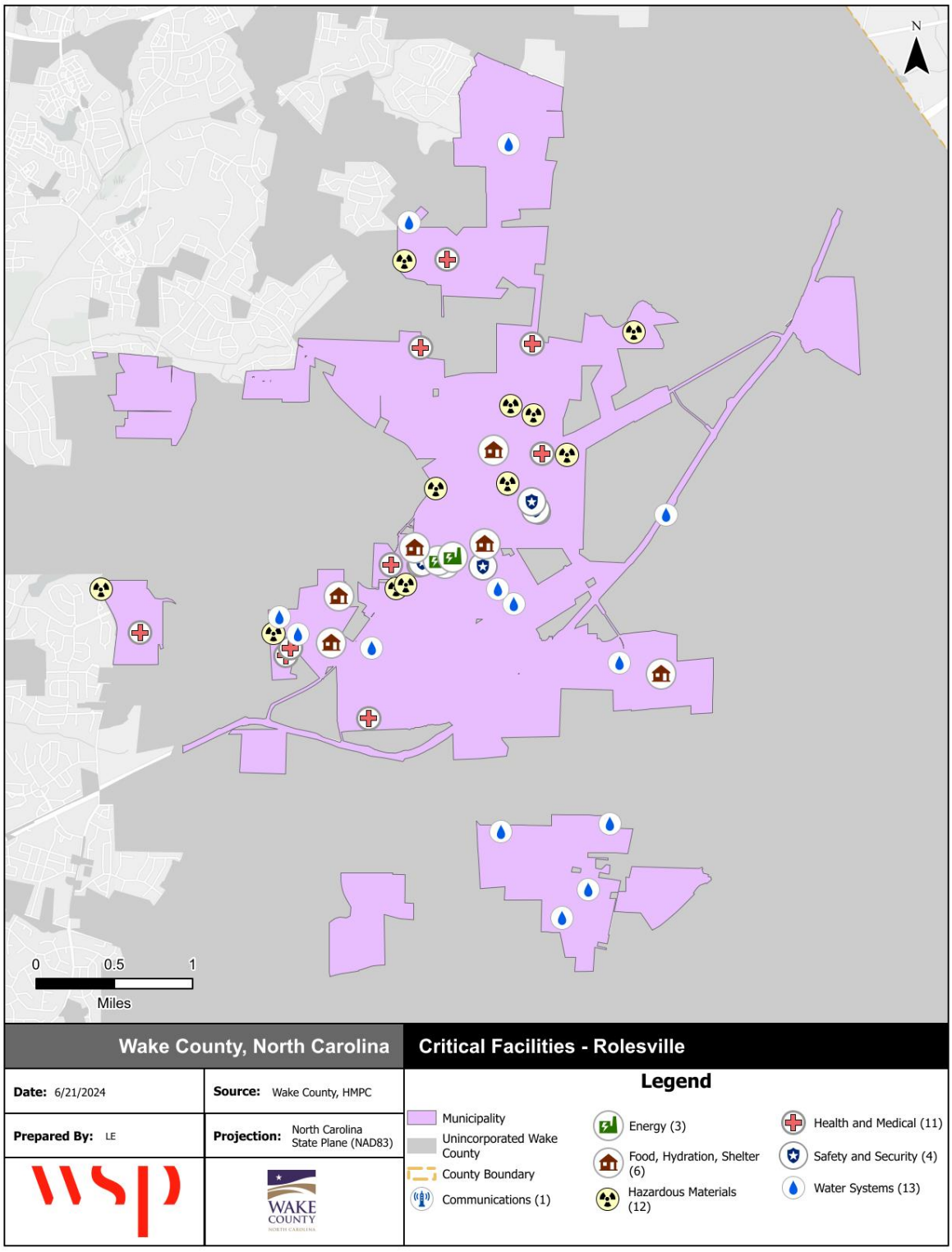
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table J.1 provides a count of critical facilities by FEMA lifeline category within the Town of Rolesville. Figure J.1 shows the locations of all critical facilities within the Town of Rolesville.

Table J.1 – Critical Facilities by Type, Town of Rolesville

Facility Type	Count of Facility Type	Structure Value
Communications	1	$0
Energy	3	$2,949,873
Food, Hydration, Shelter	2	$23,695,027
Hazardous Materials	15	$6,699,481
Health and Medical	11	$10,097,812
Safety and Security	5	$7,903,251
Transportation	0	$0
Water Systems	15	$775,122
Total	**52**	**$52,120,566**

Source: Wake County, HMPC

Figure J.1 – Town of Rolesville Critical Facilities

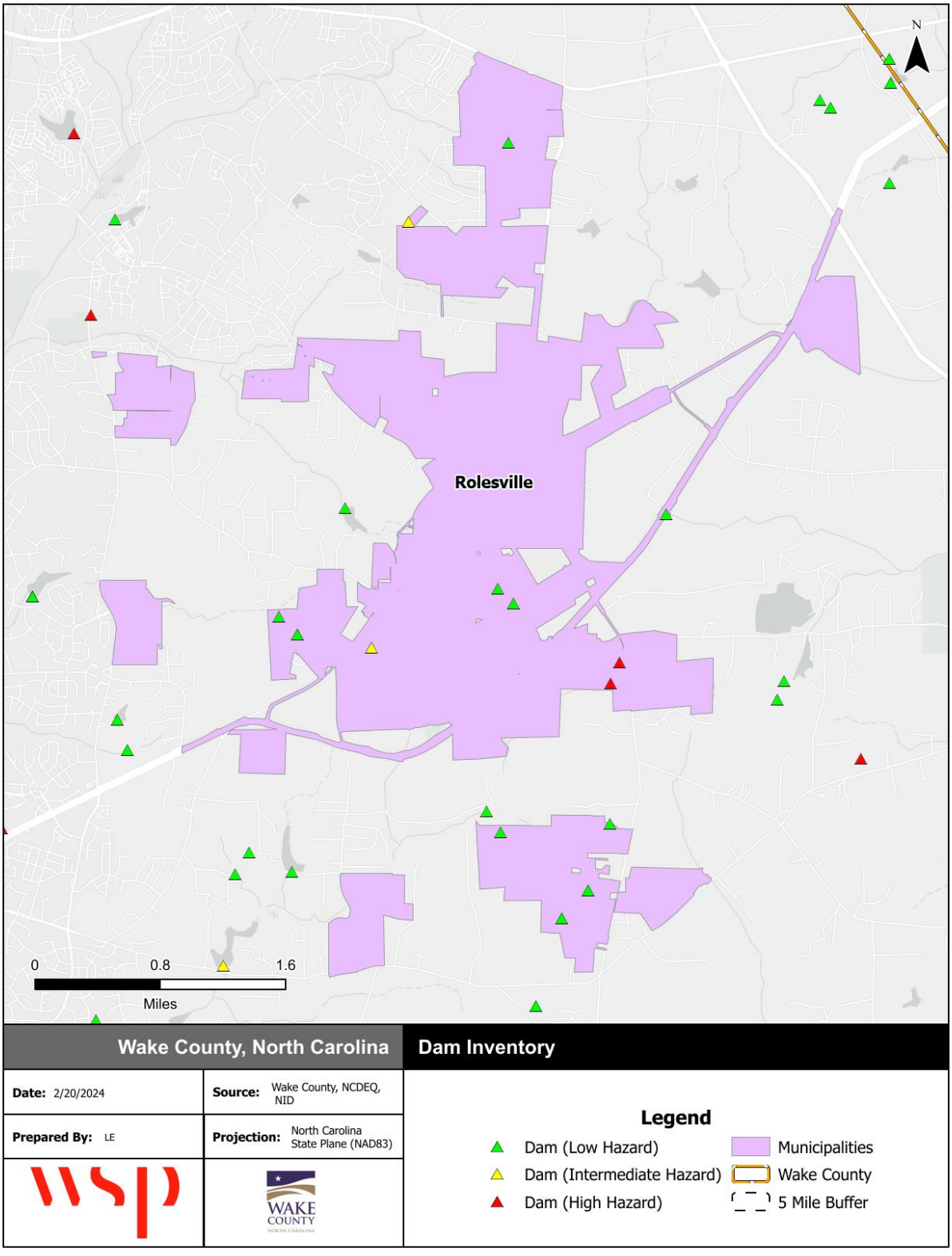


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

J.1.2 DAM FAILURE

Currently, the Town of Rolesville has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure J.2 shows the location of all dams in the Town of Rolesville.

Figure J.2 – Dam Inventory, Town of Rolesville



Source: North Carolina Dam Inventory, February 2024

J.1.3 FLOOD

Table J.2 details the acreage of the Town of Rolesville by flood zone on the effective DFIRM. Per this assessment, just over 1 percent of the Town of Rolesville falls within the mapped 1%-annual-chance floodplains.

Table J.2 – Flood Zone Acreage in the Town of Rolesville

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	74.5	1.6
Zone X (500-year)	2.0	0.04
Zone X Unshaded	4,438.1	98.3
Total	**4,514.5**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure J.3 reflects the effective mapped flood hazard zones for the Town of Rolesville, and Figure J.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table J.3 provides building counts and values for critical facilities by flood zone in the Town of Rolesville.

Table J.3 – Critical Facilities Exposed to Flooding, Town of Rolesville

Flood Zone	Critical Facility Count	Structure Value
AE	3	$2,018,394
X	49	$50,102,172
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0	$0
Total	**52**	**$52,120,566**

Source: FEMA Effective DFIRM

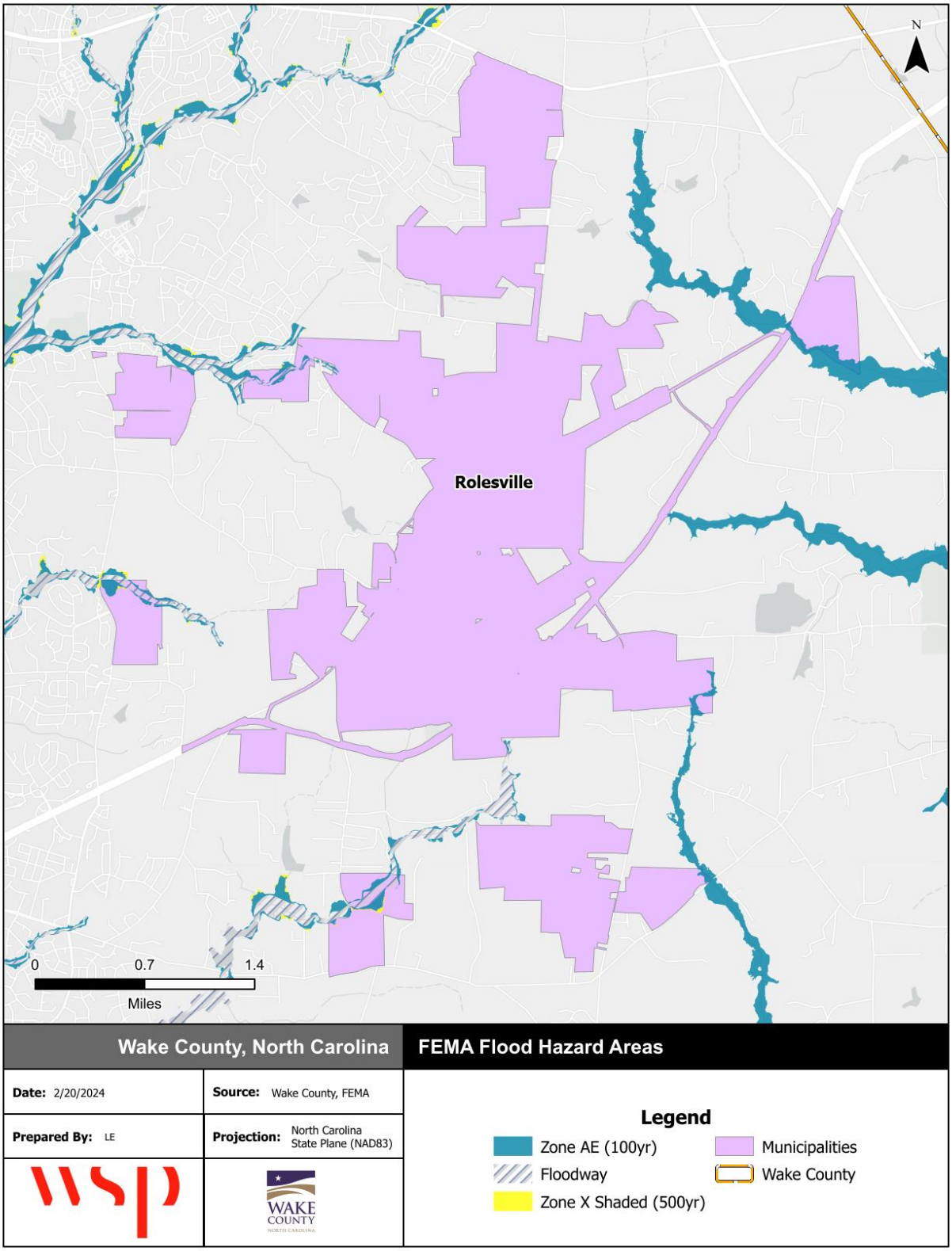
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $550,000 in building related damages. The results of the Hazus loss estimate are summarized in Table J.4.

Table J.4 – HAZUS 100-Year Flood Results, Town of Rolesville

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	0	$0	$0	$0	$0	0%
Commercial	1	$98,000	$3,000	$20,000	$23,000	23%
Educational	0	$0	$0	$0	$0	0%
Government	0	$0	$0	$0	$0	0%
Industrial	3	$118,000	$21,000	$63,000	$84,000	71%
Religious	0	$0	$0	$0	$0	0%
Residential	19	$582,000	$294,000	$149,000	$443,000	76%
Total	**23**	**$798,000**	**$318,000**	**$232,000**	**$550,000**	**69%**

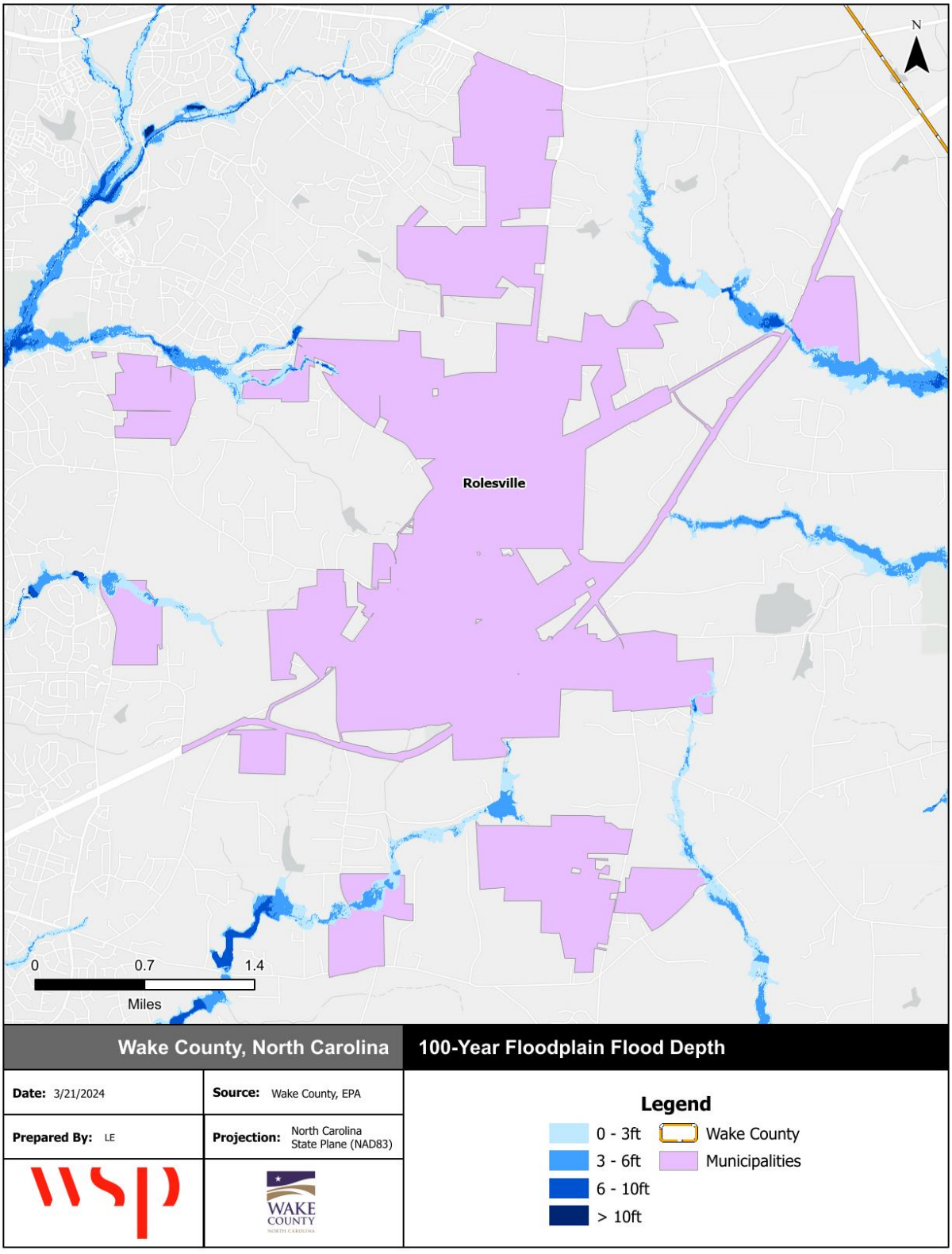
Source: FEMA Natural Hazards Risk Assessment Program

Figure J.3 – FEMA Flood Hazard Areas, Town of Rolesville



Source: FEMA Effective DFIRM

Figure J.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Rolesville



Source: FEMA Effective DFIRM

J.1.4 WILDFIRE

Table J.5 summarizes the acreage in the Town of Apex that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 14 percent of the Town of Apex is not included in the WUI.

Table J.5 – Wildland Urban Interface Acreage, Town of Rolesville

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	639.48	14.2%
	LT 1hs/40ac	708.84	15.7%
	1hs/40ac to 1hs/20ac	442.36	9.8%
	1hs/20ac to 1hs/10ac	477.05	10.6%
	1hs/10ac to 1hs/5ac	510.05	11.3%
	1hs/5ac to 1hs/2ac	596.85	13.2%
	1hs/2ac to 3hs/1ac	1,135.92	25.2%
	GT 3hs/1ac	4.00	0.1%
	Total	**4,514.55**	**100%**

Source: Southern Wildfire Risk Assessment

Figure J.5 depicts the WUI for the Town of Rolesville. Figure J.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure J.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in west, south, and northwest Rolesville. These areas, however, are largely outside of the WUI. Additionally, the town center has some areas to the east and west with a burn probability of moderate to high. These areas of development may be at higher risk for fires.

Table J.6 provides the count and estimated value of all structures that intersect with areas of the Town of Rolesville that are rated moderate to high on the WUI Risk Index.

Table J.6 – Structures at Risk to Moderate-High WUI Risk Index, Town of Rolesville

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	9	$1,867,272	$1,867,272	$3,734,544
Commercial	66	$65,359,273	$65,359,273	$130,718,546
Education	11	$95,099,807	$95,099,807	$190,199,614
Government	14	$83,376,650	$83,376,650	$166,753,300
Industrial	6	$2,503,738	$3,755,607	$6,259,345
Religious	11	$15,285,171	$15,285,171	$30,570,342
Residential	2359	$889,413,183	$444,706,592	$1,334,119,775
Total	**2,476**	**$1,152,905,094**	**$709,450,372**	**$1,862,355,466**

Source: Southern Wildfire Risk Assessment

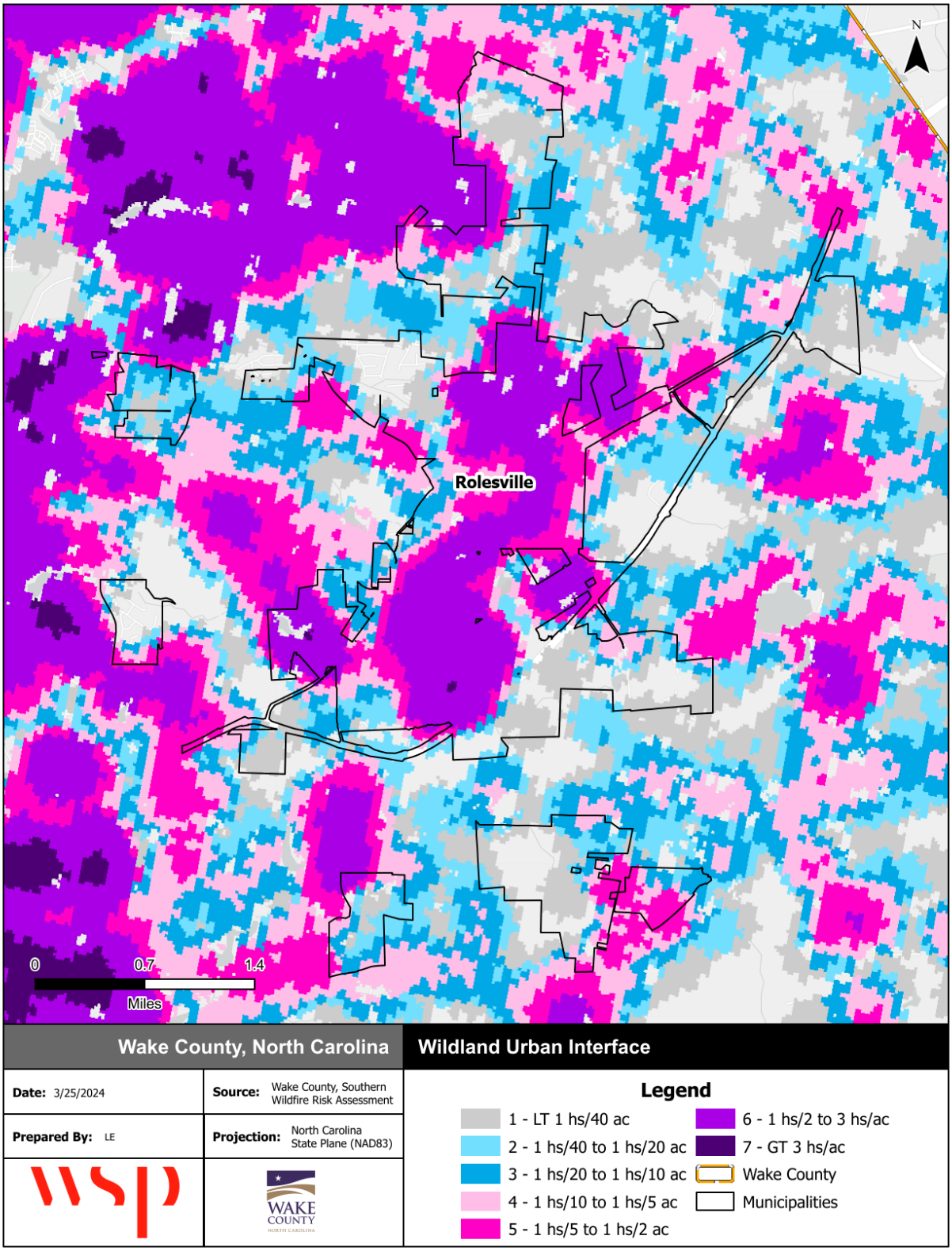
Table J.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table J.7 – Critical Facilities Exposed to Wildfire, Town of Rolesville

Type	Critical Facility Count	Structure Value
Communications	1	$0
Energy	3	$2,949,873
Food, Hydration, Shelter	2	$23,695,027
Hazardous Materials	7	$1,379,338
Health and Medical	7	$8,246,506
Safety and Security	5	$7,903,251
Transportation	0	$0
Water Systems	9	$0
Total	**34**	**$44,173,995**

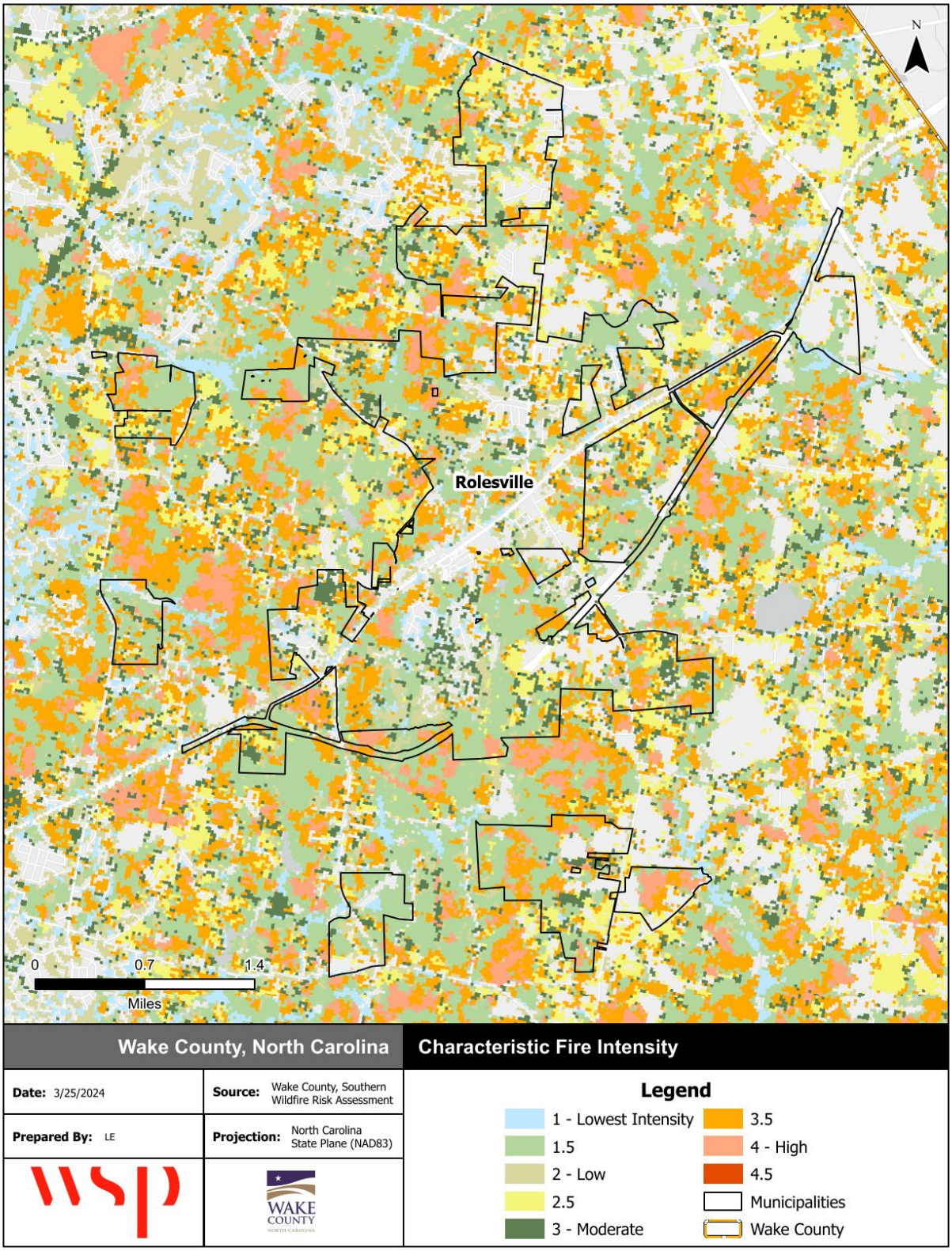
Source: Southern Wildfire Risk Assessment

Figure J.5 – Wildland Urban Interface, Town of Rolesville



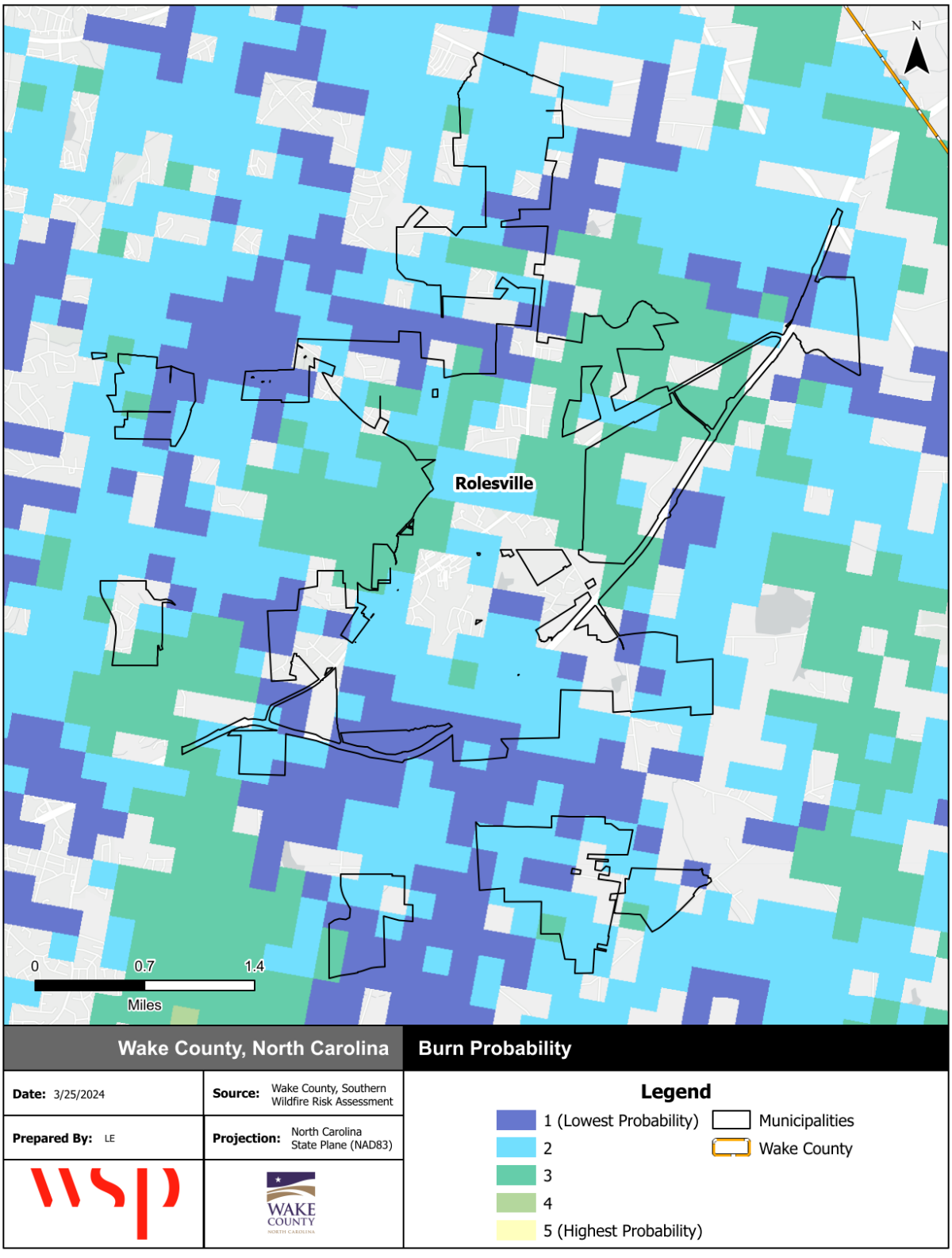
Source: Southern Wildfire Risk Assessment

Figure J.6 – Fire Intensity Scale, Town of Rolesville



Source: Southern Wildfire Risk Assessment

Figure J.7 – Burn Probability, Town of Rolesville



Source: Southern Wildfire Risk Assessment

J.2 MITIGATION STRATEGY

Town of Rolesville											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Provide backup power for all critical public facilities (wastewater treatment plant, sewer pump stations, Public Works and Utilities building, etc.) to ensure continued utility service during power loss.	3	1	All	Moderate	City of Raleigh	Cost varies by facility	Local	2 years	In-Progress – Carry Forward	City of Raleigh has updated sewer pump stations with backup power. The Town's new Public Works facility is equipped with a backup generator. Upgrade of other Town buildings is intended for future budgets.
P-2	Transportation Plan – Continue to address disaster preparedness (evacuation) through road interconnectivity, paved roads, and widening of roads.	3	2	All	Moderate	Rolesville Planning	Staff Time	Local	1 year	In-Progress – Carry Forward	Community Transportation Plan updated in 2021. Land Development Ordinance (LDO) updated in 2022 to require street connectivity to existing stub streets and connection recommendations from Traffic Impact Analysis (TIA) reports.
P-3	Update Rolesville Stormwater Management Plan for operation/implementation and program effectiveness and study the possible changes	4	1	Flood	Moderate	Rolesville Administration	Staff Time	Local	2-3 years	In-Progress – Carry Forward	Stormwater Mapping Project complete. Neuse River Local Program will be implemented in early 2025, and a Stormwater Master Plan will kick off later in 2025.
Property Protection											
PP-1	Install emergency power backup generator for Town Hall and Police Station to ensure continued operation of government during power loss.	3	2	All	High	Rolesville Administration	Over $100,000	Local	3 years	In-Progress – Carry Forward	The Rolesville Fire Department is designated as our EOC in the event of power loss. There are plans to build a new PD and it is projected to be completed Fall of 2027.
Emergency Services											
ES-1	Implement Wake County Everbridge text alert system to notify citizens in real time of an event of local interest with instructions.	1	2	All	High	Rolesville Administration	Staff Time	Local	1 year	In-Progress – Carry Forward	Implementation is ongoing as the town continues to explore a platform that will best serve our citizens for a text alert system.
Public Education and Awareness											
PEA-1	Town website – develop hazard mitigation section covering such items as public access, evacuation routes, emergency contact numbers, and detailed weather reports in case of emergency,	1	1	All	Moderate	Rolesville Administration	Staff Time	Local	1 year	In-Progress – Carry Forward	Town is in the process of website updates and development of a hazard mitigation section will be included.

K. TOWN OF WAKE FOREST

K.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Wake Forest. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Wake Forest. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

K.1.1 CRITICAL FACILITIES

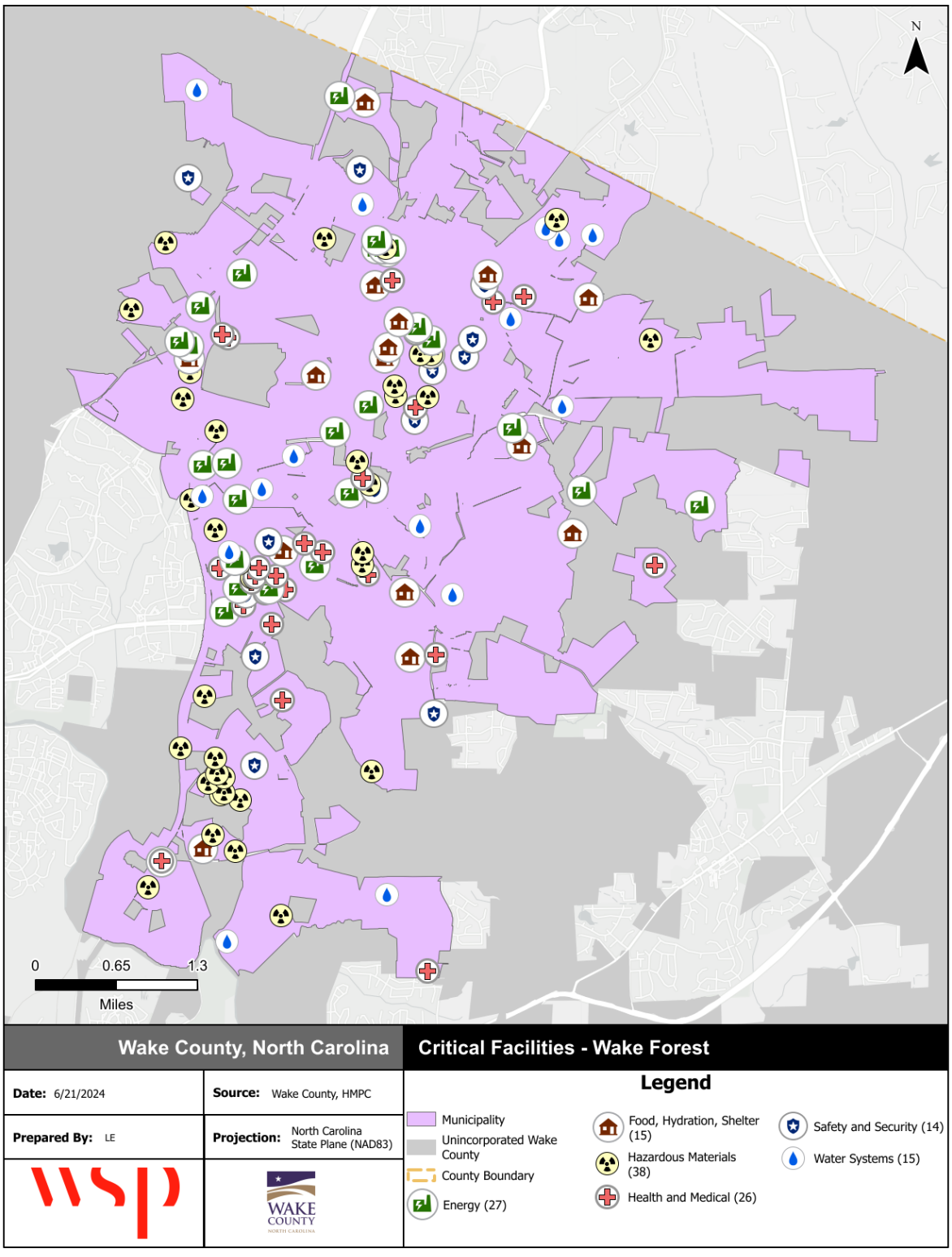
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table K.1 provides a count of critical facilities by FEMA lifeline category within the Town of Wake Forest. Figure K.1 shows the locations of all critical facilities within the Town of Wake Forest.

Table K.1 – Critical Facilities by Type, Town of Wake Forest

Facility Type	Count of Facility Type	Structure Value
Communications	0	$0
Energy	31	$40,097,929
Food, Hydration, Shelter	8	$118,771,216
Hazardous Materials	41	$133,712,647
Health and Medical	26	$37,725,139
Safety and Security	14	$79,303,931
Transportation	0	$0
Water Systems	18	$72,809,327
Total	**138**	**$482,420,189**

Source: Wake County, HMPC

Figure K.1 – Town of Wake Forest Critical Facilities



Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

K.1.2 DAM FAILURE

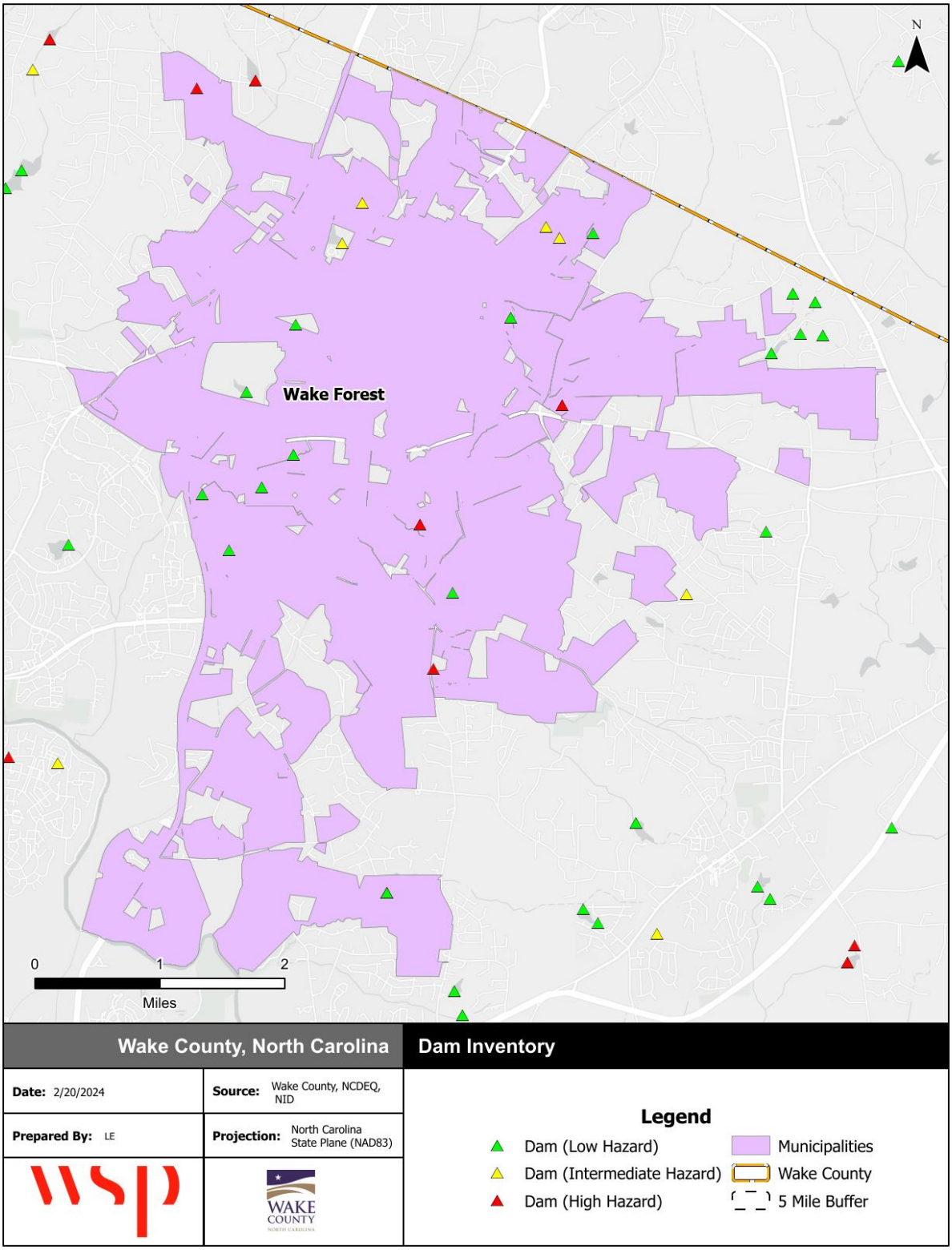
Table K.2 lists all high hazard dams located in the Town of Wake Forest that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor". Figure K.2 shows the location of dams in the Town of Wake Forest.

Table K.2 – High Hazard Dams in the Town of Wake Forest with Condition Assessment of "Poor"

Dam Name	NID ID	Inspection Date	Nearest Downstream City & Distance (mi.)	EAP in Place
Lewis Dam	NC04439	07/12/2022	Wake Forest (3 mi.)	Yes

Source: North Carolina Dam Inventory, February 2024

Figure K.2 – Dam Inventory, Town of Wake Forest



Source: North Carolina Dam Inventory, February 2024

K.1.3 FLOOD

Table K.3 Details the acreage of the Town of Wake Forest by flood zone on the effective DFIRM. Per this assessment, over 8 percent of the Town of Wake Forest falls within the mapped 1%-annual-chance floodplains.

Table K.3 – Flood Zone Acreage in the Town of Wake Forest

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.01	0.0001
Zone AE	1,074.5	8.7
Zone X (500-year)	26.3	0.2
Zone X Unshaded	11,310.4	91.1%
Total	**12,411.3**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure K.3 reflects the effective mapped flood hazard zones for the Town of Wake Forest, and Figure K.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table K.4 provides building counts and values for critical facilities by flood zone in the Town of Wake Forest.

Table K.4 – Critical Facilities Exposed to Flooding, Town of Wake Forest

Flood Zone	Critical Facility Count	Structure Value
AE	28	$130,276,916
X	110	$352,143,273
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0	$0
Total	**138**	**$482,420,189**

Source: FEMA Effective DFIRM

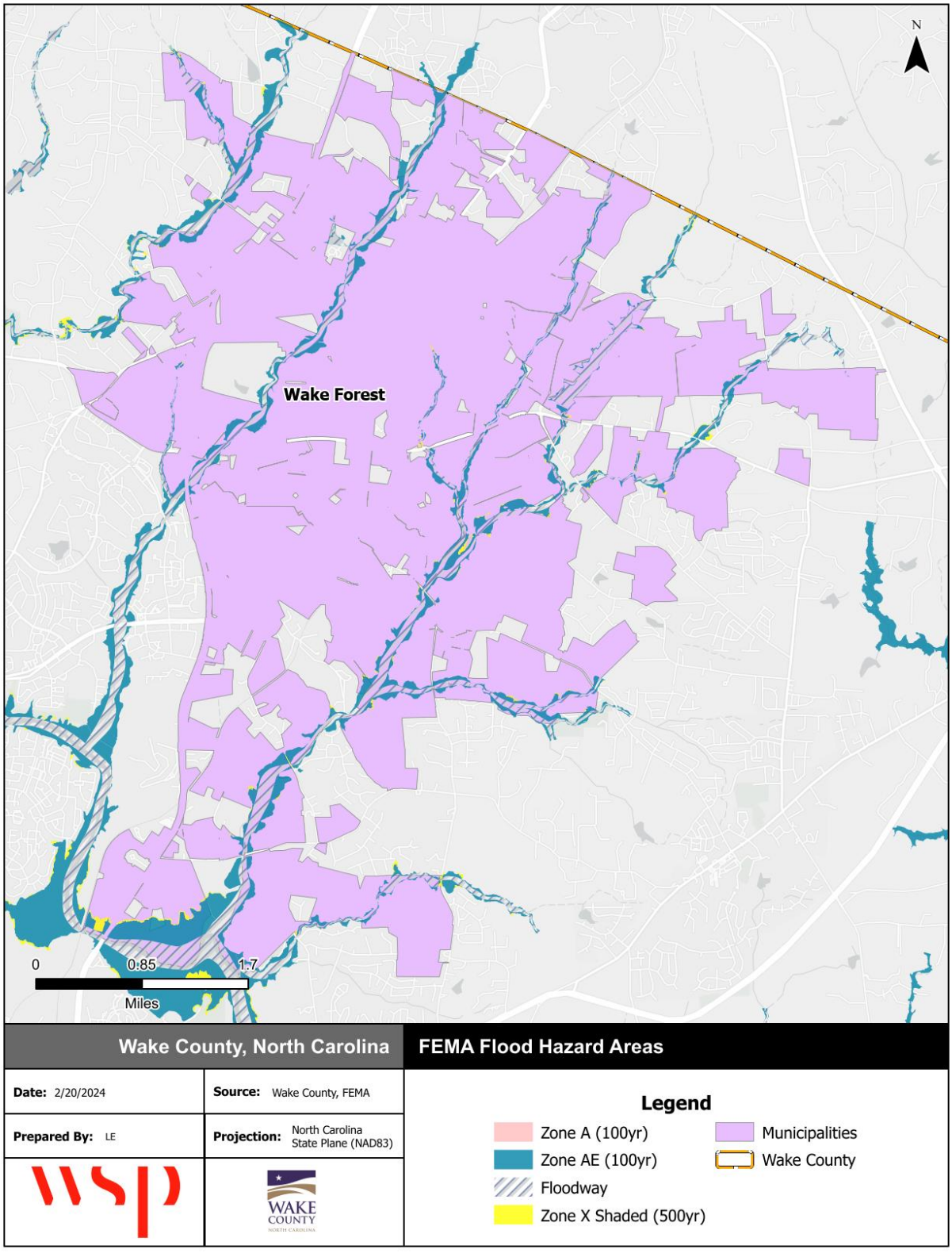
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $18.7 million in building related damages. The results of the Hazus loss estimate are summarized in Table K.5.

Table K.5 – HAZUS 100-Year Flood Results, Town of Wake Forest

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	0	$0	$0	$0	$0	0%
Commercial	23	$1,912,000	$136,000	$456,000	$592,000	31%
Educational	4	$9,513,000	$381,000	$2,303,000	$2,684,000	28%
Government	1	$80,000	$3,000	$12,000	$15,000	19%
Industrial	10	$164,000	$56,000	$91,000	$147,000	90%
Religious	5	$456,000	$22,000	$159,000	$181,000	40%
Residential	89	$19,371,000	$9,913,000	$5,216,000	$15,129,000	78%
Total	**132**	**$31,496,000**	**$10,511,000**	**$8,237,000**	**$18,748,000**	**60%**

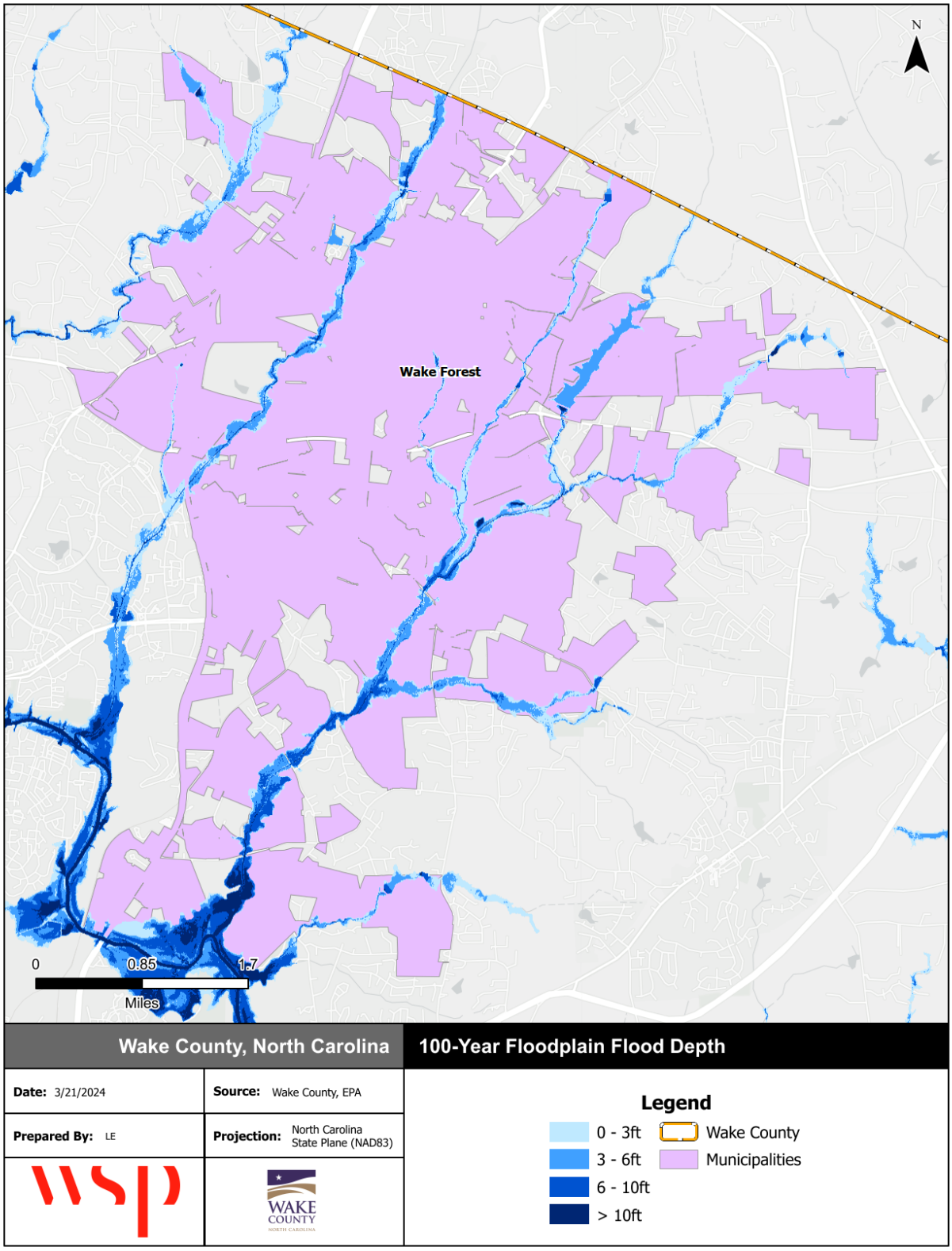
Source: FEMA Natural Hazards Risk Assessment Program

Figure K.3 – FEMA Flood Hazard Areas, Town of Wake Forest



Source: FEMA Effective DFIRM

Figure K.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Wake Forest



Source: FEMA Effective DFIRM

K.1.4 WILDFIRE

Table K.6 summarizes the acreage in the Town of Wake Forest that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 10 percent of the Town of Wake Forest is not included in the WUI.

Table K.6 – Wildland Urban Interface Acreage, Town of Wake Forest

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	1,326.78	10.7%
	LT 1hs/40ac	640.11	5.2%
	1hs/40ac to 1hs/20ac	628.07	5.1%
	1hs/20ac to 1hs/10ac	654.78	5.3%
	1hs/10ac to 1hs/5ac	882.86	7.1%
	1hs/5ac to 1hs/2ac	1,587.64	12.8%
	1hs/2ac to 3hs/1ac	6,301.75	50.8%
	GT 3hs/1ac	389.22	3.1%
	Total	**13,666.3**	**100%**

Source: Southern Wildfire Risk Assessment

Figure K.5 depicts the WUI for the Town of Wake Forest. Figure K.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure K.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in the northwest, southern, and central eastern regions of Wake Forest. Some of these areas are in the WUI, but they do not have a high burn probability. Overall, the Town of Wake Forest does not have a high burn probability.

Table K.7 provides the count and estimated value of all structures that intersect with areas of the Town of Wake Forest that are rated moderate to high on the WUI Risk Index.

Table K.7 – Structures at Risk to Moderate-High WUI Risk Index, Town of Wake Forest

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	4	$1,755,104	$1,755,104	$3,510,208
Commercial	416	$697,272,147	$697,272,147	$1,394,544,294
Education	151	$387,867,335	$387,867,335	$775,734,670
Government	116	$84,517,808	$84,517,808	$169,035,616
Industrial	57	$73,372,906	$110,059,359	$183,432,265
Religious	46	$98,741,867	$98,741,867	$197,483,734
Residential	13360	$5,577,209,337	$2,788,604,669	$8,365,814,006
Total	**14,150**	**$6,920,736,504**	**$4,168,818,289**	**$11,089,554,793**

Source: Southern Wildfire Risk Assessment

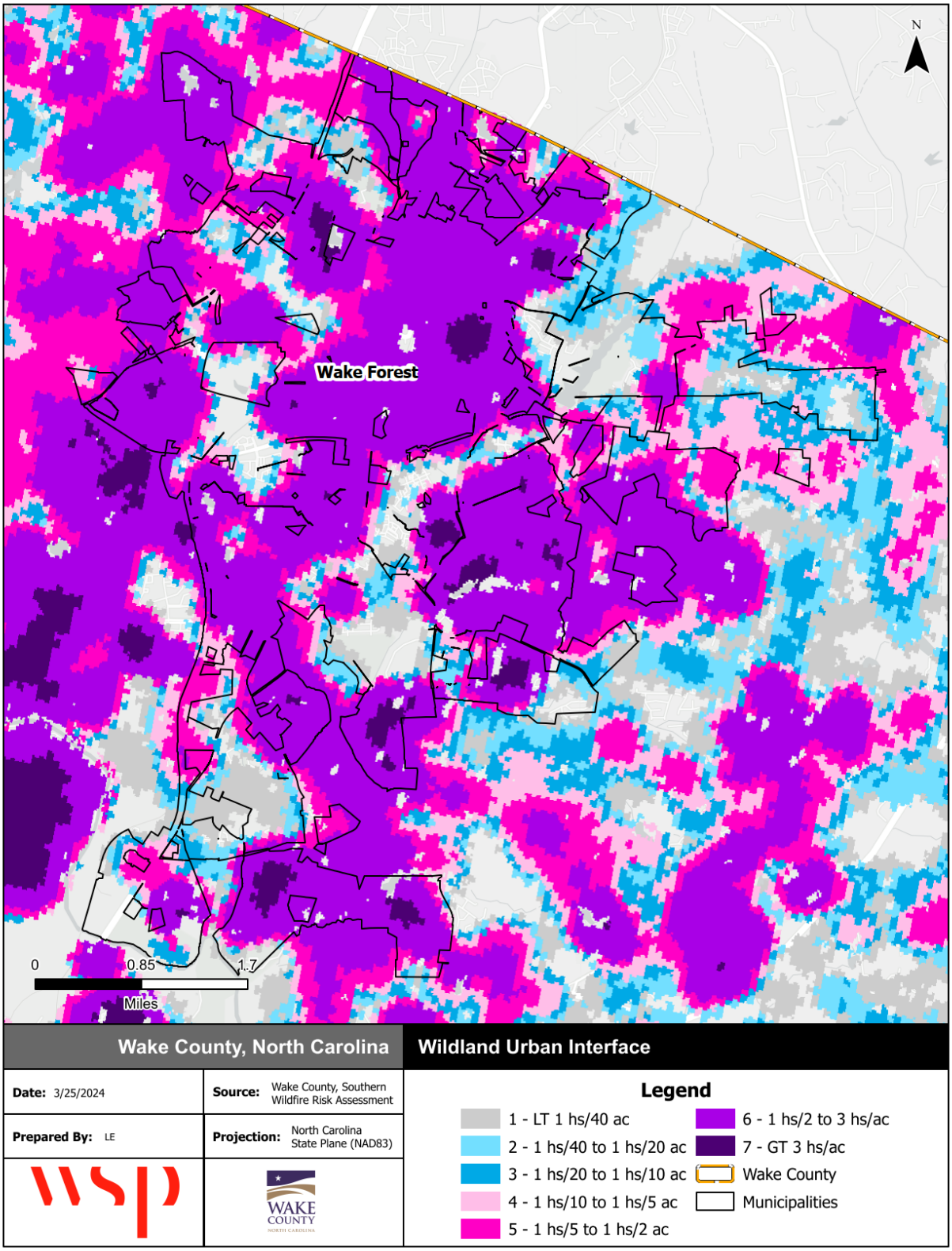
Table K.8 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table K.8 – Critical Facilities Exposed to Wildfire, Town of Wake Forest

Type	Critical Facility Count	Structure Value
Communications	0	$0
Energy	24	$30,677,251
Food, Hydration, Shelter	6	$76,858,506
Hazardous Materials	25	$81,758,723
Health and Medical	23	$26,993,915
Safety and Security	13	$79,143,155
Transportation	0	$0
Water Systems	18	$72,809,327
Total	**109**	**$368,240,877**

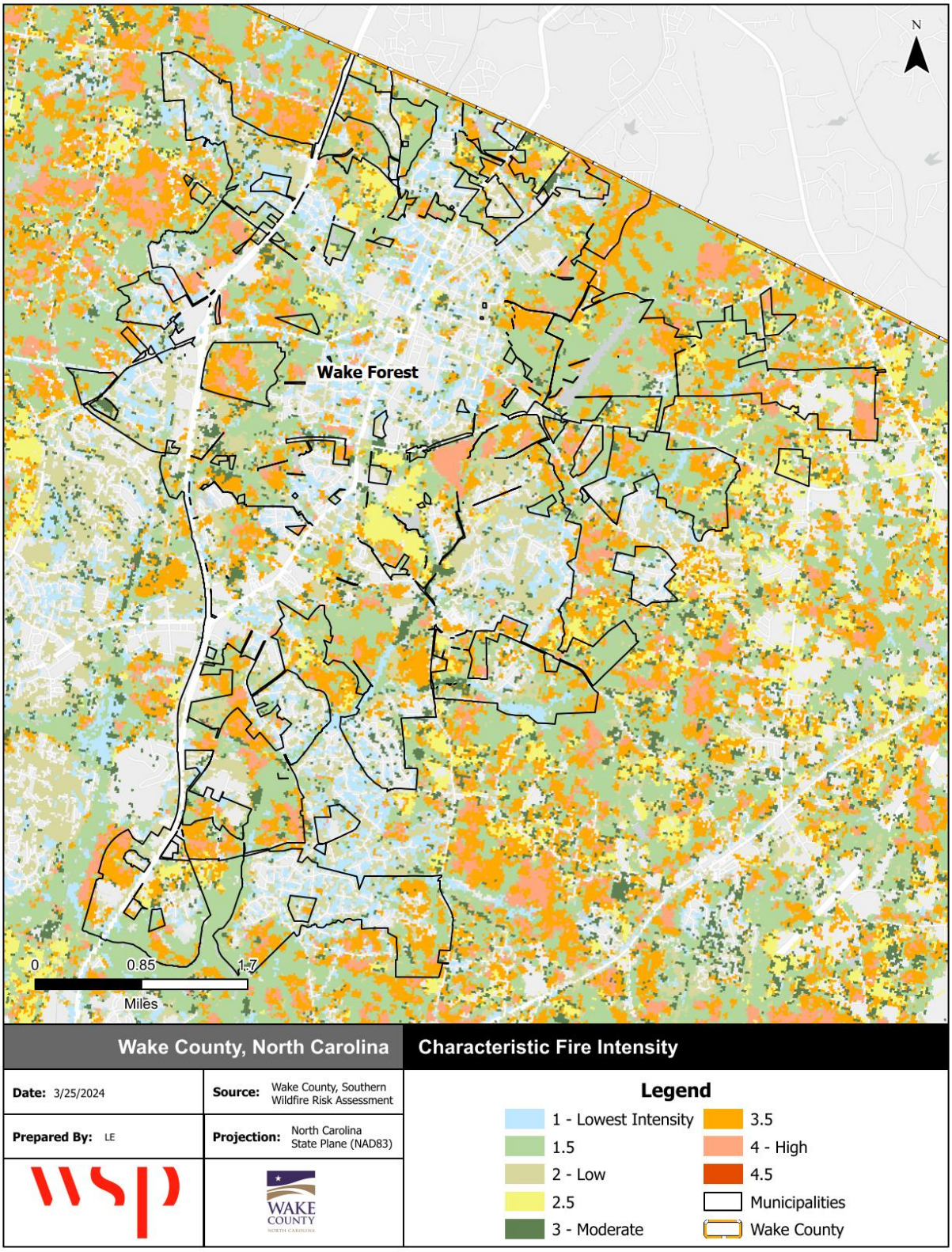
Source: Southern Wildfire Risk Assessment

Figure K.5 – Wildland Urban Interface, Town of Wake Forest



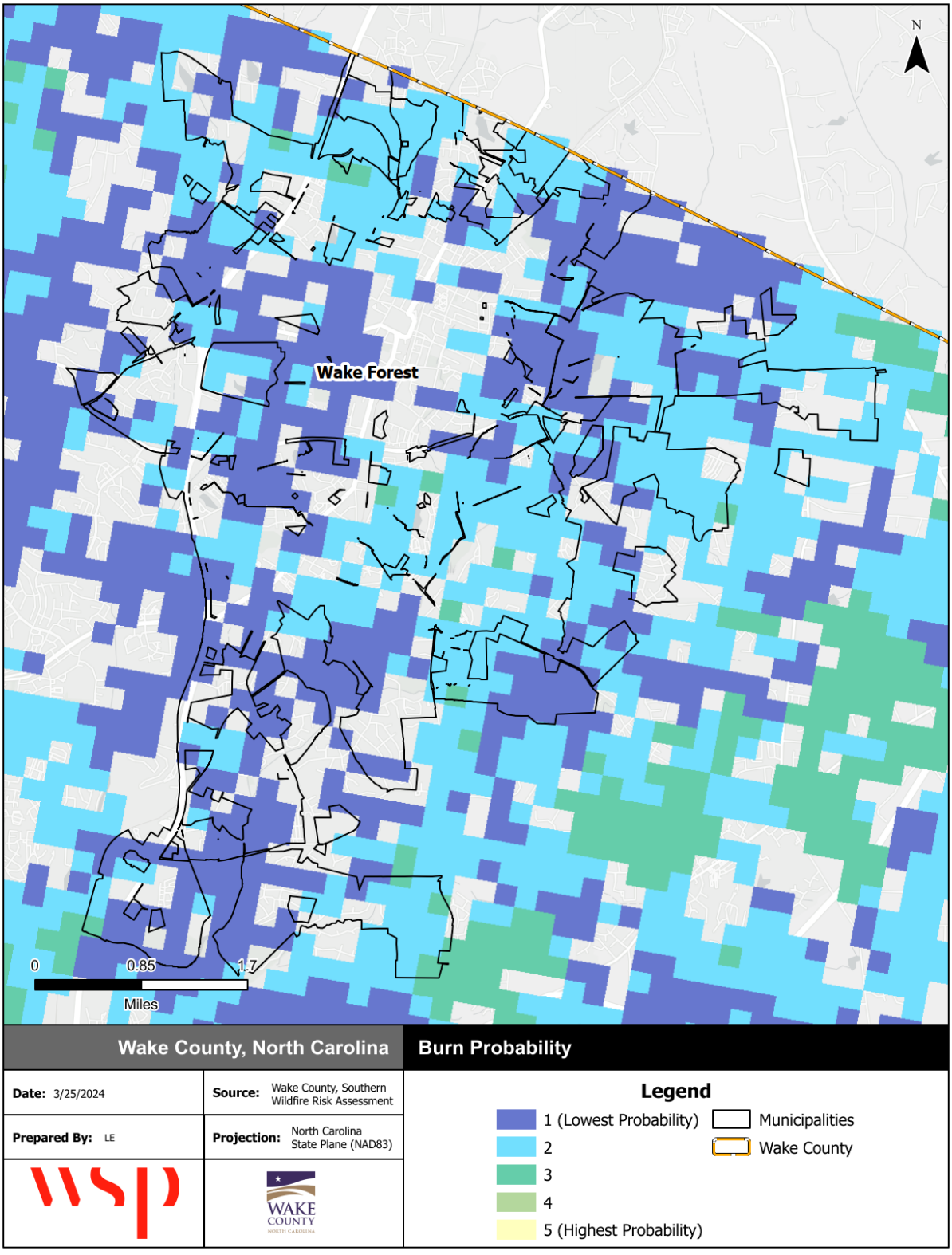
Source: Southern Wildfire Risk Assessment

Figure K.6 – Fire Intensity Scale, Town of Wake Forest



Source: Southern Wildfire Risk Assessment

Figure K.7 – Burn Probability, Town of Wake Forest



Source: Southern Wildfire Risk Assessment

K.2 MITIGATION STRATEGY

Town of Wake Forest											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Prepare a Storm Drainage Master Plan to include all storm drainage, infrastructure, and capacity analysis.	2	2	Flood	High	Wake Forest Engineering	$400,000	General Fund	2024	In-Progress – Carry Forward	90% complete, completion scheduled before EOY 2024.
P-2	Put electric distribution lines underground.	3	1	Hurricane, Severe Weather, Severe Winter Storm, Tornado, Wildfire	Low	Wake Forest Power	$10,000,000	Electric Fund, General Fund, and Bonds	2029	In-Progress – Carry Forward	Where feasible, electric lines have been put underground. However, there are still some lines that could be buried, and the town will look into carrying that out going forward. This is a multi-year project.
P-3	Become a CRS community	2	2	Flood	Low	Wake Forest Public Works	$100,000	General Fund	2026	In-Progress – Carry Forward	Work towards becoming a CRS community
P-4	Maintain a GIS database of building footprints and use it to regularly update a map of critical facilities and vulnerable buildings.	2	2	All	Moderate	Wake Forest GIS	Staff time	General Fund	Ongoing Annually	In-Progress – Carry Forward	Updated data will be used to identify properties that should be prioritized for mitigation. This action item is ongoing and requires regular updates as the Town of Wake Forest footprint expands.
Property Protection											
PP-1	Provide for primary or mobile generators to shelter sites.	2	1	All	Moderate	Wake County Emergency Management	$500,000	General Fund	2029	In-Progress – Carry Forward	Heritage High School is equipped with generators. The construction of Joyner Park is complete, and the site is intended to be used as a shelter. A generator is included with the building.
PP-2	Assess facilities for the need for emergency generation, giving consideration to alternate facility sites.	2	1	All	High	Wake Forest Power	$250,000	General Fund	2028	In-Progress – Carry Forward	The town has assessed facilities for the need for emergency generation and many facilities have been fitted with generators. However, additional facilities with emergency generation would be useful. The Town of Wake Forest will purchase generators in FY25.
Natural Resource Protection											
NRP-1	Expansion of our greenway trail network	3	2	Flood, Hurricane, Extreme Heat	Moderate	Wake Forest Planning	$14,350,000	General Fund and Bonds	2029	In-Progress – Carry Forward	The Town has multiple greenway extensions and new routes planned. By installing greenways along our waterways, it gives the Town a better opportunity to remove fallen debris and trash that helps alleviate possible flooding. Greenway projects are currently ongoing and pending bond funding.

Town of Wake Forest											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Structural Projects											
SP-1	Conduct stream mitigation projects on Old Mill Stream, Richland Creek, and others subject to flooding or erosion.	3	2	Flood	Moderate	Wake Forest Engineering	$2,350,000	General Fund, Clean Water Management Trust Fund, Ecosystem Enhancement Program	2028	In-Progress – Carry Forward	Some mitigation projects have been conducted on these water bodies, but there is significant effort that is still needed to reduce potential erosion. Current projects include: Old Mill Stream and Richland Creek - construction plans @ 90%. Ailey Young Dam - completion June 2019; Smith Creek - quote has been requested for work to be done. Stream erosion throughout town continues to be an ongoing process as needed. Stormwater utility funding has been approved which will help assist funding projects moving forward.
Emergency Services											
ES-1	See that all nursing homes and assisted living facilities have backup generators.	1	1	All	High	Property owners	$150,000	Property owners	2028	In-Progress – Carry Forward	New facilities are being encouraged to include generators. Existing facilities without generators are financially constrained and have little ability to add generators. The town will continue to promote the installation of generators in new facilities as development progresses.
Public Education and Awareness											
PEA-1	Develop a policy and advise the public that all outside above ground LP or propane gas tanks be cut off during a major event.	1	1	All	Moderate	Wake Forest Communications	$10,000	General Fund	2025	In-Progress – Carry Forward	Past communications have included information advising the public of turning off propane tanks during a storm, but better outreach is needed to ensure this occurs. A policy should be put in place to ensure it is regularly communicated.

L. TOWN OF WENDELL

L.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Wendell. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Wendell. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

L.1.1 CRITICAL FACILITIES

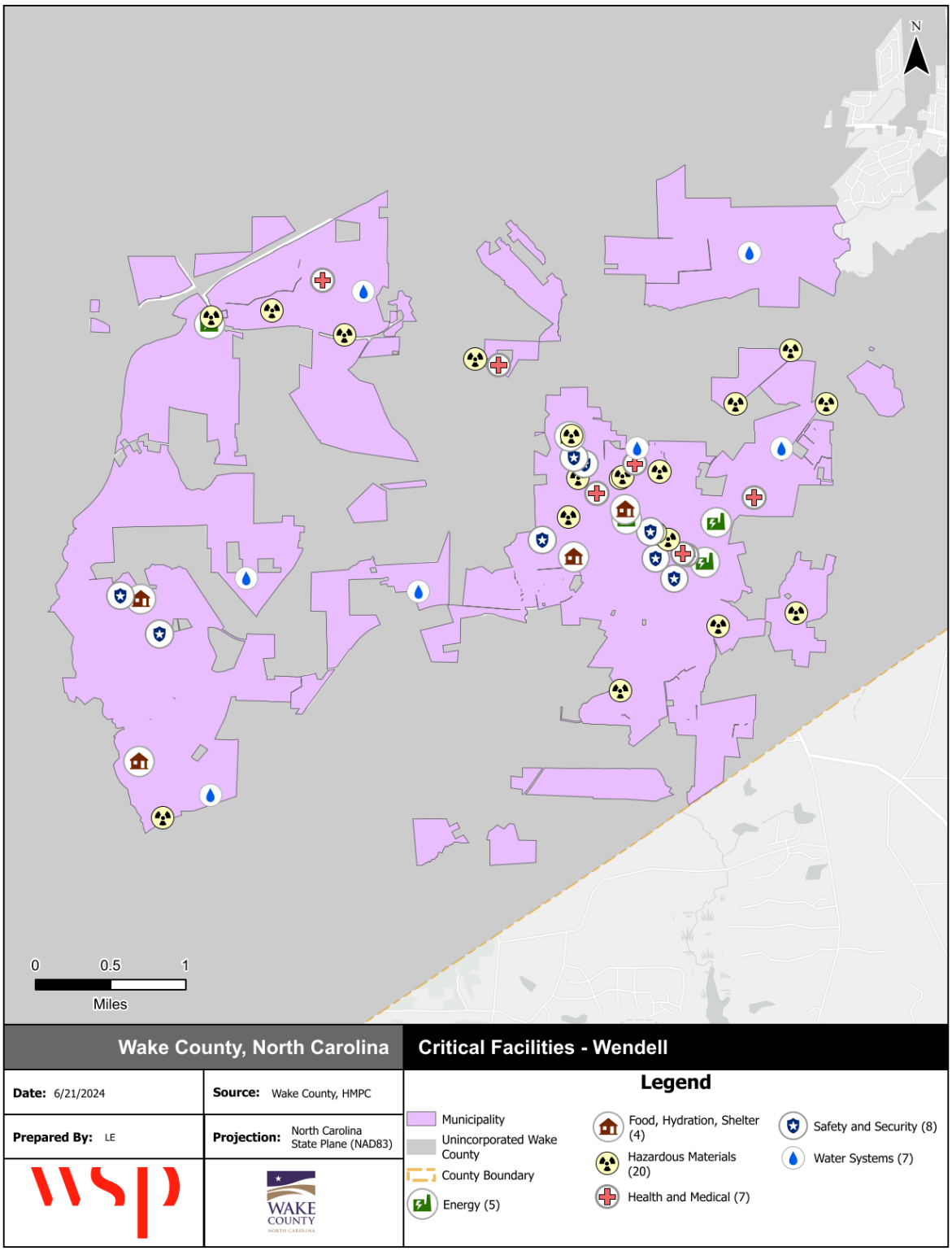
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table L.1 provides a count of critical facilities by FEMA lifeline category within the Town of Wendell. Figure L.1 shows the locations of all critical facilities within the Town of Wendell.

Table L.1 – Critical Facilities by Type, Town of Wendell

Facility Type	Count of Facility Type	Structure Value
Communications	0	$0
Energy	8	$19,681,573
Food, Hydration, Shelter	3	$27,618,670
Hazardous Materials	32	$47,135,103
Health and Medical	7	$4,646,176
Safety and Security	12	$30,140,818
Transportation	0	$0
Water Systems	9	$1,262,637
Total	**71**	**$130,484,977**

Source: Wake County, HMPC

Figure L.1 – Town of Wendell Critical Facilities

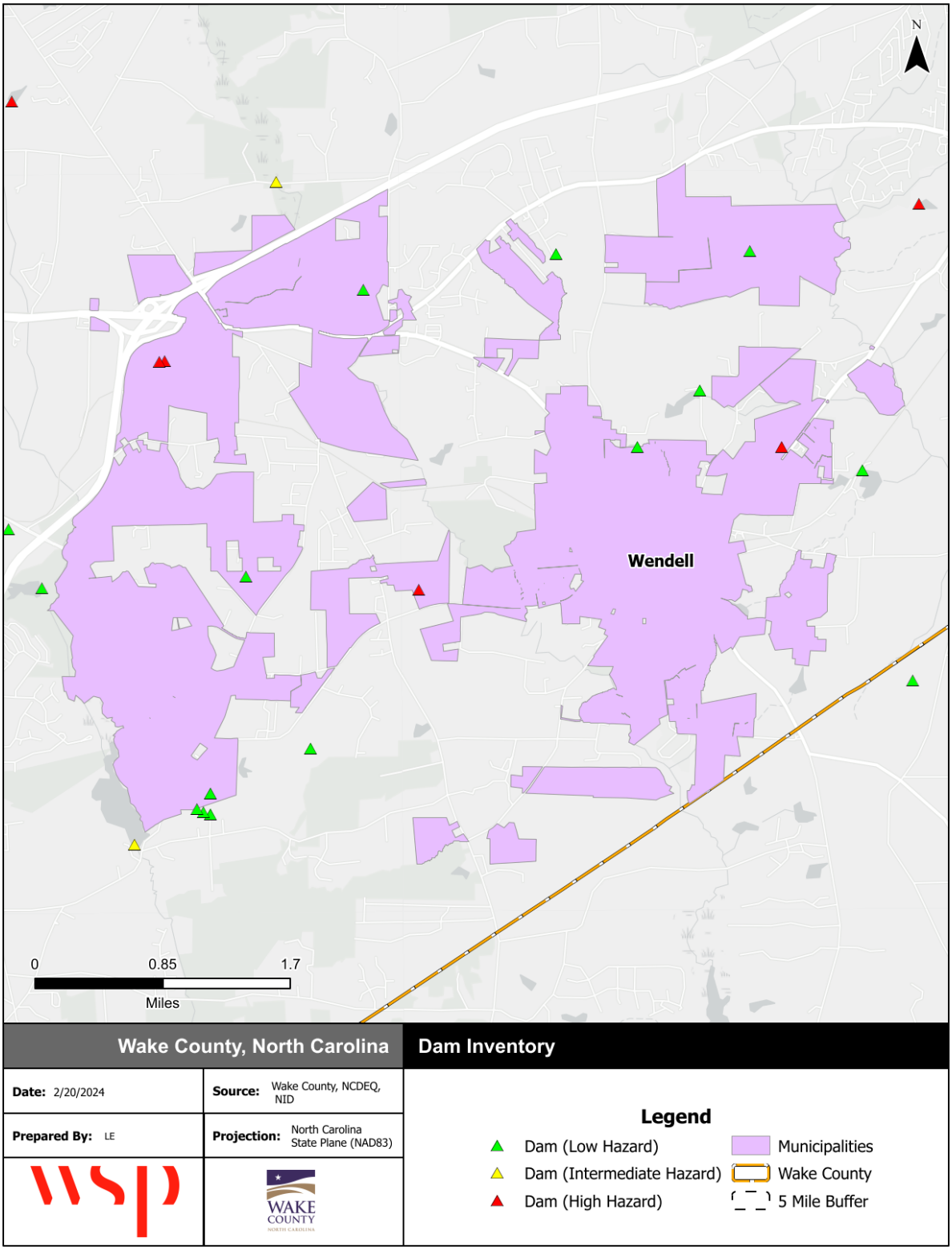


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

L.1.2 DAM FAILURE

Currently, the Town of Wendell has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure L.2 shows the location of all dams in the Town of Wendell.

Figure L.2 – Dam Inventory, Town of Wendell



Source: North Carolina Dam Inventory, February 2024

L.1.3 FLOOD

Table L.2 details the acreage of the Town of Wendell by flood zone on the effective DFIRM. Per this assessment, over 6 percent of the Town of Wendell falls within the mapped 1%-annual-chance floodplains.

Table L.2 – Flood Zone Acreage in the Town of Wendell

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	384.4	6.4
Zone X (500-year)	23.0	0.4
Zone X Unshaded	5,607.0	93.32
Total	**6,014.4**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure L.3 reflects the effective mapped flood hazard zones for the Town of Wendell, Figure L.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table L.3 provides building counts and values for critical facilities by flood zone in the Town of Wendell.

Table L.3 – Critical Facilities Exposed to Flooding, Town of Wendell

Flood Zone	Critical Facility Count	Structure Value
AE	12	$15,237,617
X	59	$115,247,360
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0	$0
Total	**71**	**$130,484,977**

Source: FEMA Effective DFIRM

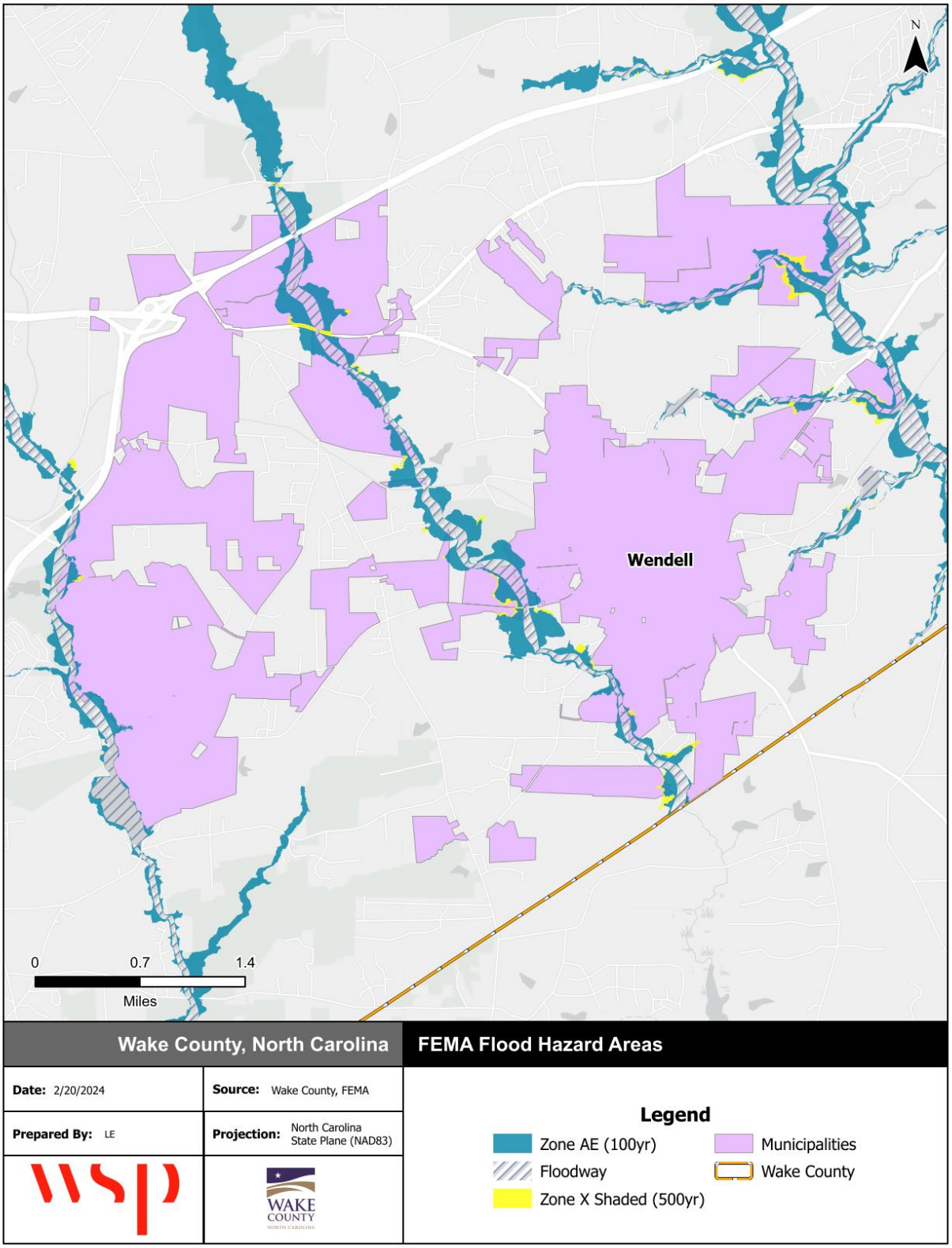
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $8.2 million in building related damages. The results of the Hazus loss estimate are summarized in Table L.4.

Table L.4 – HAZUS 100-Year Flood Results, Town of Wendell

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	14	$1,433,000	$224,000	$459,000	$683,000	48%
Commercial	7	$682,000	$67,000	$284,000	$351,000	51%
Educational	1	$7,603,000	$443,000	$2,840,000	$3,283,000	43%
Government	0	$0	$0	$0	$0	0%
Industrial	8	$1,526,000	$376,000	$956,000	$1,332,000	87%
Religious	2	$84,000	$4,000	$32,000	$36,000	43%
Residential	48	$2,965,000	$1,685,000	$853,000	$2,538,000	86%
Total	**80**	**$14,293,000**	**$2,799,000**	**$5,424,000**	**$8,223,000**	**58%**

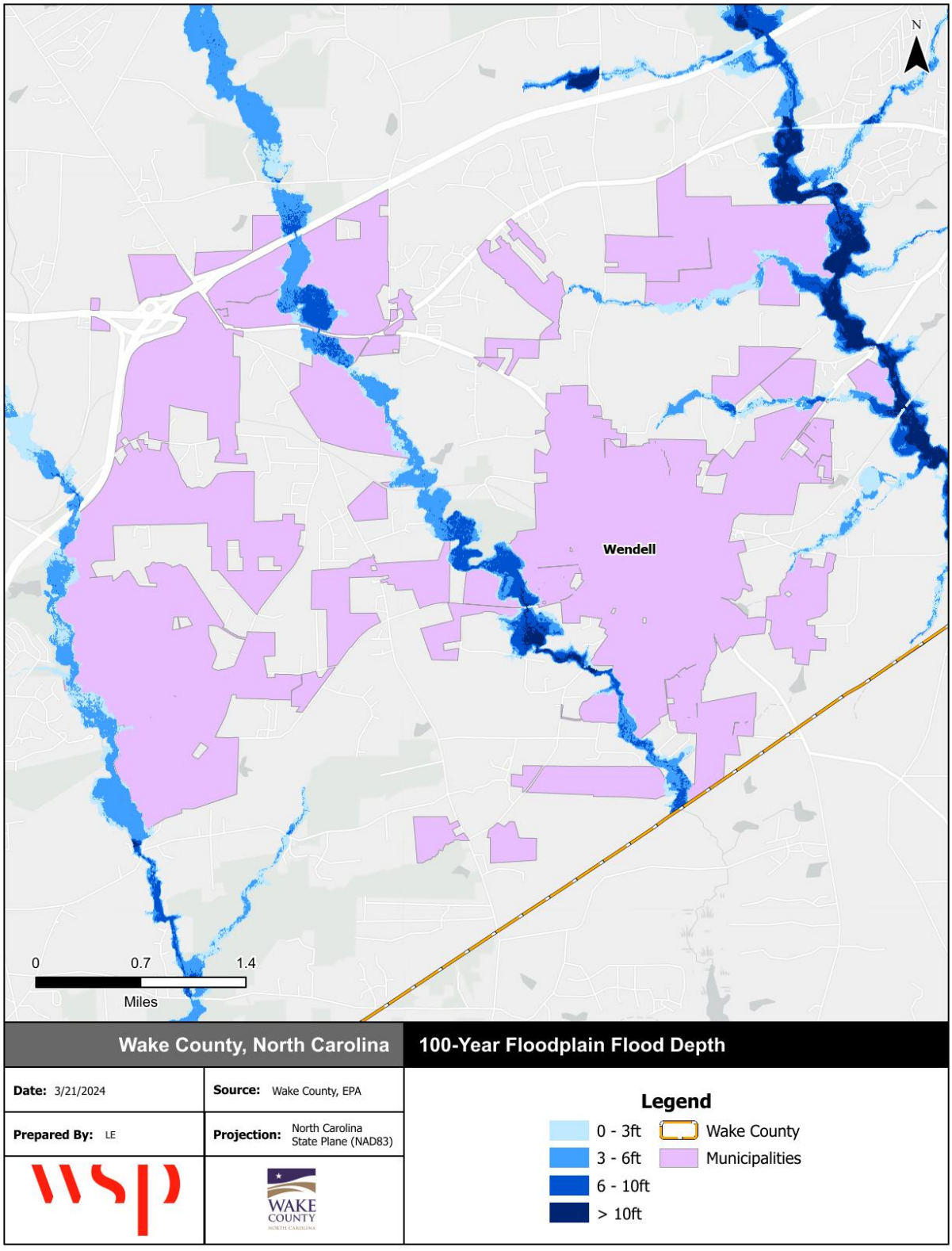
Source: FEMA Natural Hazards Risk Assessment Program

Figure L.3 – FEMA Flood Hazard Areas, Town of Wendell



Source: FEMA Effective DFIRM

Figure L.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Wendell



Source: FEMA Effective DFIRM

L.1.4 WILDFIRE

Table L.5 summarizes the acreage in the Town of Wendell that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 26 percent of the Town of Wendell is not included in the WUI.

Table L.5 – Wildland Urban Interface Acreage, Town of Wendell

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	1,583.42	26.3%
	LT 1hs/40ac	673.27	11.2%
	1hs/40ac to 1hs/20ac	593.46	9.9%
	1hs/20ac to 1hs/10ac	600.23	10.0%
	1hs/10ac to 1hs/5ac	525.59	8.7%
	1hs/5ac to 1hs/2ac	533.39	8.9%
	1hs/2ac to 3hs/1ac	1,502.36	25.0%
	GT 3hs/1ac	2.00	0.0%
	Total	**6,013.72**	**100%**

Source: Southern Wildfire Risk Assessment

Figure L.5 depicts the WUI for the Town of Wendell. Figure L.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure L.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

There are pockets of higher potential fire intensity throughout the eastern and western regions of the Town of Wendell. While some of these areas do fall within the WUI, the Town has a moderate to high burn probability throughout the western half. This means that these areas of development could be at higher risk for fires.

Table L.6 provides the count and estimated value of all structures that intersect with areas of the Town of Wendell that are rated moderate to high on the WUI Risk Index.

Table L.6 – Structures at Risk to Moderate-High WUI Risk Index, Town of Wendell

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	28	$4,327,644	$4,327,644	$8,655,288
Commercial	156	$102,342,168	$102,342,168	$204,684,336
Education	11	$50,873,180	$50,873,180	$101,746,360
Government	18	$20,209,216	$20,209,216	$40,418,432
Industrial	44	$41,861,767	$62,792,651	$104,654,418
Religious	42	$73,066,580	$73,066,580	$146,133,160
Residential	3230	$698,467,081	$349,233,541	$1,047,700,622
Total	**3,529**	**$991,147,636**	**$662,844,979**	**$1,653,992,615**

Source: Southern Wildfire Risk Assessment

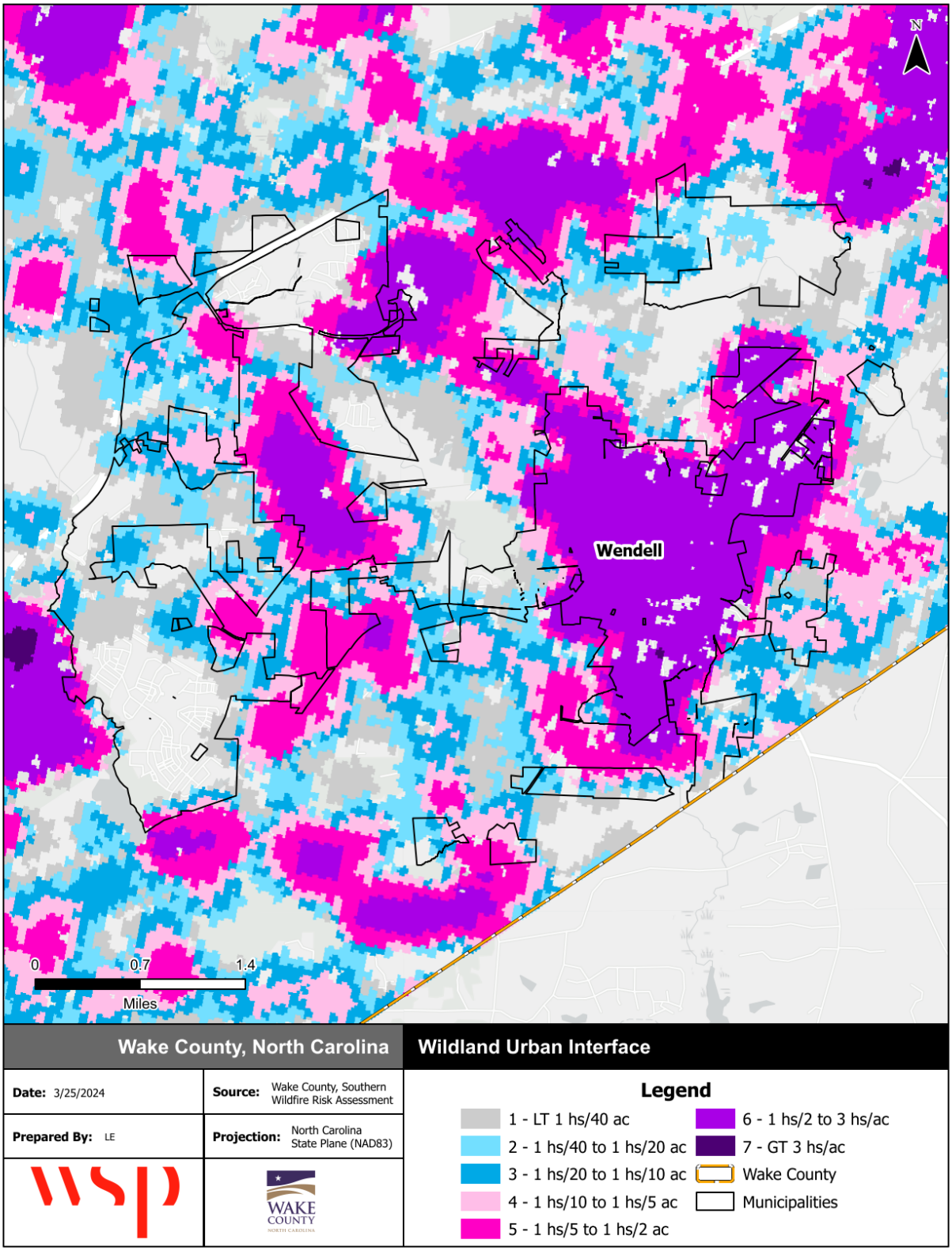
Table L.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table L.7 – Critical Facilities Exposed to Wildfire, Town of Wendell

Type	Critical Facility Count	Structure Value
Communications	0	$0
Energy	5	$2,064,708
Food, Hydration, Shelter	2	$6,856,625
Hazardous Materials	18	$8,187,162
Health and Medical	6	$4,351,693
Safety and Security	9	$24,914,576
Transportation	0	$0
Water Systems	6	$558,874
Total	**46**	**$46,933,638**

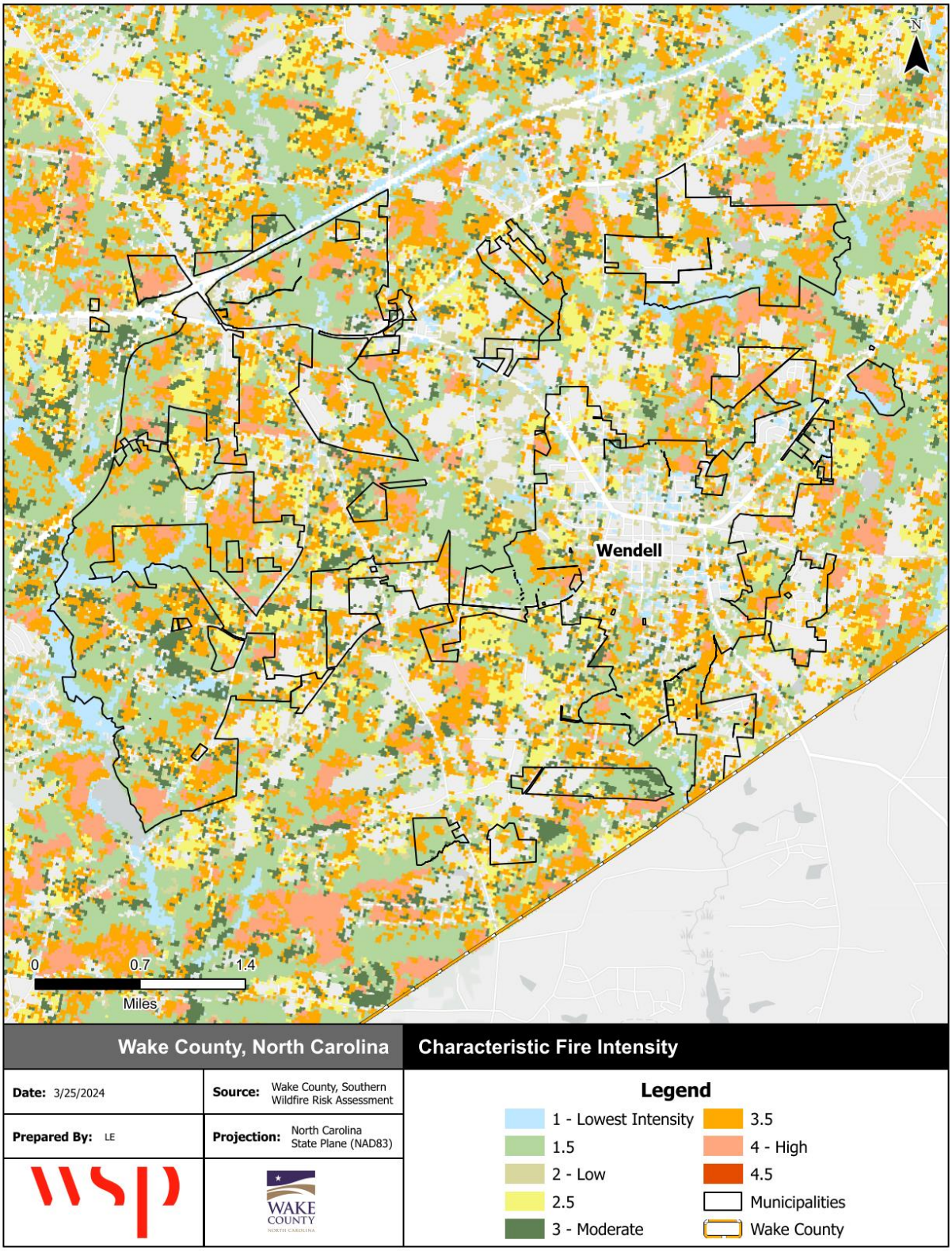
Source: Southern Wildfire Risk Assessment

Figure L.5 – Wildland Urban Interface, Town of Wendell



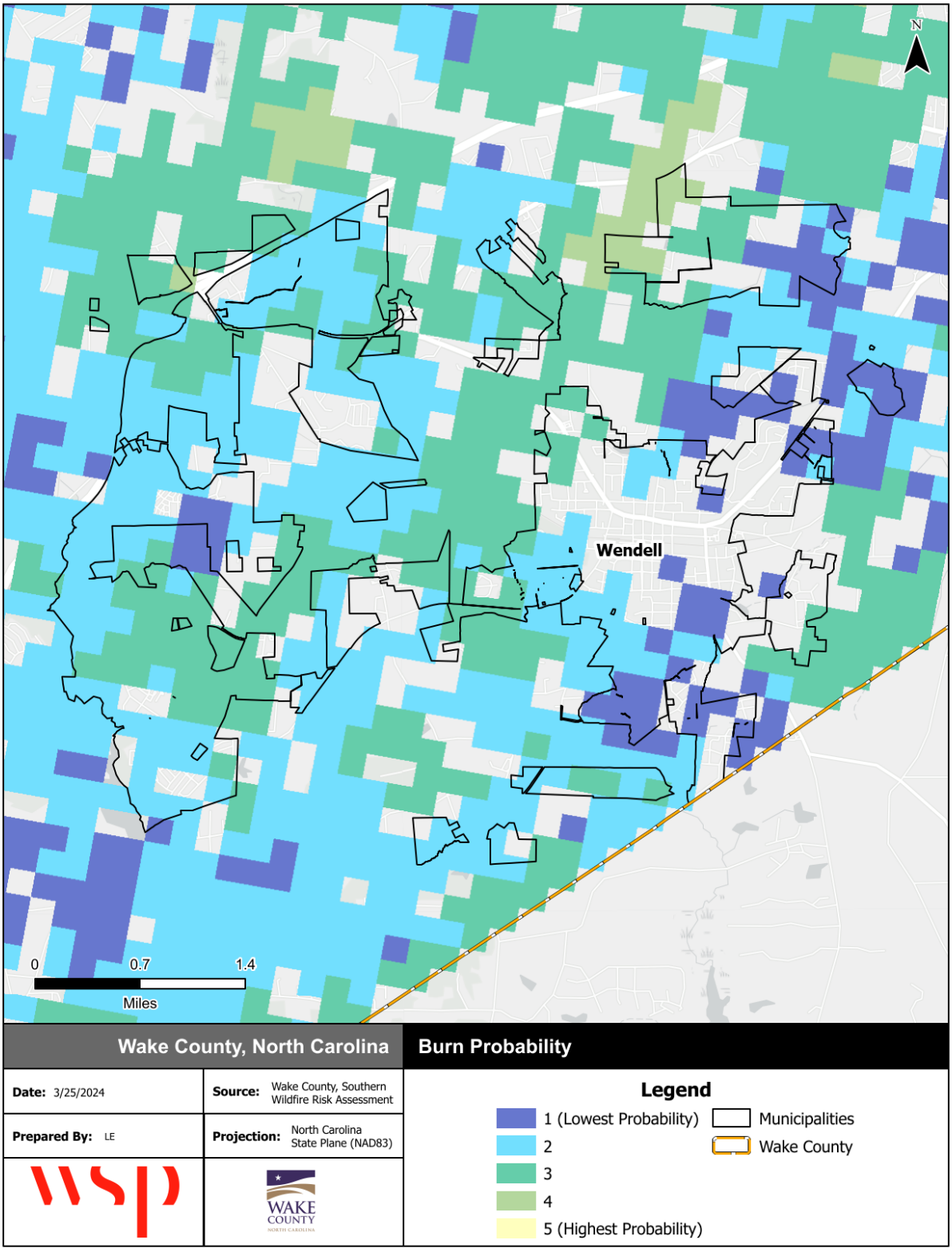
Source: Southern Wildfire Risk Assessment

Figure L.6 – Fire Intensity Scale, Town of Wendell



Source: Southern Wildfire Risk Assessment

Figure L.7 – Burn Probability, Town of Wendell



Source: Southern Wildfire Risk Assessment

L.2 MITIGATION STRATEGY

Town of Wendell											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Amend the Town's Water Allocation Policy to add a new point category for voluntarily increasing undisturbed riparian buffer protections from 50 to 100 feet around Neuse perennial streams	4	1	Flood, Dam Failure, Hurricane	High	Wendell Planning	$10,000	N/A	1 year	In Progress – Carry Forward	Policy is being looked at wholistically and a policy update is planned.
P-2	Consider amendments to the UDO to establish minimum ingress/egress standards for new residential development based on density/# of lots	4	1	Earthquake, Flood, Dam Failure, Hurricane, Wildfire, Tornado, Severe Winter Storm, Hazardous Materials Incident, Radiological Incident, Terrorism	High	Wendell Planning	$150,000	N/A	1 year	In Progress – Carry Forward	Money has not previously been budgeted for this update. UDO update is planned in 2025 and budgeted for.
P-3	Encourage the use of low-impact development techniques through amendments to the Town's Water Allocation Policy	4	1	Flood, Dam Failure, Hurricane	High	Wendell Planning	$0	N/A	1 year	In Progress – Carry Forward	Policy is being looked at wholistically and a policy update is planned.
P-4	Evaluate potential changes to the Town's Arterial and Collector Street Plan to minimize adverse impacts to environmentally sensitive areas due to new roadway construction or widening	4	2	Flood	Moderate	Wendell Planning	$5,000	Town of Wendell	2-3 years	In Progress – Carry Forward	Two changes have already been made but more are anticipated during UDO rewrite.
P-5	Complete a tree health study to encourage a healthy tree canopy and improved public safety in conjunction with continuation of being a Tree City USA.	2	2	All	Moderate	Wendell Public Works/Parks & Rec	$40,000	Town of Wendell	3-4 years	New	N/A
P-6	Stormwater Management Plan accepted by NC to be implemented within the next permit term to include adoption of Stormwater Best Management Practices	4	2	Flood, Dam Failure, Hurricane, Severe Winter Storm	High	Wendell Public Works	$400,000	Town of Wendell	3-4 years	New	N/A
P-7	Discourage development in flood-prone areas by including density allowances through clustering of buildings and complementary mixed-use developments.	4	2	Flood, Hurricane	High	Wendell Planning	$0	Town of Wendell	2-4 years	New	N/A
Natural Resource Protection											
NRP-1	Perform environmental asset mapping in order to identify areas most key for preservation and potential acquisition due to an array of environmental factors	2	2	Flood, Drought	Moderate	Wendell Planning	$10,000	Town of Wendell	2-3 years	In Progress – Carry Forward	Ongoing project due to lack of staff and GIS capabilities. Planner III will be added FY24/25 to do this type of work.

Town of Wendell											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
NRP-2	Evaluate policy regarding greenway dedication requirements in order to expand greenway network and further protect riparian corridors	4	2	Flood	High	Wendell Planning	$0	Town of Wendell	2-3 years	In Progress – Carry Forward	Working on greenway map and policies as part of UDO update.
NRP-3	Conserve natural resources and open space especially in the key areas of Buffalo Creek and Little River.	3	2	Flood	Moderate	Wendell Planning	$400,000	Town of Wendell	3-5 years	New	N/A
Structural Projects											
SP-1	Perform improvements to existing open drainage device near intersection of 1st St & Pine St. to increase total water volume & flow	3	1	Flood	Moderate	Wendell Public Works	$5,000	Town of Wendell	3-5 years	Complete	New pipe and culvert improvements and installation.
Emergency Services											
ES-1	Develop Adverse Weather Plan Map for Public Works crew	2	1	Severe Weather, Severe Winter Storm, Hurricane	High	Wendell Planning	$5,000	N/A	1 year	In Progress – Carry Forward	Was action item in 2019 under Planning but need to move to Public Works.
ES-2	Provide written after-action report of response to severe weather and hazard events to include recommendations for process improvements and improve planning for future disasters	2	2	All	Moderate	Wendell Police Dept.	$0	Town of Wendell	2-3 years	In Progress – Carry Forward	No opportunity to complete at this time. See if opportunity occurs so that we can conduct an after-action report.
ES-3	Secure and utilize visual warning barricades for vehicular and pedestrian traffic to block properties, roadways, etc. for public safety during or following hazard events	2	1	All	Moderate	Wendell Public Works	$2,000	Town of Wendell	3-5 years	In Progress – Carry Forward	Ongoing as town grows. At this time more than $100,000 spent on class 3 barricades, message boards, light towers, etc.
ES-4	Conduct periodic training exercises, related to higher-risk hazard threats identified by the Hazard Mitigation Plan	2	2	All	Moderate	Wendell Police Dept.	$500	Town of Wendell	2-3 years	In Progress – Carry Forward	Ongoing and required for police accreditation and also best practices.
ES-5	Work with Wake County and the City of Raleigh to operate and update the County's Master Address Repository program, which will support emergency response following hazards.	2	2	All	High	Wendell Planning	$0	Town of Wendell	2-3 years	In Progress – Carry Forward	Ongoing with new developments
Public Education and Awareness											
PEA-1	Implement a new electronic app/website for citizens to report flood or other hazards to the town	1	2	Flood	Moderate	Wendell IT	To Be Determined	Town of Wendell	2-3 years	In Progress – Carry Forward	Previous app “Tell Wendell” did not contain functionality needed so a new mechanism for public reporting is needed and will be replaced within this goal.

M. TOWN OF ZEBULON

M.1 RISK ASSESSMENT

This section contains an inventory of critical facilities at risk within the planning area of the Town of Zebulon. Additionally, hazard risk and vulnerability details are provided for those hazards that are spatially defined and have variations in risk that could be evaluated quantitatively on a jurisdictional level within the Town of Zebulon. The hazards included in this section are: Dam Failure, Flood, and Wildfire.

M.1.1 CRITICAL FACILITIES

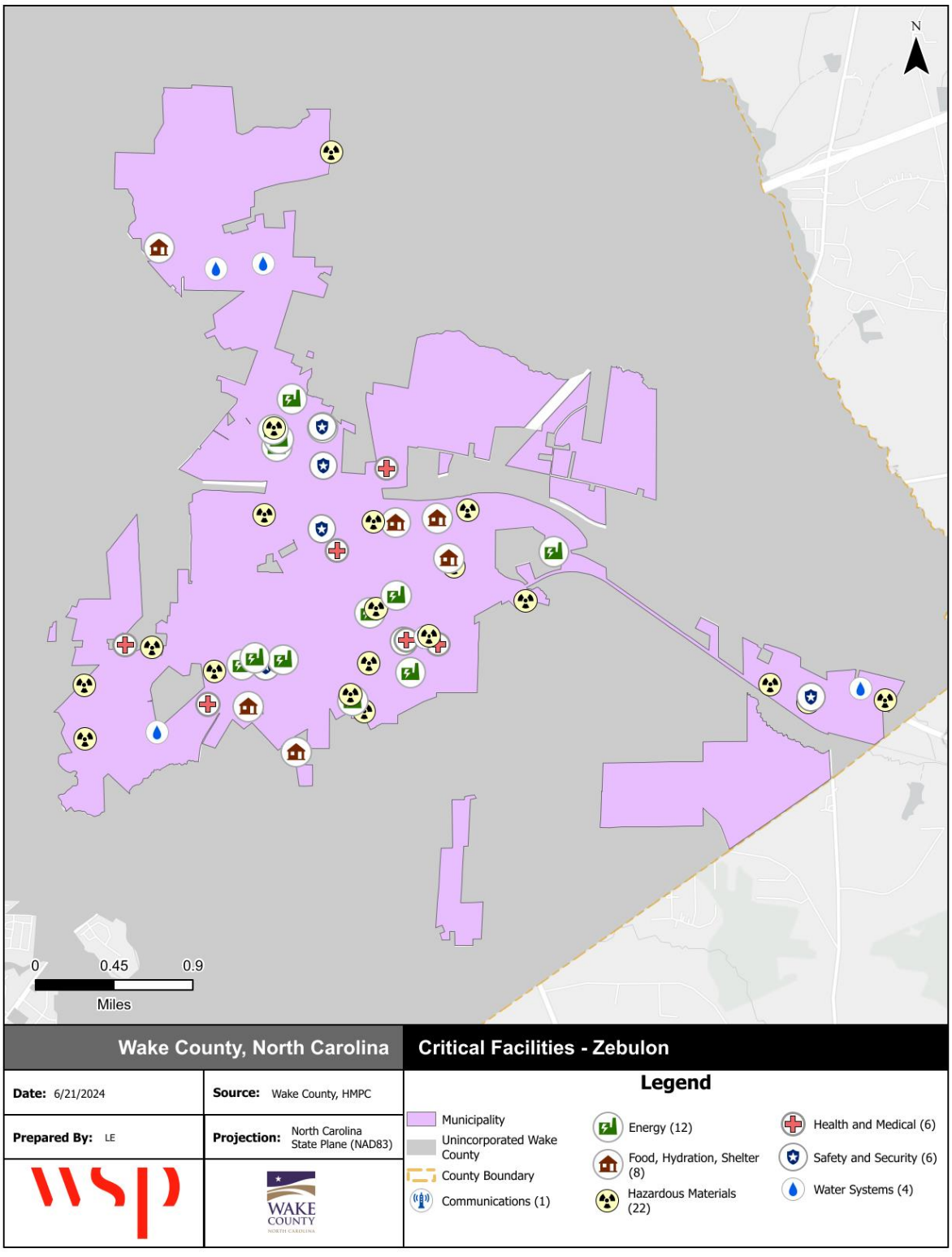
Wake County and the HMPC provided a local inventory of critical facilities and community lifelines, which are a priority for mitigation planning and emergency management. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Table M.1 provides a count of critical facilities by FEMA lifeline category within the Town of Zebulon. Figure M.1 shows the locations of all critical facilities within the Town of Zebulon.

Table M.1 – Critical Facilities by Type, Town of Zebulon

Facility Type	Count of Facility Type	Structure Value
Communications	1	$0
Energy	13	$7,965,769
Food, Hydration, Shelter	6	$30,497,105
Hazardous Materials	35	$119,786,882
Health and Medical	6	$6,485,914
Safety and Security	6	$36,683,708
Transportation	0	$0
Water Systems	6	$25,223
Total	**73**	**$201,444,601**

Source: Wake County, HMPC

Figure M.1 – Town of Zebulon Critical Facilities

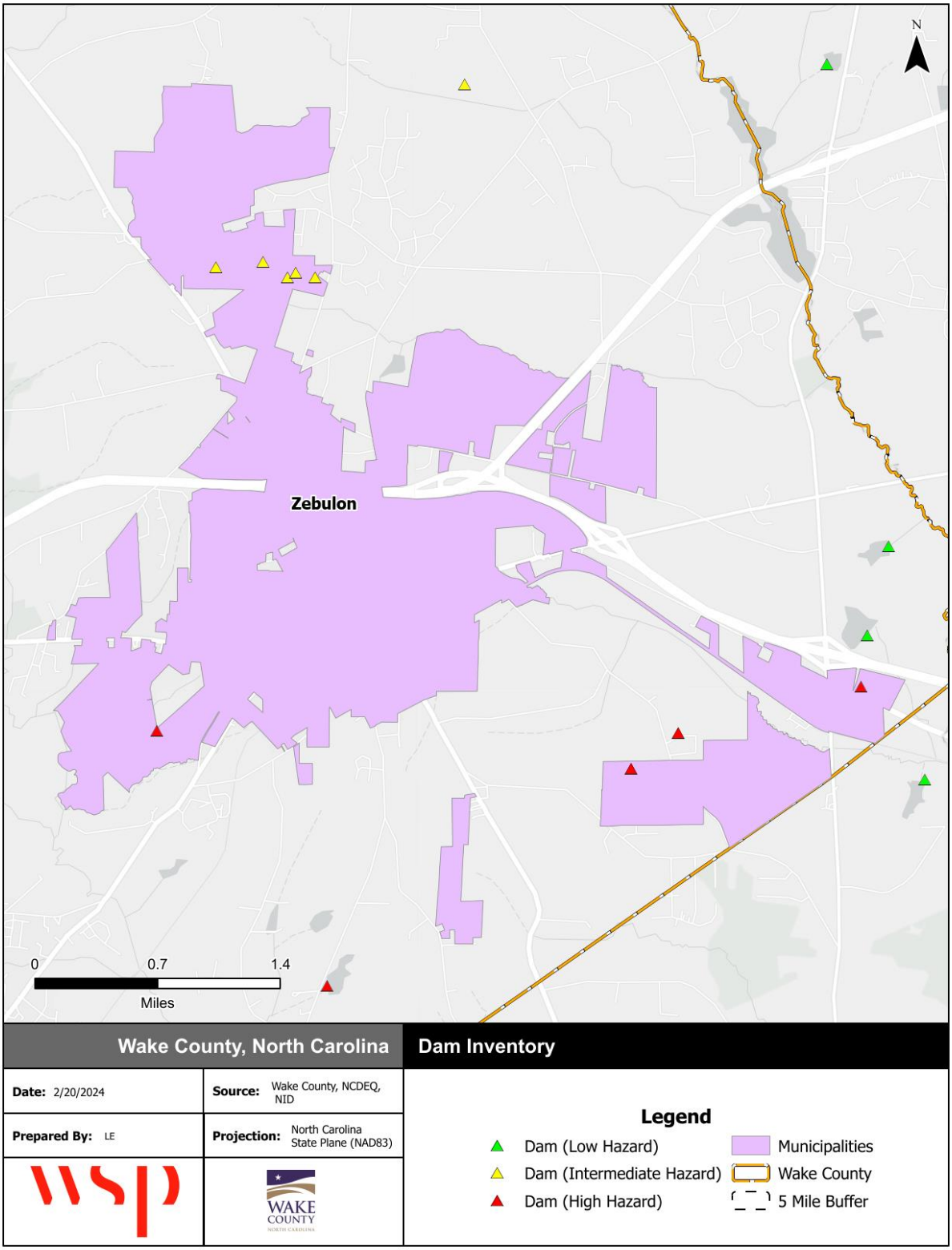


Source: Wake County, HMPC
(Note: Values were not available for some facilities in the IRISK database)

M.1.2 DAM FAILURE

Currently, the Town of Zebulon has no high hazard dams that have been identified by the North Carolina Dam Inventory with a condition assessment of "poor." Figure M.2 shows the location of all dams in the Town of Zebulon.

Figure M.2 – Dam Inventory, Town of Zebulon



Source: North Carolina Dam Inventory, February 2024

M.1.3 FLOOD

Table M.2 details the acreage of the Town of Zebulon by flood zone on the effective DFIRM. Per this assessment, around 5 percent of the Town of Zebulon falls within the mapped 1%-annual-chance floodplains.

Table M.2 – Flood Zone Acreage in the Town of Zebulon

Flood Zone	Acreage	Percent of Total (%)
Zone A	0.0	0.0
Zone AE	209.9	5.0
Zone X (500-year)	2.0	0.05
Zone X Unshaded	4,000.3	95.0
Total	**4,212.2**	--

Source: FEMA Effective DFIRM; Wake County GIS

Figure M.3 reflects the effective mapped flood hazard zones for the Town of Zebulon, and Figure M.4 displays the depth of flooding estimated to occur in these areas during the 1%-annual-chance flood.

Table M.3 provides building counts and values for critical facilities by flood zone in the Town of Zebulon.

Table M.3 – Critical Facilities Exposed to Flooding, Town of Zebulon

Flood Zone	Critical Facility Count	Structure Value
AE	12	$101,403,005
X	61	$100,041,596
X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0	$0
Total	**73**	**$201,444,601**

Source: FEMA Effective DFIRM

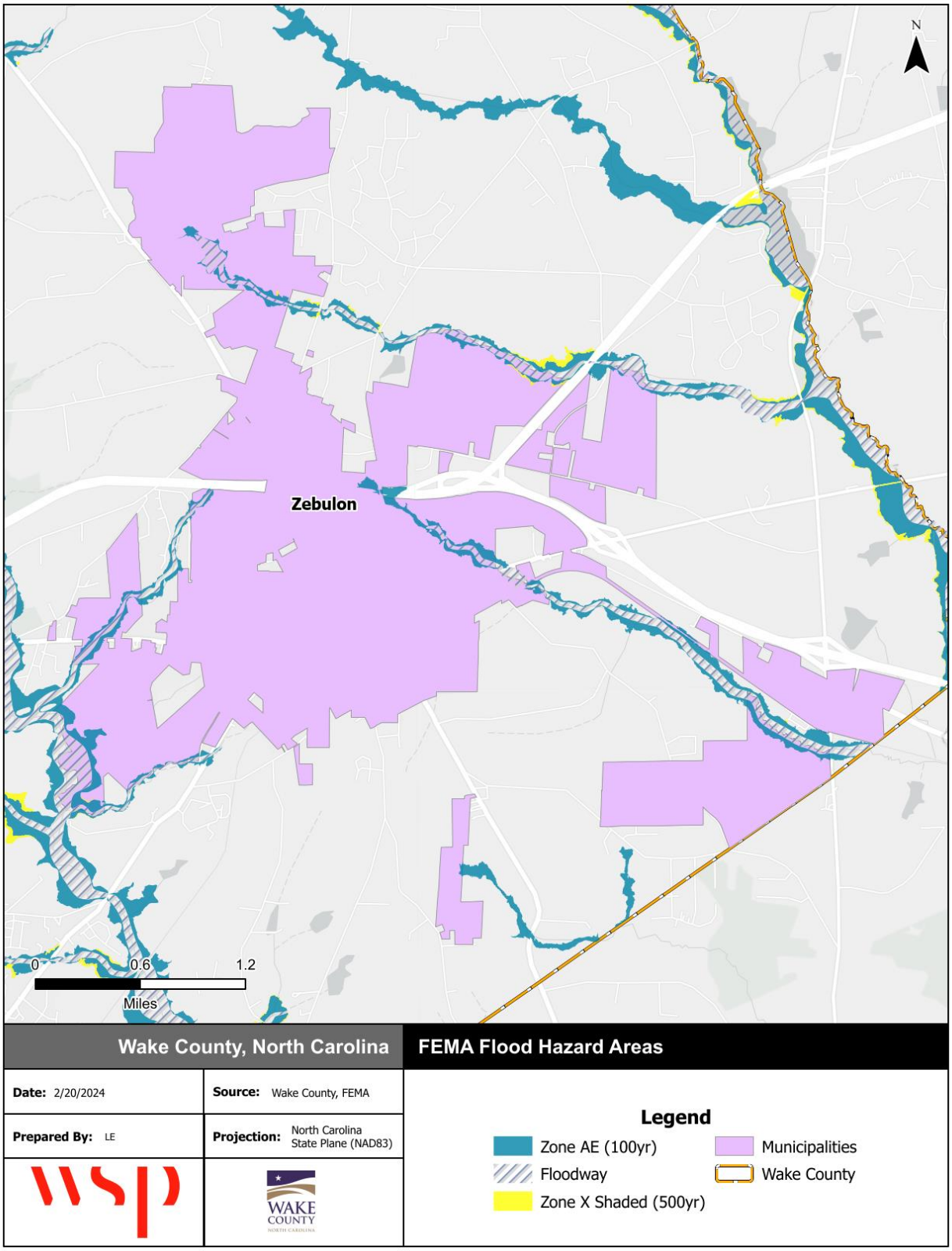
To supplement the IRISK assessment of property at risk from the 1% annual chance flood event, the planning team evaluated flood risk using a level one analysis in FEMA's Hazus software. Per this analysis, a 1% annual chance flood event would cause an estimated $2.6 million in building related damages. The results of the Hazus loss estimate are summarized in Table M.4.

Table M.4 - HAZUS 100-Year Flood Results, Town of Zebulon

Occupancy Type	Total Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Loss	Estimated Total Damage	Loss Ratio
Agriculture	4	$195,000	$19,000	$67,000	$86,000	44%
Commercial	5	$464,000	$25,000	$133,000	$158,000	34%
Educational	2	$113,000	$5,000	$33,000	$38,000	34%
Government	1	$59,000	$1,000	$7,000	$8,000	14%
Industrial	5	$923,000	$175,000	$556,000	$731,000	79%
Religious	0	$0	$0	$0	$0	0%
Residential	28	$2,130,000	$1,084,000	$561,000	$1,645,000	77%
Total	**45**	**$3,884,000**	**$1,309,000**	**$1,357,000**	**$2,666,000**	**69%**

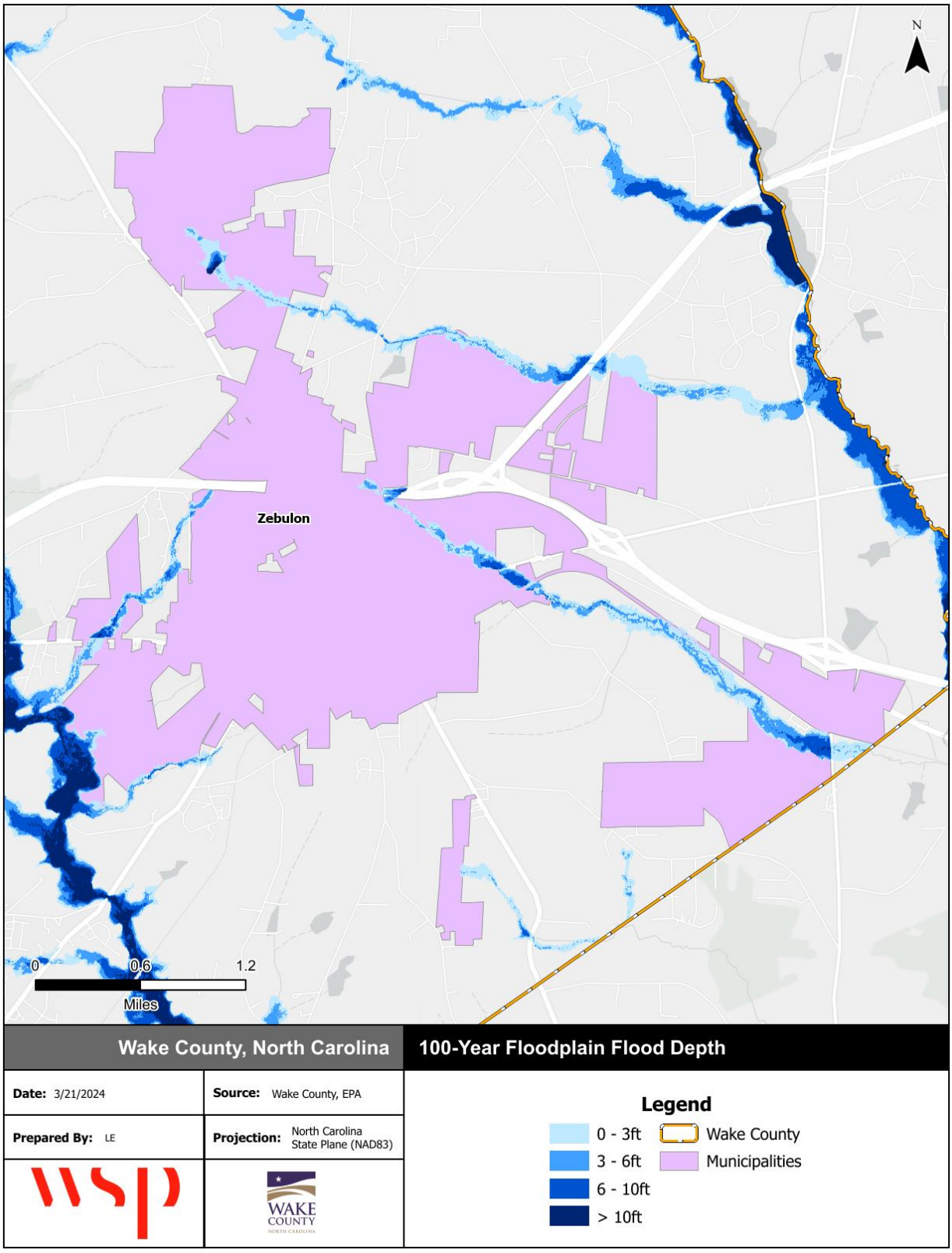
Source: FEMA Natural Hazards Risk Assessment Program

Figure M.3 – FEMA Flood Hazard Areas, Town of Zebulon



Source: FEMA Effective DFIRM

Figure M.4 – Flood Depth, 1%-Annual-Chance Floodplain, Town of Zebulon



Source: FEMA Effective DFIRM

M.1.4 WILDFIRE

Table M.5 summarizes the acreage in the Town of Zebulon that falls within the Wildland Urban Interface (WUI), categorized by housing density. The WUI is the area where housing development is built near or among areas of vegetation that may be prone to wildfire. Areas in the WUI are those where development may intermix with flammable vegetation. Over 23 percent of the Town of Zebulon is not included in the WUI.

Table M.5 – Wildland Urban Interface Acreage, Town of Zebulon

	Housing Density	Total Acreage	Percent of Total Acreage
	Not in WUI	1,000.05	23.7%
	LT 1hs/40ac	334.71	7.9%
	1hs/40ac to 1hs/20ac	239.45	5.7%
	1hs/20ac to 1hs/10ac	317.50	7.5%
	1hs/10ac to 1hs/5ac	488.04	11.6%
	1hs/5ac to 1hs/2ac	684.83	16.3%
	1hs/2ac to 3hs/1ac	1,140.05	27.1%
	GT 3hs/1ac	7.78	0.2%
	Total	**4,212.41**	**100%**

Source: Southern Wildfire Risk Assessment

Figure M.5 depicts the WUI for the Town of Zebulon. Figure M.6 depicts the Fire Intensity Scale, which indicates the potential severity of fire based on fuel loads, topography, and other factors. Figure M.7 depicts Burn Probability based on landscape conditions, percentile weather, historical ignition patterns, and historical prevention and suppression efforts.

Potential fire intensity is highest in the north, east, and western regions of Zebulon outside of the Town center; however, these areas are largely outside of the WUI and have low burn probabilities. The area with the highest burn probability, in northwest Zebulon, does not overlay with high potential fire intensity and is partially outside of the WUI.

Table M.6 provides the count and estimated value of all structures that intersect with areas of the Town of Zebulon that are rated moderate to high on the WUI Risk Index.

Table M.6 – Structures at Risk to Moderate-High WUI Risk Index, Town of Zebulon

Occupancy	Structures at Risk	Structure Value	Estimated Content Value	Total Value
Agriculture	12	$1,638,789	$1,638,789	$3,277,578
Commercial	180	$100,668,304	$100,668,304	$201,336,608
Education	21	$87,265,886	$87,265,886	$174,531,772
Government	19	$17,235,003	$17,235,003	$34,470,006
Industrial	83	$234,500,054	$351,750,081	$586,250,135
Religious	20	$20,264,581	$20,264,581	$40,529,162
Residential	2243	$529,580,189	$264,790,095	$794,370,284
Total	**2,578**	**$991,152,806**	**$843,612,739**	**$1,834,765,545**

Source: Southern Wildfire Risk Assessment

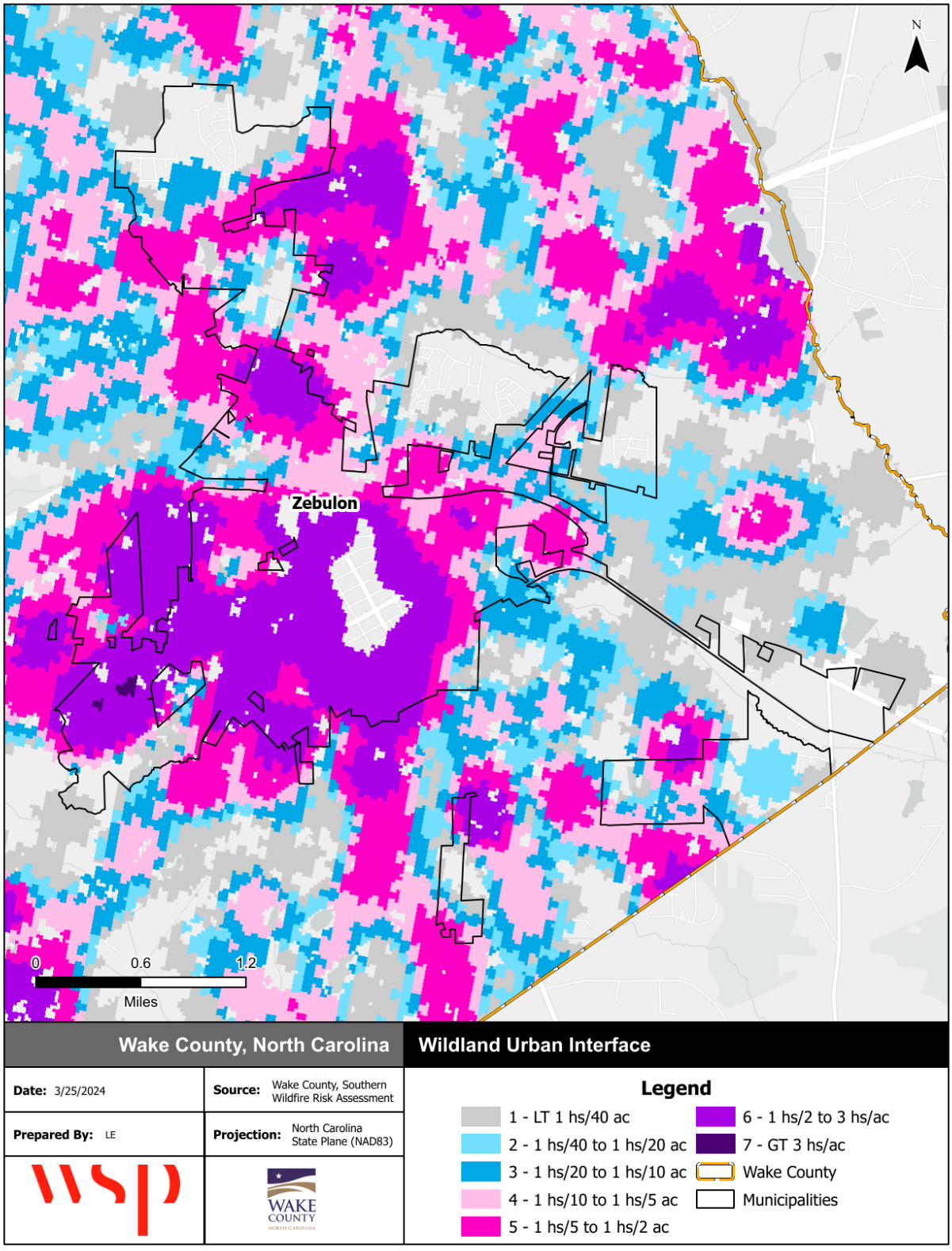
Table M.7 provides building counts and values for critical facilities by FEMA lifeline that are located in areas rated moderate to high on the WUI Risk Index.

Table M.7 – Critical Facilities Exposed to Wildfire, Town of Zebulon

Type	Critical Facility Count	Structure Value
Communications	1	$0
Energy	11	$6,814,292
Food, Hydration, Shelter	6	$30,497,105
Hazardous Materials	19	$104,009,044
Health and Medical	6	$6,485,914
Safety and Security	5	$29,388,950
Transportation	0	$0
Water Systems	3	$1,250
Total	**51**	**$177,196,555**

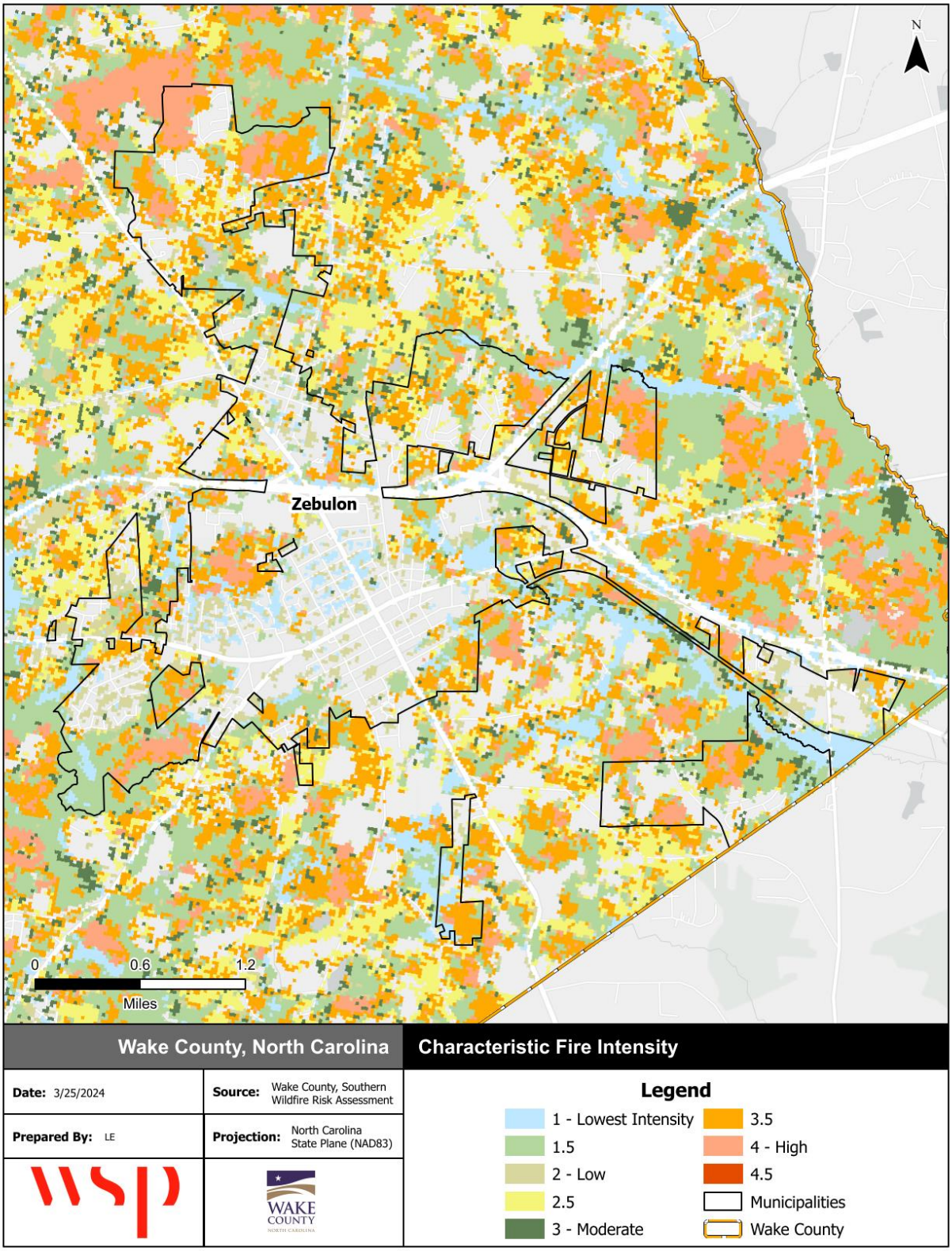
Source: Southern Wildfire Risk Assessment

Figure M.5 – Wildland Urban Interface, Town of Zebulon



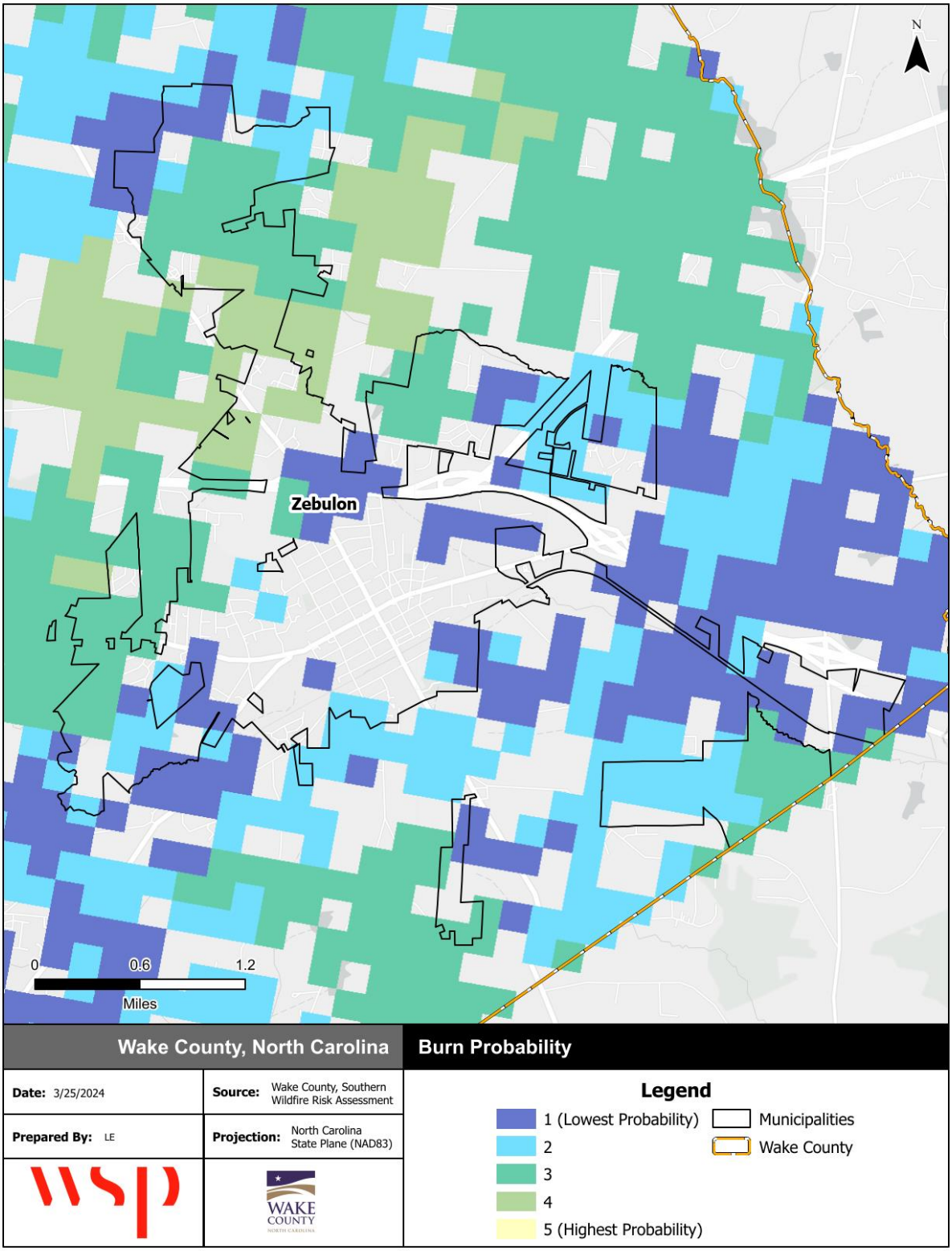
Source: Southern Wildfire Risk Assessment

Figure M.6 – Fire Intensity Scale, Town of Zebulon



Source: Southern Wildfire Risk Assessment

Figure M.7 – Burn Probability, Town of Zebulon



Source: Southern Wildfire Risk Assessment

M.2 MITIGATION STRATEGY

Town of Zebulon											
Action #	**Description**	**Goal**	**Objective**	**Hazard(s) Addressed**	**Relative Priority**	**Lead Agency/ Department**	**Estimated Cost**	**Potential Funding Sources**	**Implementation Schedule**	**2024 Status**	**Status Comments/Explanation**
Prevention											
P-1	Prepare Plan maintenance report.	2	2	All	High	Zebulon Planning Department	Staff time	Town of Zebulon	Annually	In Progress – Carry Forward	Plan maintenance meetings have been held annually and will continue to be held going forward.
P-2	Hiring Storm Water Manager	2	2	Flood, Hurricane, Dam Failure	High	Zebulon Planning	Staff time	Town of Zebulon	2025	New	Plan to hire a Storm Water Manager by the first quarter of FY 2025
Natural Resource Protection											
NRP-1	Working with Wake County Parks and Recreation for revitalization of Little River Park which will include enhanced storm water management to minimize potential damage from higher water levels on little river following heavy rainfall.	3	2	Flood	Moderate	Zebulon Planning	TBD	Federal, Local	Next 5 Years	New	Design award to be issued 1st quarter FY 2026
Structural Projects											
SP-1	Updating and reconfiguring storm water system in downtown to relocate old storm mains into public right of way, easements, or other accessible areas.	3	1	Flood, Hurricane	Moderate	Zebulon Planning	TBD	Town of Zebulon	2026	New	N/A
Emergency Services											
ES-1	Develop an Emergency Operations Plan	2	2	All	Moderate	Zebulon Fire Department	TBD	Town of Zebulon	2-3 Years	In-Progress – Carry Forward	The Town has been in the process of developing an Emergency Operations Plan.
Public Education and Awareness											
PEA-1	Require disclosure of flood hazard in real estate transactions.	1	1	Flood	Moderate	Zebulon Planning Department	Little to no cost	Town of Zebulon	2024	Not Started – Carry Forward	No progress to report
PEA-2	Promotion of Ready-Wake system to alert citizens of hazards.	1	2	All	Moderate	Zebulon Planning Department	Staff time	Town of Zebulon	Next 5 Years	New	This will be an on-going project.
PEA-3	Acquire additional technology to allow system-wide communication across various radio systems	1	1	All	Moderate	Zebulon Planning Department	Staff time	Town of Zebulon	Next 5 Years	New	Initial steps have been completed and will continue to monitor.

A. PLAN REVIEW TOOL

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Local Mitigation Plan Review Tool

Cover Page

The Local Mitigation Plan Review Tool (PRT) demonstrates how the local mitigation plan meets the regulation in 44 CFR § 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the local governments, including special districts.

1. The Multi-Jurisdictional Summary Sheet is a worksheet that is used to document how each jurisdiction met the requirements of the plan elements (Planning Process; Risk Assessment; Mitigation Strategy; Plan Maintenance; Plan Update; and Plan Adoption).
2. The Plan Review Checklist summarizes FEMA's evaluation of whether the plan has addressed all requirements.

For greater clarification of the elements in the Plan Review Checklist, please see Section 4 of this guide. Definitions of the terms and phrases used in the PRT can be found in Appendix E of this guide.

Plan Information	
Jurisdiction(s)	Wake County, City of Raleigh, Town of Apex, Town of Cary, Town of Fuquay-Varina, Town of Garner, Town of Holly Springs, Town of Knightdale, Town of Morrisville, Town of Rolesville, Town of Wake Forest, Town of Wendell, Town of Zebulon
Title of Plan	Wake County, NC Multi-Jurisdictional Hazard Mitigation Plan
New Plan or Update	Update
Single- or Multi-Jurisdiction	Multi-jurisdiction
Date of Plan	7/25/2024
Local Point of Contact	
Title	Sasha Godwin, Emergency Management Specialist
Agency	Emergency Management
Address	337 S. Salisbury Street, 13th Floor/PO Box 550, Raleigh, NC, 27601
Phone Number	919-856-5587
Email	Sasha.godwin@wake.gov

Additional Point of Contact	
Title	David Stroud
Agency	WSP
Address	4021 Stirrup Creek Drive, Suite 100, Durham, NC 27703
Phone Number	919-325-6497
Email	david.stroud@wsp.com

Review Information	
State Review	
State Reviewer(s) and Title	John Mello
State Review Date	9/23/2024
FEMA Review	
FEMA Reviewer(s) and Title	Kymberly Kudla, Community Planner, Jake Grabowsky (QC)
Date Received in FEMA Region	9/23/2024
Plan Not Approved	Click or tap to enter a date.
Plan Approvable Pending Adoption	11/20/2024
Plan Approved	11/20/2024

Multi-Jurisdictional Summary Sheet

#	Jurisdiction Name	Requirements Met (Y/N)						
		A. Planning Process	B. Risk Assessment	C. Mitigation Strategy	D. Plan Maintenance	E. Plan Update	F. Plan Adoption	G. State Requirements
1	Wake County	Y	Y	Y	Y	Y		
2	Raleigh	Y	Y	Y	Y	Y		
3	Apex	Y	Y	Y	Y	Y		
4	Cary	Y	Y	Y	Y	Y		
5	Fuquay-Varina	Y	Y	Y	Y	Y		
6	Garner	Y	Y	Y	Y	Y		
7	Holly Springs	Y	Y	Y	Y	Y		
8	Knightdale	Y	Y	Y	Y	Y		
9	Morrisville	Y	Y	Y	Y	Y		
10	Rolesville	Y	Y	Y	Y	Y		
11	Wake Forest	Y	Y	Y	Y	Y		
12	Wendell	Y	Y	Y	Y	Y		
13	Zebulon	Y	Y	Y	Y	Y		

Plan Review Checklist

The Plan Review Checklist is completed by FEMA. States and local governments are encouraged, but not required, to use the PRT as a checklist to ensure all requirements have been met prior to submitting the plan for review and approval. The purpose of the checklist is to identify the location of relevant or applicable content in the plan by element/sub-element and to determine if each requirement has been "met" or "not met." FEMA completes the "required revisions" summary at the bottom of each element to clearly explain the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is "not met." Sub-elements in each summary should be referenced using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each element and sub-element are described in detail in Section 4: Local Plan Requirements of this guide.

Plan updates must include information from the current planning process.

If some elements of the plan do not require an update, due to minimal or no changes between updates, the plan must document the reasons for that.

Multi-jurisdictional elements must cover information unique to all participating jurisdictions.

Element A: Planning Process

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))		
A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved?	Section 2, p.7-25 Concur, Appendix B	Met
A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process?	Section 1.3, p.2; Section 2.3, p.7-25 Concur, Appendix B	Met

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))		
A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity?	Section 2.4, p.11-13; Section 2.5, p.13-14; Section 2.7, p.14-15, Appendix B, p.B.60-B.62 Concur	Met
A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))		
A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan?	Section 2.4, p.17-18; Section 2.6-2.7, p.14-16; Concur, p. 11-16, Appendix B	Met
A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))		
A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document?	Section 2.3.1, p.8-9 Concur	Met
ELEMENT A REQUIRED REVISIONS		
Required Revision: NCEM 1st Review: No revisions required.		

Element B: Risk Assessment

<table>
<tr><th>Element B Requirements</th><th>Location in Plan
(section and/or page number)</th><th>Met / Not Met</th></tr>
<tr><td colspan="3">B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))</td></tr>
<tr><td>B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area?</td><td>Section 4.2, p.64-72, Section 4.5, (p.85-271; Hazard Description, Location, Extent, Hazard Summary by Jurisdiction)

(PDF Pages)<table><tr><td>Dam Failure</td><td>94</td></tr><tr><td>Drought</td><td>106</td></tr><tr><td>Earthquake</td><td>113</td></tr><tr><td>Extreme Heat</td><td>127</td></tr><tr><td>Flood</td><td>133-134</td></tr><tr><td>Hurricane / Tropical Storm</td><td>166</td></tr><tr><td>Landslide</td><td>189</td></tr><tr><td>Severe Weather</td><td>195-196</td></tr><tr><td>Severe Winter Storm</td><td>216</td></tr><tr><td>Tornado</td><td>223-224</td></tr><tr><td>Wildfire</td><td>237</td></tr><tr><td colspan="2">73-76</td></tr></table></td><td>Met</td></tr>
</table>

<table>
<tr><th>Element B Requirements</th><th>Location in Plan
(section and/or page number)</th><th>Met / Not Met</th></tr>
<tr><td>B1-b. Does the plan include information on the location of each identified hazard?</td><td>Section 4.5, (p.85-271 “Location” subheadings)

<table><tr><td>Dam Failure</td><td>96-101</td></tr><tr><td>Drought</td><td>107</td></tr><tr><td>Earthquake</td><td>114-115, 117-118</td></tr><tr><td>Extreme Heat</td><td>128, 130</td></tr><tr><td>Flood</td><td>136, 391, 425, 440, 472, 489, 503, 516, 529, 543, 557</td></tr><tr><td>Hurricane / Tropical Storm</td><td>166, 169</td></tr><tr><td>Landslide</td><td>189-190, 192</td></tr><tr><td>Severe Weather</td><td>196-197</td></tr><tr><td>Severe Winter Storm</td><td>216-217</td></tr><tr><td>Tornado</td><td>225-226</td></tr><tr><td>Wildfire</td><td>238-241</td></tr><tr><td colspan="2">86-93</td></tr></table></td><td>Met</td></tr>
<tr><td>B1-c. Does the plan describe the extent for each identified hazard?</td><td>Section 4.5, (p.85-271 “Extent” subheadings)<table><tr><td>Dam Failure</td><td>102-103</td></tr><tr><td>Drought</td><td>107-109</td></tr><tr><td>Earthquake</td><td>115-119</td></tr><tr><td>Extreme Heat</td><td>128-129</td></tr><tr><td>Flood</td><td>137-138, 392, 426, 441, 473, 490, 504, 517, 530, 544, 558</td></tr><tr><td>Hurricane / Tropical Storm</td><td>166-172</td></tr><tr><td>Landslide</td><td>190-191</td></tr><tr><td>Severe Weather</td><td>197-208</td></tr><tr><td>Severe Winter Storm</td><td>216-221</td></tr><tr><td>Tornado</td><td>226-228</td></tr><tr><td>Wildfire</td><td>242-244</td></tr><tr><td colspan="2"></td></tr></table></td><td>Met</td></tr>
</table>

<table>
<tr><th>Element B Requirements</th><th>Location in Plan
(section and/or page number)</th><th>Met / Not Met</th></tr>
<tr><td>B1-d. Does the plan include the history of previous hazard events for each identified hazard?</td><td>Section 4.5, (p.85-271 Historical Occurrences" subheadings)<table><tr><td>Dam Failure</td><td>102-103</td></tr><tr><td>Drought</td><td>108-109</td></tr><tr><td>Earthquake</td><td>116-119</td></tr><tr><td>Extreme Heat</td><td>129</td></tr><tr><td>Flood</td><td>139-145</td></tr><tr><td>Hurricane / Tropical Storm</td><td>170-172</td></tr><tr><td>Landslide</td><td>191</td></tr><tr><td>Severe Weather</td><td>197, 199-208</td></tr><tr><td>Severe Winter Storm</td><td>218-221</td></tr><tr><td>Tornado</td><td>226-228</td></tr><tr><td>Wildfire</td><td>244</td></tr><tr><td colspan="2">p. 74</td></tr></table></td><td>Met</td></tr>
<tr><td>B1-e. Does the plan include the probability of future events for each identified hazard? Does the plan describe the effects of future conditions, including climate change (e.g., long-term weather patterns, average temperature and sea levels), on the type, location and range of anticipated intensities of identified hazards?</td><td>Section 4.5, (p.85-271 Probability of Future Occurrence" subheadings<table><tr><td>Dam Failure</td><td>103</td></tr><tr><td>Drought</td><td>110</td></tr><tr><td>Earthquake</td><td>119-121</td></tr><tr><td>Extreme Heat</td><td>129-130</td></tr><tr><td>Flood</td><td>145-146</td></tr><tr><td>Hurricane / Tropical Storm</td><td>172</td></tr><tr><td>Landslide</td><td>193</td></tr><tr><td>Severe Weather</td><td>208</td></tr><tr><td>Severe Winter Storm</td><td>221</td></tr><tr><td>Tornado</td><td>229</td></tr><tr><td>Wildfire</td><td>245-247</td></tr><tr><td colspan="2"></td></tr></table></td><td>Met</td></tr>
<tr><td>B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area?</td><td>Section 4.5, (p.85-271 Hazard Summary by Jurisdiction" subheadings) Annexes

Concur</td><td>Met</td></tr>
</table>

<table>
<tr><th>Element B Requirements</th><th>Location in Plan
(section and/or page number)</th><th>Met / Not Met</th></tr>
<tr><td colspan="3">B2. Does the plan include a summary of the jurisdiction’s vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIP-insured structures that have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))</td></tr>
<tr><td>B2-a. Does the plan provide an overall summary of each jurisdiction’s vulnerability to the identified hazards?</td><td>Section 4.3, p.69-70; Section 4.5, (p. 85-271 “Vulnerability Assessment” subheadings)
Annexes<table><tr><td>Dam Failure</td><td>104-105</td></tr><tr><td>Drought</td><td>110-112</td></tr><tr><td>Earthquake</td><td>121-126</td></tr><tr><td>Extreme Heat</td><td>127-131</td></tr><tr><td>Flood</td><td>147-156, 164-165</td></tr><tr><td>Hurricane / Tropical Storm</td><td>173-180</td></tr><tr><td>Landslide</td><td>193-194</td></tr><tr><td>Severe Weather</td><td>208-215</td></tr><tr><td>Severe Winter Storm</td><td>221-222</td></tr><tr><td>Tornado</td><td>229-236</td></tr><tr><td>Wildfire</td><td>247-251</td></tr><tr><td colspan="2">51, 59-61, 80-93, Annex A</td></tr></table></td><td>Met</td></tr>
<tr><td>B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction?</td><td>Section 4.5, p.85-272, Annexes<table><tr><td>Dam Failure</td><td>103-105</td></tr><tr><td>Drought</td><td>110-112</td></tr><tr><td>Earthquake</td><td>120-125</td></tr><tr><td>Extreme Heat</td><td>129-132</td></tr><tr><td>Flood</td><td>139-144, 146-165</td></tr><tr><td>Hurricane / Tropical Storm</td><td>168-180</td></tr><tr><td>Landslide</td><td>191-194</td></tr><tr><td>Severe Weather</td><td>197, 199-215</td></tr><tr><td>Severe Winter Storm</td><td>218-222</td></tr><tr><td>Tornado</td><td>226-236</td></tr><tr><td>Wildfire</td><td>247-251</td></tr><tr><td colspan="2">40, 43, 53-56, 59, 61-70, 80-81</td></tr></table></td><td>Met</td></tr>
</table>

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods?	Section 4.5.5, p.148-155 Concur	Met
ELEMENT B REQUIRED REVISIONS		
Required Revision: NCEM 1st Review: No revisions required.		

Element C: Mitigation Strategy

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))		
C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?	Section 5, p.272-291 Concur	Met
C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?	Section 5, p.272-291 Concur	Met
C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C2-a. Does the plan contain a narrative description or a table/list of their participation activities?	Section 5.3.1, p.278-285, Table 5.2 Concur, 127, 137, 146, 287, 289-292, 298	Met
C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))		
C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan?	Section 6.1, p.292-293 Concur	Met

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment?	Section 7, p.296-333; Appendix C Concur	Met
C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment?	Section 7, p.296-333 Concur	Met
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a cost-benefit review), implemented, and administered by each jurisdiction? (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))		
C5-a. Does the plan describe the criteria used for prioritizing actions?	Section 6.2, p. 294-295 Concur	Met
C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame?	Section 7, p.296-333 Concur	Met
ELEMENT C REQUIRED REVISIONS		
Required Revision: NCEM 1st Review: No revisions required.		

Element D: Plan Maintenance

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))		
D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved?	Section 8.3, p.338-339 Concur	Met
D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))		
D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process?	Section 8.2, p.336-338 Concur	Met
D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible.	Section 8.2, p.336-338 Concur	Met
D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process?	Section 8.2, p.336-338 Concur	Met
D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))		
D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?	Section 8.1, p. 334-336; Section 8.2, p.336-338 Concur	Met
D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated?	Section 8.1, p. 334-336; Section 8.2, p.336-338 Concur	Met

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms?	Section 8.1, p. 334-336; Section 8.2, p.336-338 Concur	Met
ELEMENT D REQUIRED REVISIONS		
Required Revision: NCEM 1st Review: No revisions required.		

Element E: Plan Update

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?	Sections 3.7, p.45-48; Sections 3.10, "Growth and Development Trends" subheadings, p. 53-62 Concur	Met
E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))		
E2-a. Does the plan describe how it was revised due to changes in community priorities?	Section 2.1, p.6-7; Section 6, p.292-295, Section 7, p. 296-333 Concur	Met
E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan?	Section 7, p. 296-333; Section 2.9, p.16-25 Concur	Met

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms?	Section 8.1, p.334-336 Concur	Met
ELEMENT E REQUIRED REVISIONS		
Required Revision: NCEM 1st Review: No revisions required.		

Element F: Plan Adoption

Element F Requirements	Location in Plan (section and/or page number)	Met / Not Met
F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F1-a. Does the participant include documentation of adoption?	Section 9, p.340-364	Choose an item.
F2. For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F2-a. Did each participant adopt the plan and provide documentation of that adoption?	Section 9, p.340-364	Not Met
ELEMENT F REQUIRED REVISIONS		
Required Revision: NCEM 1st Review: Plan adoption resolutions are pending formal approval by participating jurisdictions.		

Element G: High Hazard Potential Dams (Optional) – NOT APPROVED- Under review

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD1. Did the plan describe the incorporation of existing plans, studies, reports and technical information for HHPDs?		
HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency?	Section 4.5.1, p.85-96; Annexes, "Dam Failure"	Choose an item.
HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners?	Section 4.5.1, p.85-96; Annexes, "Dam Failure"	Choose an item.
HHPD2. Did the plan address HHPDs in the risk assessment?		
HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs?	Section 4.5.1, p.85-96 "Vulnerability Assessment"; Annexes, "Dam Failure"	Choose an item.
HHPD2-b. Does the plan document the limitations and describe how to address deficiencies?	Section 4.5.1, p.85-96	Choose an item.
HHPD3. Did the plan include mitigation goals to reduce long-term vulnerabilities from HHPDs?		
HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other long-term strategies?	Section 6.1, p.292-293, Section 7, p.296-333	Choose an item.
HHPD3-b. Does the plan link proposed actions to reducing long-term vulnerabilities that are consistent with its goals?	Section 7, p.296-333	Choose an item.
HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?		
HHPD4-a. Does the plan describe specific actions to address HHPDs?	Section 7, p.296-333; (Wake County, Raleigh, Cary, Fuquay-Varina, Holly Springs)	Choose an item.
HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs?	Section 6.2, p.292-295; Section 7, p.296-333	Choose an item.

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs?	Section 7, p.296-333; (Wake County, Raleigh, Cary, Fuquay-Varina, Holly Springs)	Choose an item.
HHPD Required Revisions		
Required Revision: NCEM 1st Review: No revisions required.		

Plan Assessment

These comments can be used to help guide your annual/regularly scheduled updates and the next plan update.

Element A. Planning Process

Strengths/Opportunities for Improvement

- Public was invited to participate in several ways including local community websites and social media accounts, public survey, and outreach flyer. Held a public meeting in an area known for flooding and in a community center. Received 110 survey responses. A diverse group of stakeholders was involved in some way with the process. Recommend placing flyers throughout more areas within each jurisdiction.

Element B. Risk Assessment

Strengths/Opportunities for Improvement

- Section on social vulnerability and growth and development with an overall focus on the county and more detailed look at each jurisdiction. Table of decision to include or not each hazard. Maps outlining the location of critical facilities based on lifelines. Recommend the following: more detail for climate change specifically location (for example: flooding what areas may become more likely to flood, new areas of flood), minor improvements could be made to flood maps for each jurisdiction with streets as a background layer, making it easier to see where developed areas are at risk, and consider the extent of flood depths beyond the 100 year floodplain.

Element C. Mitigation Strategy

Strengths/Opportunities for Improvement

- Section on capabilities provided a table of each jurisdiction and descriptions for each capability. Assessed each jurisdiction’s process for handling SD/SI after an event. A good array of actions that consider gaps and limitations in each jurisdiction's capabilities. Could benefit from additional actions that benefit underserved communities and socially vulnerable populations. Strongly recommend further explanation for local/state/federal funding sources.

Element E. Plan Update

Strengths/Opportunities for Improvement

- Considered social vulnerability of participating jurisdictions as a priority for revising the plan.

Resources for Implementing Your Approved Plan

Hold the CTRL key as you click on each internet link. Please inform the Region 4 Planning Team if a link is broken, or you have a suggestion to include in this collection of resources.

For questions or assistance, connect with your state planning contact, your State Hazard Mitigation Officer (SHMO), or the FEMA Region 4 Planning Team at: FEMA-r4-mitplanning@fema.dhs.gov

Equity, Vulnerability, Whole Community Planning & Capacity Building

- **Climate and Economic Justice Screening Tool (CEJST, New for 2023):** The tool has an interactive map and uses datasets that are indicators of community burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. The tool identifies 'disadvantaged' census tracks by percentile for each challenge/burden and is ideal to consider different aspects of vulnerability.

Explore the map - Climate & Economic Justice Screening Tool (geoplatform.gov)

- **Resilience and Analysis Planning Tool (RAPT):** RAPT includes over 100 preloaded layers including community resilience indicators from peer-reviewed research, the most current census demographic data, infrastructure data, and data on weather, hazards, and risk. RAPT also includes easy to use analysis tools, the ability to add in data from other sources (such as the USA structure footprint layer), and print and download functions. Data can bolster local GIS use or serve as a basic mapping/analysis system for communities without a GIS subscription.

https://www.fema.gov/about/reports-and-data/resilience-analysis-planning-tool

- **FEMA Strategic Plan Update 2022-2026** (Goal 1, Instill Equity as a Foundation of Emergency Management) Read more about the first goal from the updated FEMA Strategic Plan, focusing on equity across all elements of FEMA.

https://www.fema.gov/about/strategic-plan/goal-1

- **FEMA National Risk Index (Updated in Spring 2023):** A baseline relative risk measurement for each United States county and Census tract. Online tools help illustrate the communities most at risk for 18 natural hazards.

https://hazards.fema.gov/nri/

- **NOAA's Digital Coast:** Risk communication tools, hazard data and products, plus training that address coastal issues. The digital coast suite of data and information is helpful for coastal communities.

https://coast.noaa.gov/digitalcoast/

- **EPA's Environmental Justice Screening and Mapping Tool (Version 2.0):** Quickly visualize various environmental, health, socioeconomic, and other equity indices/layers compared to the larger US or state. https://ejscreen.epa.gov/mapper/
- **FEMA Guide to Expanding Mitigation, Making the Connection to the Whole Community:** A graphic rich, easy to understand and share, seven-page summary of mitigation considerations across the community.

https://www.fema.gov/sites/default/files/documents/fema_mitigation-guide_whole-community.pdf

- **FEMA Guide to Supporting Engagement and Resiliency in Rural Communities**: 36-page document focusing on the unique set of challenges rural communities face with lower population density and larger amounts of undeveloped land. Includes engagement activities that are authentic and right sized to make every community more resilient (large file, long download)

https://www.fema.gov/sites/default/files/documents/fema_rural-guide_jan-2021.pdf

- **American Planning Association (APA) Hazard Mitigation Policy Guide:** 29-page guide encourages planners to champion a new approach to hazard mitigation, adaptation, and recovery thinking centered on equity and established research for resiliency standards, man-made disasters, and natural disasters.

https://www.planning.org/publications/document/9203323/

Climate Resilience and Green Infrastructure

- **Climate Mapping for Resilience and Adaptation (CMRA):** CMRA integrates information from across the federal government to help people consider their local exposure to climate-related hazards. The CMRA Assessment Tool provides information on past, present, and future climate conditions. Use it to understand exposure in your area so that you can effectively plan and build more resilient infrastructure in your community.

https://resilience.climate.gov/

- **Climate Risk & Resilience Portal (ClimRR):** ClimRR allows users to generate and export a report of climate projections at a given point, especially useful for hazards such as extreme temperatures, wildfire, and precipitation. A climate projection summary can be created to help with future hazard analysis.

https://disgeoportal.egs.anl.gov/ClimRR/?page=Home&views=Wind

- **FEMA Building Community Resilience with Nature Based Solutions, A Guide for Local Communities:** The guide helps communities identify and engage the staff and resources that can be used to implement nature-based solutions to build resilience to natural hazards.

https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf

- **FEMA Resources for Climate Resilience publication:** A 33-page resource highlighting key grant programs and summarizing information on identifying climate risks, planning, and FEMA's role in community and climate resilience.

https://www.fema.gov/sites/default/files/documents/fema_resources-climate-resilience.pdf

- **FEMA Building Community Resilience with Nature-Based Solutions:** A 38-page resource highlighting strategies for successfully incorporating nature-based solutions and right-sized mitigation efforts into development decisions.

https://www.fema.gov/sites/default/files/documents/fema_nature-based-solutions-guide-2-strategies-success_2023.pdf

- **National Climate Assessment (November 2023 Update):** Written to help inform decision-makers, utility and natural resource managers, public health officials, emergency planners, and other stakeholders by providing a thorough examination of the effects of climate change on the United States.

https://nca2023.globalchange.gov/

- **Addressing Future Climate, Population, and Land Use Changes Through Mitigation Planning Training:** 1.5 hour YouTube video, part of FEMA training series:

Addressing Future Climate, Population, and Land Use Changes Through Hazard Mitigation Planning - YouTube

- **FEMA/EPA Regional Resilience Toolkit:** Summary of large-scale technical assistance projects from 2013 to 2018 discussing regional-scale disaster resilience, with expanded lessons learned. Part of the larger EPA Smart Growth program.

https://www.epa.gov/smartgrowth/regional-resilience-toolkit

- **National Stormwater Calculator & Climate Assessment:** A software application tool that estimates the annual amount of rainwater and frequency of runoff from a specific site using green infrastructure as low impact development controls. The SWC is designed for use by anyone interested in reducing runoff from a property.

http://www.epa.gov/nrmrl/wswrd/wq/models/swc/

- **Including Watershed Planning and Green Infrastructure into State Hazard Mitigation Plans**: High level watershed planning opportunities during state hazard mitigation plan updates.

https://www.epa.gov/sites/production/files/2019-04/documents/final4_good_reasons_for_shmos_to_inc_gi_into_shmps_-_508.pdf

- **USDA Natural Resources Conservation Service, Landscape Planning:** Main landing site for the NRCS landscape and watershed programs, with notes on recent legislation, program fact sheets, and available assistance.

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/

- **FEMA Strategic Plan Update 2022-2026** (Goal 2, Lead Whole of Community in Climate Resilience). Read more about the second goal from the updated FEMA Strategic Plan and how climate resilience is critical for long term mitigation.

https://www.fema.gov/about/strategic-plan/goal-2

- **U.S. Climate Resilience Toolkit:** A website designed to help people find and use tools, information, and subject matter expertise to build climate resilience. The Toolkit offers information from across the U.S. federal government in one easy-to-use location. Includes 200+ digital tools, case studies for building resilience, and climate and expected future conditions data.

https://toolkit.climate.gov/

- **NOAA's Digital Coast:** Sea level rise viewer, green infrastructure information, coastal flooding information, and other data, tools, and training that address coastal issues. The digital coast suite of data and information is invaluable for coastal communities.

https://coast.noaa.gov/digitalcoast/

- **American Planning Association (APA) Climate Change Resources:** Planning works at the intersection of transportation, development, and land use — sectors critical to climate mitigation and adaptation. Site includes resources and news related to energy, green infrastructure, climate change, and mitigation.

https://www.planning.org/resources/climatechange/

Planning, Administrative Plan Management, & General Resources

- **Local Mitigation Planning Handbook** (Updated for new guidance April 19, 2023, updated policy effective April 19, 2023, is the next link): This Handbook provides guidance to local governments on developing or updating hazard mitigation plans to meet the requirements under the Code of Federal Regulations (CFR) Title 44 – Emergency Management and Assistance §201.6. Use the Local Plan Guide and Handbook in tandem to understand technical requirements.

https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-handbook_052023.pdf

- **Updated Local Mitigation Planning Policy Guide** effective April 19, 2023:

https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-policy-guide_042022.pdf

- **State NFIP Coordinators:**

https://www.floods.org/membership-communities/connect/state-floodplain-managers-scs/

- **FEMA Mitigation Planning** (Central Landing Page) – FEMA website includes recent news from the Agency, links to regional resources such as the Region 9 audio series, and key planning information.

https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning

- **Recovery and Resilience Resource Library** – Subpage from the main landing page above - Allows users to find and research federal disaster recovery resources, beneficial in pre-disaster recovery planning or in the wake of a disaster.

https://www.fema.gov/emergency-managers/practitioners/recovery-resilience-resource-library

Plan Integration, Mitigation Actions

- **Implement, Integrate and Maintain Mitigation Planning Activities:** Mitigation is most effective when it is part of other community planning processes, regulations, and policies. The publications included will help communities integrate principles of hazard mitigation with planning efforts.

https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/implementing

- **Mitigation Assistance Programs:** Currently, FEMA administers three primary programs that provide funding for eligible mitigation projects that reduces disaster losses and protect life and property from

future disaster damages. The three programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Building Resilient Infrastructure and Communities (BRIC). More funding resources are on the following page.

https://www.fema.gov/grants/mitigation

- **Integrating Mitigation Strategies with Local Planning**: Provides practical guidance on how to incorporate risk reduction strategies into existing local plans, policies, codes, and programs that guide community development or redevelopment patterns.

https://www.fema.gov/emergency-managers/national-preparedness/frameworks/community-recovery-management-toolkit/recovery-planning/integrating-mitigation/case-studies-tools-community

- **Integrating Mitigation Strategies with Local Planning:** This resource provides practical guidance on how to incorporate risk reduction strategies into existing local plans, policies, codes, and programs that guide community development or redevelopment patterns.

https://www.fema.gov/media-collection/integrating-hazard-mitigation-local-planning-case-studies-and-tools-community

- **Mitigation Ideas:** Communities can use this resource to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

https://www.fema.gov/sites/default/files/2020-06/fema-mitigation-ideas_02-13-2013.pdf

- **American Planning Association (APA), Post Disaster Recovery Resources:** An APA collection of resources, documents, and briefing papers related to post disaster recovery and public engagement. https://www.planning.org/resources/disaster/

Risk Assessment, Hazard Specific Analyses

- **The Southern Wildfire Risk Assessment Portal (SouthWRAP):** A risk information portal maintained by the Southern Group of State Foresters that provides maps of fire intensity scales that meet extent and location planning requirements. Site also includes Wildland Urban Interface (WUI) maps and other tools to discuss risk at the county level. While this is a commonly used, high-quality resource, local firefighters should verify the data. Request access to the free 'Professional Viewer' to see dedicated fire risk graphics/maps such as WUI interface, burn probability, fire intensity, and more.

www.southernwildfirerisk.com

- **Building Wildfire Resilience: A Land Use Toolbox for County Leaders (National Association of Counties, NACo):** Targeting county leaders, resources provides simplified guidance around wildland fire strategy, examples of local fire mitigation efforts, and extensive integration opportunities with other community documents.

Building Wildfire Resilience: A Land Use Toolbox for County Leaders (naco.org)

- **Profiling Difficult Hazards (Flooding, Drought, Wildfire) + Vulnerability and Multi-Jurisdiction Requirements Job Aids:** Region 4 Planning Team produced job aids with examples, clarifying details, and suggestions for addressing the most missed elements of the current guidance. Hazards of flooding, drought, and wildfire are specifically profiled. These job aids are not online, but can be requested through the State Planning Coordinator as well as the FEMA Planning Team via email: FEMA-r4-mitplanning@fema.dhs.gov

Funding Sources, Guidance

- **Federal Emergency Management Agency:**
  - **Mitigation Planning and Grants Overview:** Main landing page with requirements and information around the primary FEMA grant programs surrounding hazard mitigation planning.

https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/requirements

- **Building Resilient Infrastructure and Communities (BRIC):** Support states, local communities, tribes and/or territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards.
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

- **Pre-Disaster Mitigation Program (PDM):** Provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.
https://www.fema.gov/grants/mitigation/pre-disaster

- **Flood Mitigation Assistance (FMA):** Provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis.
https://www.fema.gov/grants/mitigation/floods

- **Environmental Protection Agency, Department of Agriculture, and Other Federal Sources:**
  - **(EPA) Wetland Program Development Grants:** The EPA makes available funds for water management and wetlands protection programs that help mitigate against future costs associated with hazard damage. Provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis

    https://www.epa.gov/wetlands/wetland-program-development-grants-and-epa-wetlands-grant-coordinators

  - **(EPA) Water Infrastructure and Resiliency Finance Center:** The Water Finance Center provides financing information to help local decision makers make informed decisions for drinking water, wastewater, and stormwater infrastructure to protect human health and the environment https://www.epa.gov/waterfinancecenter
  - **National Oceanic and Atmosphere Administration (NOAA) Funding Opportunities:** NOAA offers major source for mitigation funding related to coastal zone management and other coastal protection projects.

    https://coast.noaa.gov/funding/

  - **Natural Resource Conservation Service (USDA) Financial Assistance:** NRCS offers voluntary programs to eligible landowners and agricultural producers to provide financial and technical assistance to help manage natural resources in a sustainable manner.

    https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/

  - **U.S. Department of Agriculture (USDA) Forest Service National Fire Plan:** Funding for organizing, training, and equipping fire districts through volunteer, state and rural fire assistance programs. Technical assistance for fire related mitigation.

    http://www.forestsandrangelands.gov/

  - **Natural Resources Conservation Service Watershed Protection and Flood Prevention (USDA):** Information and funds for landscape planning, soil conservation; flood prevention; conservation, development, utilization and disposal of water; and conservation and proper utilization of land.

http://www.nrcs.usda.gov/programs/watershed/index.html

- **Firewise Communities Program:** Effort to involve homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of wildland fire before a fire starts.

http://www.firewise.org

B. PLANNING PROCESS DOCUMENTATION

PLANNING STEP 1: ORGANIZE TO PREPARE THE PLAN

Table B.1 – HMPC Meeting Topics, Dates, and Locations

Meeting Title	Meeting Topic	Meeting Date	Meeting Location
HMPC Mtg. #1 – Project Kick-Off	1) Introduction to DMA requirements and the planning process 2) Review of HMPC responsibilities and the project schedule.	January 11, 2024	337 S Salisbury St. Raleigh, NC (Hybrid)
HMPC Mtg. #2 – HIRA Review	1) Review Draft Hazard Identification & Risk Assessment (HIRA) 2) Review asset inventory and discuss critical facilities	April 24,2024	Waverly F. Akins – Wake County Office Building, Raleigh NC (Hybrid)
HMPC Mtg. #3 – Mitigation Strategy	1) Review Capability Assessment and Mitigation Strategies 2) Solicit comments and feedback	May 30, 2024	Waverly F. Akins – Wake County Office Building, Raleigh NC (Hybrid)
HMPC Mtg. #4 – Draft Plan Review	1) Review draft Hazard Mitigation Plan	July 31, 2024	Virtual (Zoom)

Note: All HMPC Meetings were open to the public.

HMPC MEETING AGENDAS, MINUTES, AND SIGN-IN SHEETS

HMPC MEETING 1: JANUARY 11, 2024

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Meeting 1: Hazard Mitigation Planning Committee Kick-Off Meeting
Time & Date: January 11, 2024, 9:00-11:00 AM
Location: 337 S Salisbury St, Raleigh, NC (Hybrid)

I. Introductions
II. Project Overview
    a. Requirements for Update
    b. Trend in Disasters – Why Plan?
    c. Disaster Mitigation Act (DMA) Requirements
        i. Organized Resources
        ii. Risk Assessment
            1. Hazard Identification
            2. Vulnerability Assessment
            3. Capability Assessment
        iii. Develop Mitigation Plan
            1. Hazard Strategies
            2. Mitigation Categories
    d. Scope of Work
    e. Risk Management Tool
III. Project Schedule
IV. Plan Website
V. Next Steps
    a. Capability Assessment
    b. Mitigation Action Status Updates
    c. Mitigation Goals Update
VI. Questions
VII. Adjourn

2025 Wake County Multi-Jurisdictional Hazard Mitigation Plan Update Kickoff
Waverly F. Akins Wake County Office Building, 337 S. Salisbury St., Raleigh, NC
January 11, 2024, 9 AM – 11 AM
Draft Notes

Online Participants – Abigail Moore, Ben Mills, David Stroud, Dianne Khin, Donna Goodman, Ed Ridpath, Hannah Delude, Jason Brown, Jeff Parker, Jeff Triezenberg, Kymberly Kudla, Loren Cone, Matt Jacoby, Michael Clark, Mike Voiland, Nathan Lozinsky, Pam Davison, Ranger Ruffins, Reginald Buie, Robin Peyton, Satwana Hurdle, Shelly Mayo, Wayne Miles

In-Person Participants – Nathan Slaughter, John Flores, Sasha Godwin, Eric Kulz, Mikayla Renn, Antione Jordan, Daniel Colavito, Mary Beth Spoehr, Allyssa Holman, Terry Nolan, Allison Bryan, Ben Brown, Bryan Coates, Stacy Griffin, Carl Baker, Josh Hodge

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1. Agenda Overview
2. Introductions
    a. Welcomes
    b. Overview of Previous Multi-Jurisdictional Planning Process
    c. Introductions
3. Project Overview
4. Requirements for Update
    a. Driven by DMA 2000, fed legislation requiring hazard mitigation plans for certain pots of FEMA money. Specifically talking about HMGP, BRIC, and FMA.
        i. Update every 5 years.
    b. NC also has a Senate bill piece of legislation for smaller events of state disaster requiring HMP as well.
5. Trends in Disasters – Why Plan?
    a. Tremendous growth in Wake County – more people, assets, and other things.
    b. Building most of the time into safe areas and safe standards, but sometimes still end up with development in the floodplain.
    c. Continuing to do this work for funding that does come around when hazard events occur.
6. DMA 2000 Requirements
    a. 4 Phases
        i. Organize Resources (total of 4 meetings, all hybrid)
        ii. Risk Assessment (lay out all the hazards impacting Wake)
        iii. Develop a Mitigation Plan (solutions to those problems)
        iv. Adoption and Implementation
    b. Process blends with processes of FMA and CRS
7. Step 1: Organize Resources
    a. List of stakeholders for involvement in HMPC
    b. Some of you representing the community as citizen representatives, thank you for your commitment!

   c. There is a plan for public involvement. Rolling out a few public meetings and a public survey. Working with Sasha to get them out and advertised, hoping you all can help with that.
8. Step 2: Risk Assessment
   a. List of previously identified hazards in plan right now, good list of both natural/manmade hazards.
   b. Looking at Hazard ID, what can happen here?
   c. Looking at Vulnerability ID, what are the problems these hazards cause for our communities?
      i. Using county parcel data, FEMA Hazus, NCEM tools, etc.
   d. Capability assessment for separate jurisdictions – spoiler alert that you are all high capability. Helps build a stronger mitigation strategy and come up with better mitigation actions.
9. Step 3: Develop a Mitigation Plan
   a. Setting planning goals
   b. Reviewing mitigation alternatives
   c. Drafting an action plan
      i. Good time to identify new actions to include in the plan. Through the vulnerability/risk assessments, we may get some new ideas.
10. Step 4: Adoption and Implementation
   a. Most benefits from these plans come from actually doing something with them.
   b. Have worked with many communities in the past where they can mark off a significant number of mitigation actions completed in ~5 years.
   c. Ones that have the most success are the ones looking at it on an annual basis.
11. Questions?
   a. None
12. Scope of Work
   a. Criteria addressed by the plan.
      i. All FEMA elements
      ii. Meet or exceed 44 CFR, Section 201.6
      iii. Coordinate with FEMA-approved State Mitigation Plan
   b. 2 NEW THINGS
      i. New interpretation of guidance:
         1. Climate change data and impacts
         2. Equitable outcomes in underserved/vulnerable communities
13. Question of timeframe for community engagement?
   a. Starting very soon. Not sure on the exact dates yet, but this is rolling out ASAP.
14. Project Schedule
   a. Project kickoff date – 1/4/24
   b. Total of 4 meetings with 2 public meetings
   c. Proposed delivery of draft – 6/2/24
   d. Existing plan expiration – 12/2/24
   e. Question here: is state emergency management of timeline here?

        i. Yes, they are in attendance today. We have pieces of the update already running and gotta get the planning process done. Good thing about hybrid meetings is the wherever/whenever part of it.

15. Plan Website
    a. Wake County website will host information and project updates
    b. Used as tool for HMPC coordination and public outreach
    c. Would love for more of the word to get out through everyone's channels
16. Next Steps
    a. A couple of outstanding citizen reps to be determined. Think of ideas for somebody that could come to future meetings as a citizen rep.
    b. For those familiar with capability assessment, we are not sending out a survey again and instead working with what we have/know. Will draft updated capability assessment and send out for review.
    c. Mitigation action status updates – pull out your HMP now and prepare for what stays vs. what changes in this update.
        i. CB – think about any BRIC projects you might apply for and lets make sure we have an action tied to any possible projects. If there is not an action covering that, we have to do a plan amendment… just because you put it in a plan, it does not bind you to any specific action(s).
            1. NS – NC has been one of the best states in securing funds from these federal programs in part because of the HMPs
17. Questions
    a. David Stroud – if you have a CIP or other program, we can borrow those projects into your part of the Wake HMP. Look at other plans that have other potential projects included in them.
    b. Wayne Miles – do all local government councils/commissions have to adopt the new plan before Dec 24?
        i. Once approved, everyone will start adopting it. We just need to get the one main adoption first. However in the past we got the APA letter from FEMA and then everyone started appealing their adoptions… Once we send it up to FEMA to get reviewed, we can start sending adoption letters in advance.
            1. NS – FEMA likes to see more adoption notices turned in with the plan
                a. NS/SG – At least 1 of you all need to get it done before December 2, the first jurisdiction to do it starts the cycle for everyone else.
    c. Wayne Miles – any clarity around scheduling to take to city council?
        i. When your governing body adopts the plan, you are adopting the approved version of the plan.
            1. NS – there will be communities not comfortable with adopting in December. Once one community does it, that becomes the first day of the adoption process, which should last for the next year. Working closely with Carl and Kim and her team over at FEMA.
    d. Shelly Mayo – will these slides be available to us?
        i. NS – yes, will send them out to everyone on invitation roster.

e. Last update there were worksheets to go over our last set of goals, can we go ahead and start ranking those goals?
    i. NS – will coordinate with David and his team on getting those sent out soon.

18. Carl Baker – David and Nathan are well versed to getting reach to the environmental justice and socially vulnerable populations, but should be thinking of who to involve there and how.
    a. Getting them to 2 meetings somewhere in Wake County is not entirely realistic. We should be going to them with a flyer/survey. From a Wendell perspective, telling them a meeting is in downtown Raleigh does not get them there based on their daily schedules.
        i. CB – will be doing that as much as we can, but we have to document that too.
    b. These are happening in the next 2 months or so? Timing is going to be weird since nobody is gathering right now.
        i. NS – need everyone's help as much as we can. Have 1-pager developed and will also work on other outreach materials. Meetings will be hybrid for people to tap into them, and one meeting will be further down the line.
    c. Will survey be in Spanish?
        i. NS – we have done previous ones like that and can do it again.
    d. Maybe regional centers for potential meetings?
        i. NS – local sports season could be a good thing to coordinate with.
19. Is there going to be a social media or branding package to go with this? Are we ok to do this with our own departments?
    a. NS – depends on everyone's preferences… we could look into it, but doe not have to be definite.
20. Sign in sheet was collected and hardcopy 1-pagers were passed around at the conclusion of the meeting.

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Project Kickoff Meeting

January 11, 2024
9:00 - 11:00 AM

Name	Jurisdiction	Title	Phone Number	E-mail Address
Eric Kutz	CARY	ENVIRONMENTAL SPECIALIST	919-462-3931	eric.kutz@carync.gov
Mikayla Renn	Wake Soil & Water	Natural Resource conservationist	919-250-1061	mikayla.renn@wake.gov
Antione Jordan	Wake Forest	Long Range Planner	919-266-7927	ajordan@WakeForestNC.gov
Daniel Colavito	Holly Springs	Environmental and Stormwater Manager	919.567.4027	daniel.colavito@hollyspringsnc.gov
MaryBeth Spoehr	Holly Springs	Budget & Strategy Analyst	919-577-3143	marybeth.spoehr@hollyspringsnc.gov
Allyssa Holman	Fuquay-Varina	Senior Planner	919-753-1874	aholman@fuquay-varina.org
Terry Nolan	Wake County	Planner III	919-856-6320	terry.nolan@wake.gov
Allison Bryan	Raleigh	Floodplain Mapping Engineer	919-996-3776	allison.bryan@raleighnc.gov

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Project Kickoff Meeting

January 11, 2024
9:00 - 11:00 AM

Name	Jurisdiction	Title	Phone Number	E-mail Address
Ben Brown	City of Raleigh	Floodplain administrator	919 996 3515	ben.brown@raleighnc.gov
Bryan Coates	Town of Wendell	Planning Director	919-366-1878	bcoates@townofwendellnc.gov
Stacy Griffin	Town of Wendell	Asst Planning Director	919-366-1464	sgriffin@townofwendellnc.gov.
CARL BAKER	NCEM	HM Planner	919 873 5886	carl.baker@ncdps.gov
Josh Hoods	Wake County EM	EM Specialist	919.618.7558	josh.hoods@wake.gov
Sasha Godwin	Wake EM	EM specialist	919 576 7968	sasha.godwin@wakegov

In this meeting (27)
Mute all
AM Moore, Abigail
BM Ben M. Mills
DK Dianne Khin
DG Donna Goodman
ER Ed Ridpath (Fuq... (Guest)
Meeting guest
HD Hannah Delude
SH Hurdle, Satwana
JB Jason Brown
JP Jeff Parker
JT Jeff Triezenberg
JF John Flores
KK Kudla, Kymberly (External)
External
LC Loren Cone
MJ Matt Jacoby
MC Michael Clark
MV Mike Voiland (Guest)
Meeting guest
WM Miles, Wayne
NL Nathan H. Lozinsky
NS Nathan Slaughter
PD Pam Davison
RP Peyton, Robin
RB Reginald Buie
Ruffins, Ranger
SG Sasha Godwin
Organizer
SM Shelly Mayo
Stroud, David
+1 more

HMPC MEETING 2: APRIL 24, 2024

Wake County HIRA Findings Meeting
4/24/2024, 2 PM – 4 PM
[Draft Notes]
[Online Participants; 26] – Carl Baker, Matt Jacoby, Allyssa Holman, Shelly Mayo, Chief Cone, Donna Goodman, Ranger Ruffins, Michael Clark, Sharon Peterson, Antoine Jordan, Erin Joseph, Eric Kulz, Jason Brown, Kymberly Kudla, Nathan Lozinsky, Pam Davison, Stacy Griffin, David Stroud, Suzanne Mason, Joshua Creighton, Jordan Brummal, Eric Marsh, Allison Bryan, Christopher Parker, Ben McDonald, Reginald Buie,
[In-person Participants] – see meeting sign-in sheet

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1. Welcome to the second meeting of the Wake County Hazard Mitigation Plan
    a. Nathan Slaughter, here with ESP
    b. Starting to lay out hazards in Wake County and begin developing solutions to reduce the impact of hazards
    c. The first step in the process and from here we start to zero in on solutions to the most pressing hazard issues
    d. Just doing presentation of hazards and looking at profiles this time and will come back really soon for the Mitigation Strategy meeting to get a draft together by June
        i. Next meeting is most likely mid to late May
2. Agenda
    a. Welcome & introductions
    b. Meeting objectives
    c. Hazard identification
    d. Asset inventory
    e. Hazard profiles: risk & vulnerability
    f. Discuss findings
    g. Next steps & questions
3. Sign-in sheet going around the room
4. Meeting objectives
    a. Identifying hazards
    b. Assessing hazard and vulnerability
    c. Potential impacts and priorities
    d. Discuss findings
    e. Educate and inform
5. 10-step planning process in total
    a. We are in step 4 & 5 (assess the hazard and problem)
    b. Existing risk assessment in plan, things change which is why we update every 5 years
    c. Review of planning goals and mitigation action plans in upcoming meetings and updates
    d. Every jurisdiction and the county MUST adopt the plan by resolution
        i. Once we have it drafted with notice from FEMA of approval pending adoption
            1. Start thinking about this ASAP
6. HIRA process
    a. Identify hazards → Profile hazard events → Inventory assets → Estimate losses
7. Hazard identification

a. FEMA declarations
    i. One of the first things we do is look at what has happened historically
    ii. 12 major disaster declarations since 1968 with 23 total declarations including emergency declarations
b. Review of existing plan hazards
    i. How does Wake County risk assessment align with the state plan
    ii. State of North Carolina expanded scope about 10 years to include man-made and technological hazards
        1. Many local and regional plans are moving to align with the updated state plans
        2. A few hazards we do not quite cover yet
        3. Any hazards you think should be in here?
c. Hazards not included
    i. Levee failure – no levees in Wake County
    ii. Sinkholes – 2019 plan did not include
    iii. Erosion – carrying 2019 sub-hazard approach forward
    iv. Infectious disease – 2019 plan did not include
    v. Cyber threat, EMP – best left to the state?
d. Hazards profiled (profiles include background, location, extent, historical occurrence, probability, climate change, vulnerability assessment, summary by jurisdiction)
    i. Dam failure
    ii. Drought
    iii. Earthquake
    iv. Extreme heat
    v. Flood
    vi. Landslide
    vii. Hurricane and tropical storm
    viii. Severe weather
    ix. Severe winter storm
    x. Tornado
    xi. Wildfire
    xii. Hazardous materials incident
    xiii. Radiological incident
    xiv. Terrorism

8. Asset Inventory
    a. Population – lots of growth happening throughout the county and municipalities
        i. QUESTION (SG): do you need updated population numbers from us? Ours is way higher than that.
            1. NS: no, we should be able to pull that information.
    b. Building exposure – pulled out of state risk management tool (RMT) from 2010 and this data is a bit old
        i. Trying to get an idea of counts, number of buildings, and value of buildings to pinpoint problem areas

c. Critical facilities – sent out email earlier today to get updated information from each area
    i. Spreadsheet of critical facilities by FEMA lifeline and jurisdiction
    ii. The sooner you can look at this to update the better
    iii. DS: FEMA wants to know about lifeline data when going for a federal grant program (e.g., BRIC) – hoping to have the updated spreadsheet back within 2 weeks
    iv. QUESTION: can you explain what a lifeline is?
        1. NS: FEMA came up with to categorize critical facilities
    v. QUESTION: 2 rows for Water System at the bottom?
        1. DS: probably just a typo
    vi. QUESTION (SP): specific descriptions of lifeline categories?
        1. NS: we can provide specific descriptions of categories
        2. DS: link in the chat (https://www.fema.gov/emergency-managers/practitioners/lifelines) discusses what those 8 categories are and we will get that sent out to everyone attending
    vii. QUESTIONS: do you just leave blanks or can you put a 0? What about aviation facilities? Transportation hubs?
        1. NS: this is your list and we will try to assign any updated facilities to a FEMA lifeline as received
        2. SG: if you need help with power/substation data please let me know
        3. DS: this is the data that comes from the risk management tool, once we get the info back from the jurisdictions we will make the necessary tweaks

9. Hazard Profile Summary
    a. Image of current draft Priority Risk Index (PRI)
    b. Demonstrates main hazards of concern in Wake County
        i. A lot of details you can get wrapped around here, but trying to figure out main hazards of concern to start working on mitigation
10. Hazard Profiles
    a. Dam Failure
        i. 577 dams in Wake County
            1. 206 high-hazard
            2. 59 intermediate hazard
            3. 312 low-hazard
        ii. CC: FEMA has asked for a deeper dive into this one for this round, separate planning guidance for this program we are trying to mesh
            1. Wake County has 1, Cary has 1, and Wake Forest has 1 high-hazard dam in poor condition meeting funding program guidelines
            2. Let us know who to contact for dam safety in your jurisdiction
            3. Main goal in this update is to make some effort to reach out to dam operators and owners to ensure an updated Emergency Action Plan (EAP)
            4. Not a lot of funding available, money comes from NCDEQ and not NCEM

5. Wake County would be a good place to figure out how to meet all the planning requirements for this hazard

iii. List of dams that have failed in the past for Wake County

b. Drought
   i. Do have a disaster declaration for this
   ii. Wake County susceptibility to droughts
   iii. Reported impacts
   iv. 514 weeks of drought conditions over the 1,303-week period from 1998 to 2023
   v. Drought likely to increase in intensity/duration over time
c. Earthquake
   i. Potential seismicity from Charleston Fault, Central Virginia Seismic Zone, and/or Pembroke Faults
   ii. Major ground shaking unlikely
   iii. Estimated building losses from 250-year earthquake
      1. FEMA provided HAZUS software where we can model the damages from certain hazard events
      2. Countywide earthquake event looking like $4M
d. Extreme Heat
   i. Extreme heat is the #1 killer, impacts are critical over a large area = highest PRI out of current plan hazards
   ii. Wake County experienced 49 days with temperature over 100 degrees F
   iii. Number of extreme warm days over 95 degrees F expected to increase
e. Flooding
   i. 2 main sources of flooding
      1. Riverine and flash
   ii. Flood map
   iii. Number of reported events per National Centers for Environmental Information (NCEI) from 1996 to 2023
   iv. Flooding building loss estimates from 100-year flood from NCEM risk management tool (RMT)
f. Hurricane & Tropical Storm
   i. Categories of hurricanes
   ii. Hurricane and tropical storm spaghetti map
   iii. 49 hurricanes and tropical storms within 50 miles of Wake County since 1900, plus NCEI loss numbers and Hurricane Fran stats
   iv. Building loss estimates from 25-year hurricane wind
g. Landslide
   i. 11 events reported per NCGS
   ii. Some western border areas indicate moderate susceptibility and incidence
      1. Most other areas are low
h. Severe Weather – Thunderstorm Wind
   i. Definition of thunderstorm winds
   ii. NCEI records (note that these are underreported especially for storms)
   iii. Scores pretty high on PRI

iv. Building loss estimates from 50-year winds

i. Severe Weather – Lightning
   i. NCEI recorded 41 strikes from 1998-2023
   ii. Lightning density map

j. Severe Weather – Hail
   i. NCEI records and size of hailstones

k. Severe Winter Weather
   i. 60 past occurrences between 1998 to 2023
   ii. 6 disaster declarations
   iii. Major infrastructure risks

l. Tornado
   i. Highest tornado intensity was an F4 in 1988 that injured over 100 people
   ii. 22 recorded incidents from 1988 to 2023 per NCEI
   iii. Tornado path map

m. Wildfire
   i. NC Forest Service reported 153 fires burning over 899 acres from 2009-2023
   ii. Some areas at higher risk
   iii. Maps of Wildland Urban Interface (WUI) and Burn Probability

n. Hazardous Materials
   i. 35 sites with hazardous materials per EPA TRI

o. Radiological Incident
   i. Harris Nuclear Plant nearby

p. Terrorism
   i. 5 hate groups reported by Southern Poverty Law Center (SPLC)
   ii. QUESTION: other resources used to evaluate hate groups?
      1. NS: first use of listing I have seen with this, if you know of better resources please send them our way.
   iii. No major attacks have happened
   iv. Some plans lump active shooter events in with this
   v. QUESTION: this one does not feel incident-focused, do not think the groups make sense if we could revise the approach?
      1. DS: in the past, we have used JHU hazard assessment tool and this is just a small part of what we have for the hazard
      2. SG + larger group: reconsider naming any specific groups in the plan
         a. GROUP CONSENSUS: revise this element

q. Priority Risk Index (PRI)
   i. Levels of classification, scoring, and weighting
   ii. Technical way of evaluating hazards with a useful score output

r. PRI Results
   i. Showing PRI table results again
   ii. Want to hear from everyone about whether scoring makes sense and if PRI should be refined
   iii. High risk (> 3.0), moderate risk (2.0-2.9), low risk (< 2.0)
      1. QUESTION: why are some hazards ending up in the high-risk category?

a. RR: would not have rounded them, most likely a typo

iv. QUESTION (SP): is this where we have a conversation about why certain hazards were excluded?
    1. NS: we can have a conversation with the county about adding infectious disease and cyber

v. QUESTION: how do you keep consistency for hazards that cross the jurisdictional lines? Infectious disease would not just affect Wake County
    1. DS: FEMA will not evaluate these types of hazards added in the plan but we can still include them if that is the preferred way to go
    2. NS: only a few natural hazards even included in the FEMA hazard mitigation planning guidance
    3. CC: state plan is required to examine all hazards that impact the whole state. Sinkholes is the best example of that since we do not have it in every smaller jurisdiction. If you want to leave a hazard out you just need to tell us why. Risk assessment in state plan serves as the statewide risk assessment for a variety of other planning efforts. Putting these hazards in the Wake County plan would really only benefit those seeking money for a project or plan related to them in your area. We (NCEM) would support the decision either way.
    4. SG: cyber is the costliest hazard, we just do not hear about it every time it happens. Does anybody have a realistic negative argument to adding cyber and infectious disease?
        a. NS: the plan would just be longer
        b. CC/SG: it is easier to add these hazards in the process now versus going back later with an amendment

vi. QUESTION (MC): seeing the severe winter storm probability as highly likely and the impact being limited, given climate change trends and warming should this be revised?
    1. NS: agree with that. Highly likely is 100% of yearly probability, between 10-100% maybe more accurate?
    2. AH: this was an El Nino year, climate change data suggests things will get warmer more often and more extreme and I am in favor of keeping things the same
    3. SM: would not necessarily support changing it either. People down here are not prepared for any kind of snowfall or winter weather event, it feels like there is a much bigger impact here vs. somewhere more to the north
    4. Consider impact as the key figure to revise concerning severe winter storms

vii. KK/DS/NS: when reviewing the plan, FEMA is only looking at natural hazards and not man-made technological hazards. Dam failure might be the only one they would potentially look at.

viii. QUESTION: do you need to consider a mitigation strategy for an unusual/man-made hazard event?

1. NS: once FEMA reviews that the minimum requirements were met the mitigation strategy is whatever you want it to be

ix. GROUP CONSENSUS: adding in (1) infectious disease and (2) cyber hazards, look at severe winter storm adjustments, revise PRI high/moderate/low table

11. Project Schedule
    a. Project kickoff date – 1/4/24
    b. Public meeting 1 – 2/28/24
    c. HIRA findings – 4/24/24
    d. Mitigation Strategy Development Meeting – Date TBD
        i. NS: probably 20-30 actions your town/city has identified, time to dust those off because FEMA is REQUIRING a status update, and also the time to come up with new actions. With the implementation status update you can't just say "ongoing" anymore, more details are needed
            1. CC: not a bad mark for not doing an action, but will get a bad mark from FEMA if there is no update to the previous mitigation action
            2. QUESTION (SM): if we have certain ongoing activities that mitigate hazards can we not include those anymore?
                a. NS: think carefully about including it this time around in the mitigation strategy. How does it fit into your local capabilities
                b. SM: Apex flooding example of ongoing action of no platting in the floodplain, where exactly would that be listed if not in the mitigation strategy and would it affect how FEMA could help?
                    i. NS/CC: this would feed into the capability assessment and if you have been working on this action for several plan cycles you could likely substitute it for another action
                    ii. DS: we will be sending out the capability assessment from the previous plan and you can make any changes you would like to it
                    iii. CB: you do not need to put in actions like "maintaining floodplain ordinance" or "participating in NFIP"
    e. Proposed Delivery of Draft – 6/2/24
    f. Public Meeting 2 – Date TBD
    g. Existing Plan Expiration Date – 12/2/24
12. Next Steps
    a. Capability assessment to reflect any changes since the last update
        i. Almost every jurisdiction is rated as "high capability"
    b. Mitigation Strategy Development Meeting with HMPC (date TBD)
    c. We are going to re-send the public survey link – please help us advertise!
        i. Take off the deadline of April 12 for the survey, WSP to extend this
        ii. NS: per new FEMA guidance, we want to think about how we are conducting outreach with socially vulnerable and marginalized populations
            1. Public health, social services, emergency services departments
        iii. SG: outreach season is coming up as more people are out and about

iv. QUESTION: do you utilize the FAST teams? Special team the state has to mobilize evacuations

13. Questions/Comments/Concerns?
14. Items to share: presentation, meeting minutes, survey, capability assessments to follow

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Hazard Identification and Risk Assessment Meeting

April 24, 2024
2:00 - 4:00 PM

Name	Jurisdiction	Title	Phone Number	E-mail Address
Chris Crew	State	Mit Plng Mgr	919 218 6157	John.crew@ncdps.gov
Ben Brown	City of Raleigh	Stormwater Admin	919 996 3515	ben.brown@raleighnc.gov
Allison Bryan	City of Raleigh	Floodplain Engineer	919-996-3776	allison.bryan@raleighnc.gov
Amanda Bunce	Town of Apex	Current Planning Mgr	919-249-3529	amanda.bunce@apexnc.org
Winifred Dorer	Wake SWCD	Admin Coordinator	984-303-5941	winifred.dorer@wake.gov
Emily Batewan	Wake SWCD	Natural Resource Conservationist	984-218-0144	emily.batewan@wake.gov
Terry Nolan	Wake Planning			

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Hazard Identification and Risk Assessment Meeting

April 24, 2024
2:00 - 4:00 PM

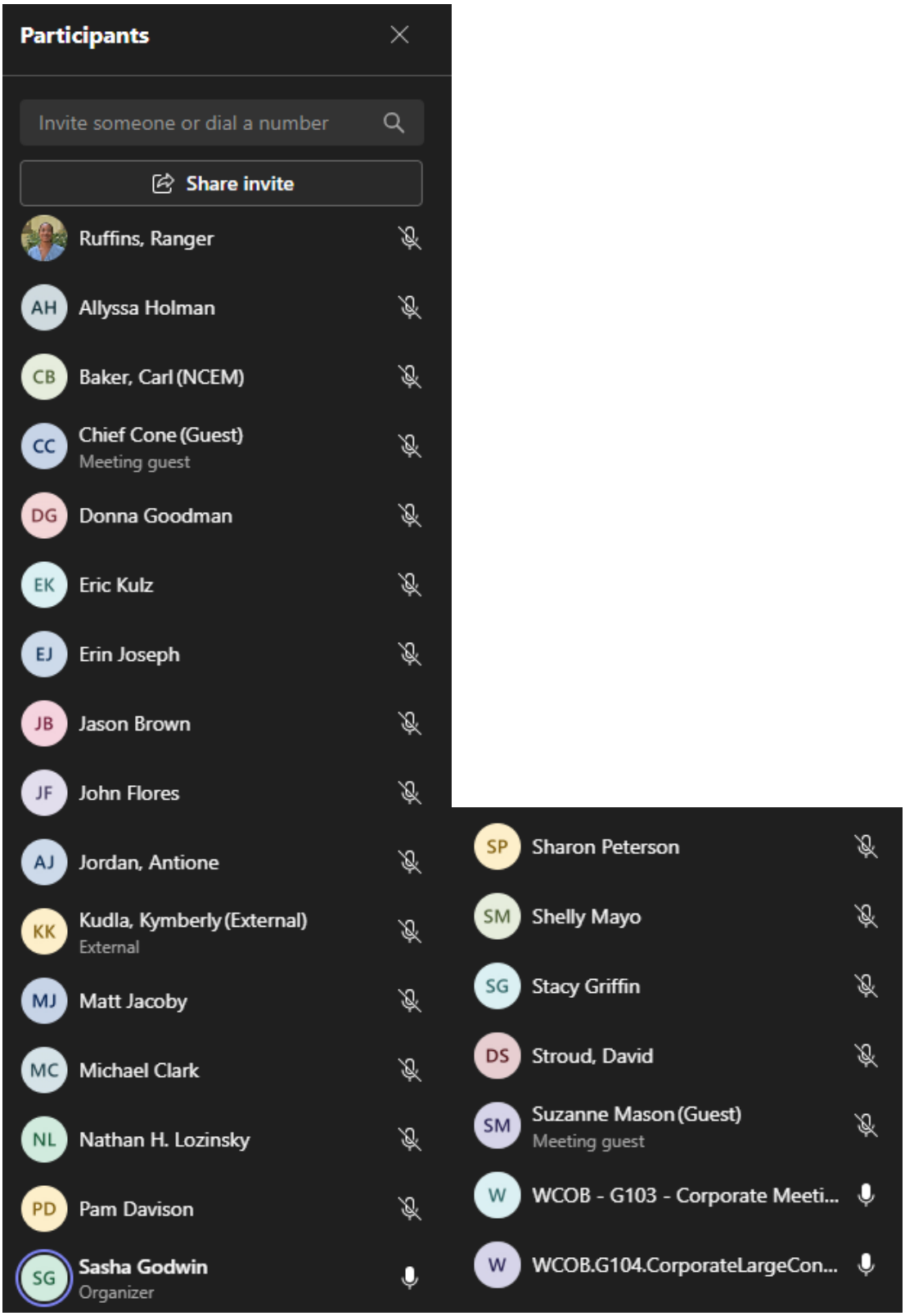
Name	Jurisdiction	Title	Phone Number	E-mail Address
John Frederick	Morrisville	CERT Team President	(919) 619-9805	jpfrederick@nc.rr.com
Daniel Colavito	Holly Springs	Env. Manager	(919) 422-9818	daniel.colavito@hollyspringsnc.gov
MaryBeth Spachr	Holly Springs	Budget Analyst	919-577-3143	marybeth.spachr@hollyspringsnc.gov
Edward Ridpath	Fuquay-Varina	Planning Board Member	919-274-0744	eridpath@gmail.com
GRIF BOND	WAKE FOREST	EHS MGR LUMEN TECH. & TOWN OF WAKE FOREST CITIZEN	919-247-5673	grif.bond@gmail.com
Jennifer Mills	Holly Springs	Emergency Mgmt	984.296.3937	Jennifer.Mills@hollyspringsnc.gov

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Hazard Identification and Risk Assessment Meeting

April 24, 2024

2:00 - 4:00 PM

Name	Jurisdiction	Title	Phone Number	E-mail Address
Jessica Leins	City of Raleigh	Emergency Management Analyst	919-608-7331 919-996-59666	jessica.leins@raleighnc.gov


Participants
Invite someone or dial a number
Share invite
Ruffins, Ranger
AH Allyssa Holman
CB Baker, Carl (NCEM)
CC Chief Cone (Guest)
Meeting guest
DG Donna Goodman
EK Eric Kulz
EJ Erin Joseph
JB Jason Brown
JF John Flores
AJ Jordan, Antione
KK Kudla, Kymberly (External)
External
MJ Matt Jacoby
MC Michael Clark
NL Nathan H. Lozinsky
PD Pam Davison
SG Sasha Godwin
Organizer
SP Sharon Peterson
SM Shelly Mayo
SG Stacy Griffin
DS Stroud, David
SM Suzanne Mason (Guest)
Meeting guest
W WCOB - G103 - Corporate Meeti...
W WCOB.G104.CorporateLargeCon...

HMPC MEETING 3: MAY 30, 2024

Wake County HMP Mitigation Strategy Meeting
5/30/24, 2 PM – 3:15 PM
[Draft Notes]
[Online Participants] – Sasha Godwin, Carl Baker, Chris Crew, John Frederick, Shelly Mayo, Adam Culpepper, Matt Jacoby, Dianne Khin, Allyssa Holman, Teresa Furr, Ranger Ruffins, Kymberly Kudla, Steven Spruill, Nathan Lozinsky, Joshua Creighton, Antione Jordan, Stacy Griffin, Grif Bond, Donna Goodman, MaryBeth Spoehr, Loren Cone, Jason Brown, Mikayla Renn, Eric Kulz, Terry Nolan, Christopher Parker, Mark Schell, Sharon Peterson, Jon Olson, Pam Davison,
[In-person Participants] – See sign-in sheet

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1. Nathan Slaughter (presenting): Still a few things to talk through and collect from each of you during the HMP update process
2. This is the third meeting in the update process, and we are coming to an end of collecting info and providing it
    a. We might have one more meeting to present the draft plan and receive feedback
    b. Last meeting in the process for getting things done
3. Agenda
    a. Welcome & introductions
    b. Meeting objectives
    c. Planning process & status updates
    d. Capability assessment
    e. Mitigation strategy
    f. Next steps & questions
4. Introductions
    a. Introductions from participants around the room and online
    b. Most if not all municipalities here, thank you all for joining!
5. Meeting Objectives
    a. Two main components of the current planning process steps:
        i. Capability assessment
            1. Overview
            2. Summary of initial findings
            3. Identify changes since last update
            4. Discuss new SDEs requirements
            5. Influence/role on mitigation actions
        ii. Mitigation strategy development
            1. Overview
            2. Consider mitigation techniques available
            3. Review previous mitigation goals
            4. Discuss existing actions and update status
            5. Identify new actions and opportunities
6. **Plan Update Process Step 1: Organize Resources**
    a. Coming close to the end of the update process, at least the heaviest lift, before last meeting for draft review and adoption of plan at the local level
7. **Plan Update Process Step 2: Risk & Capability Assessment**

a. Assessment step consists of Hazard ID, Vulnerability Assessment, and Capability Assessment
b. Capabilities do not change much over time, so we mined different websites and planning resources to see what we could find online. A draft of the capability assessment will be an important part for everyone to review in the draft plan. All of that is to understand what our capacity is to address these hazards and align with mitigation strategies.
c. Capability – measures community capability to implement mitigation activities, identifies and targets gaps/opportunities, identifies mitigation measures already in place or underway
d. Capability Indicators – plans and regulatory, admin and technical, fiscal resources, education and resources, mitigation resources, and political will all help evaluate readiness of community to effectively implement and sustain mitigation activities
e. Capability Indicator Examples – multiple examples provided for each indicator category
f. Capability Assessment Initial Findings – everybody in Wake County either falls into high or moderate capacity. This is what we could find online but certainly open to adding to this as needed. 6 jurisdictions were rated as high capability and 7 jurisdictions rated as moderate capability. We live in an area that is moderately vulnerable, we're not in the Outer Banks for instance. Higher capability is a good level to be at countywide. Consider the mix between capability and vulnerability and what mitigation actions are being taken.
g. Capability Changes Since Last Update – largest change is planning and regulatory (5 new economic development plans, 2 capital improvement plans, others added various planning documents) and other notable changes include education/outreach efforts (4), warning/alert systems (3), stormwater fees (3), water/sewer fee (2), CDBG funding (2)
h. A lot of folks asking to see capability assessment, this is what we have until we roll it out for everyone to see, review, and provide feedback on
    i. No questions asked at this point
i. New FEMA Requirement on Substantial Flood Estimates (SDE) for Capability Assessment – all tied back to mitigation action plans and risk assessments. Follow-up action is required on this item.
    i. Basically, need to collect these procedures from each municipality and the county. All of us have something we do, may not be fully codified, but this is something FEMA is requesting this time around.
    ii. QUESTION: Is the narrative sufficient? Any other details needed?
        1. NS: Yes, the narrative is fine, and you do not need to identify specific programs. I will send an email with an SDE template to help solicit responses from each of your participating jurisdictions.
    iii. KK (FEMA): More detail is better for these procedures. If you do something specific after an event, please include it. We are really focusing on the process of what you do after a hazard event.
    iv. CC (NCEM): Check your flood damage prevention ordinance for information on this
    v. COMMENT: For those that utilize Wake County, you can contact Community/Building Services as they have led a lot of these efforts.

vi. QUESTION: Was repetitive loss data ever sent out?
    1. NS: FEMA has the multiple loss properties dataset on OpenFEMA, we have been able to find that and meet the requirements. We will double check the numbers with what you guys have. No need for municipalities to send a letter or anything like that.

j. Impact on Mitigation Actions – Analysis of risks alongside capabilities is essential for informed decision-making and mitigation strategy development
    i. Looked at the data and presented to all of you, still working through feedback from HIRA meeting a little bit, brief review of hazards and rankings. Part of the risk assessment summary.
    ii. Details of the risk assessment will be in the draft plan to see how hazards impact us specifically. All of it leads to the development of the mitigation strategy.

8. **Plan Update Process Step 3: Mitigation Strategy Development**
    a. Step includes setting mitigation goals, reviewing alternatives, and drafting action plans
    b. Mitigation Strategy – the main purposes are to reduce vulnerability and mitigate the impact of hazards, prioritize actions/allocate resources effectively, and collaborate with stakeholders. For every $1 spent on mitigation, $6 is saved on future recovery costs based on the updated study results.
    c. Basic Types of Mitigation – includes (1) mitigation against hazard impacts on existing development and (2) ensuring future development is conducted in a way that does not increase vulnerability
    d. Mitigation Techniques – 6 main categories
    e. Mitigation Techniques Examples – examples provided for each of the 6 mitigation technique categories
    f. Setting Mitigation Goals – one of the things we must do as part of the update process. We updated them a little bit the last time around and added some objectives. There are 4 main goals in the plan as listed below. We will accept feedback on these in the draft plan too. If there are any major changes, we will update you at the last meeting.
        i. Goal 1: Protect public health, life, safety, and welfare by increasing public awareness and education of hazards…
        ii. Goal 2: Improve technical capability…
        iii. Goal 3: Minimize threats to life and property by protecting the most vulnerable…
        iv. Goal 4: Incorporate resiliency into future growth…
        v. QUESTION: Are you going to send these out?
            1. NS: Yes, we will send out slides and same with the draft plan.
    g. Review Mitigation Alternatives – reaching out to participating jurisdictions by email to update mitigation action spreadsheets (far right columns). FEMA requirement to define what has been done in the last 5 years regarding each mitigation action. They like to see a little narrative for the completed and/or deleted actions. Follow-up action is required on this item.
        i. "Ongoing" is too broad
        ii. You can add new mitigation actions right in the spreadsheet sent to you or let the project team know to update them
        iii. Example of Wake County 2019 Action Plan shared

iv. Example of how to develop a mitigation action
    1. QUESTION: If revising an old action, you want us to create a brand new one?
        a. NS: If you are slightly revising an old one, just tweak the text. If you are entirely scrapping one or reworking it, go ahead and make a new action. If you have any questions for us, please feel free to send them.

h. Identify New Mitigation Actions – just making sure you understand the 5-year update is an opportunity to consider capturing all types of actions. We mention BRIC specifically here because sometimes people come up with projects related to it that would benefit from being reflected in the HMP, when FEMA reviews opportunities they will ask where it is in the plan. FEMA has many helpful resources for strategy development: Local Mitigation Planning Handbook, Mitigation Ideas, Economic Development Strategy and Hazard Mitigation Plan Alignment, APA/FEMA documentation of how to integrate land use plan with HMP
i. Mitigation Strategy Example 1 – potential actions to mitigate extreme heat (highest PRI as per Risk Assessment findings)
    i. Increase green space/parks/urban forests, implement heat emergency responses, install public cooling stations, conduct outreach campaigns
j. Mitigation Strategy Example 2 – potential actions to mitigate severe storms (2nd highest PRI)
k. Mitigation Strategy Example 3 – potential actions to mitigate flooding (5th highest PRI)
l. Any questions on the Mitigation Strategy? What we need is an updated mitigation action plan, and any new actions that you've got. We have about half of them in. Trying to get this plan in quickly because we are on a super tight timeframe.
m. Project Schedule –
    i. Project Kickoff: 1/4/24
    ii. Public Meeting 1: 2/28/24
    iii. HIRA Findings: 4/24/24
    iv. Mitigation Strategy Meeting: Today
    v. Proposed Delivery of Draft: 6/2/24 (early June)
    vi. Public Meeting 2: Date TBD
    vii. Existing Plan Expiration Date: 12/2/24 (this is the most important date)
    viii. We will roll out a draft to you and will simultaneously begin going through the plan compliance review from the regulatory perspective to fast track the reviews and adoption.
    ix. QUESTION: Doesn't the plan need to be adopted by 1 jurisdiction before sending to FEMA?
        1. NS: That is how we did it in the past. One thing that has changed in recent years is NC has gotten good at meeting regulatory compliance, once NCEM has done review, they are telling jurisdictions to start moving forward on adoption. FEMA is pushing for the same. That way they can avoid the Approvable Pending Adoption (APA) letter.

2. CB (NCEM): We can send adoption letters once we send the draft plan to FEMA for review. Once it is approved, if there is at least one adoption then it is a valid plan.
3. NS: By law, FEMA has 45 days to review the plan. Getting the plan to them hopefully 5-6 months before expiration due to that.
4. CB: 2 more comments – sometimes there is reservation about adopting a plan that is not approved, you are not adopting the draft plan as handed in, but rather as FEMA approves it. As far as the mitigation strategies, some people think if they put an action in it means they have to find the $ or start working on it. It is a WISHLIST and NONBINDING, consider anything where federal funding might be a future opportunity.

x. We are still pulling all the written sections together and closing in on a full draft.

9. Next Steps
   a. Submit updated mitigation Actions
   b. Submit additional new mitigation actions
   c. Review draft capability assessment – provide input
   d. Submit SDE procedures (need this ASAP)
   e. Draft plan submitted in early June (getting this in ASAP before plan expiration)
      i. SG: Wake County is willing to adopt the plan first to lead the charge for jurisdictions
         1. COMMENT: Some of our local boards like to get into the weeds about approval vs. not. If Wake County is willing to do that then it would be a big help.
         2. CC (NCEM): Happy to show up at a local council meeting if they need more information about approving the draft HMP too
10. Questions/Comments/Concerns
   a. SG: You mentioned another meeting?
      i. NS: we can have a quick meeting on the draft plan in terms of content, organization, etc. as needed. Not required by FEMA, but we would like to follow up on it. Adoption meetings are usually public meetings. May want to have another public meeting for everybody just to wrap it up.
      ii. QUESTION: Timeframe for another public meeting?
         1. NS: No, just between now and December and we may not even want to do that. Got it covered from a compliance perspective.
         2. NS: From a CRS community perspective, there are certain requirements for when that meeting happens. It would have to be separate from adoption meeting and within a certain timeframe.
            a. Group consensus: would like to get extra CRS points, if possible, NS to dig into the requirements and confirm with the group
   b. SG: Survey results?
      i. NS: Had 109 responses on the survey, checked before we came here.
   c. QUESTION: What was the timeframe on the first adoption?
      i. NS: First adoption will be recommended once the first draft is done in June, NCEM does review, and at some point, they will tell us it is good to adopt

11. Sending follow-ups on: SDEs, mitigation actions, and slides
12. Meeting adjourned and sign-in sheets collected

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Mitigation Strategy Meeting

May 30, 2024
2:00 - 4:00 PM

Name	Jurisdiction	Title	Phone Number	E-mail Address
Seamus Riley	City of Raleigh	Floodplain Management Supervisor	919-996-3598	Seamus.Riley@raleighNC.Gov
Ben Brown	City of Raleigh	Floodplain Admin	919 996 3515	ben.brown@raleighnc.gov
Allison Bryan	City of Raleigh	Floodplain Engineer	919-996-3776	allison.bryan@raleighnc.gov
Jennifer Mills	Town of Holly Springs	Emergency Managemint	984.296.3937	jennifer.mills@hollyspringsnc.gov

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Mitigation Strategy Meeting

May 30, 2024
2:00 - 4:00 PM

Name	Jurisdiction	Title	Phone Number	E-mail Address
David Nicewinter	RDU Airport	Director of Emergency Ops	813-340-4754	david.nicewinter@rdu.com
Jessica Leins	City of Raleigh	EM Analyst	919-996-5966	jessica.leins@raleighnc.gov
Sasha Godwin	WCEM	EM Specialist	919-576-7968	sasha.godwin@wake.gov

HMPC MEETING 4: JULY 31, 2024

Wake County Hazard Mitigation Plan
Final Plan Meeting
7/31/24, 10 AM – 10:45 AM
Virtual, Microsoft Teams

[**Online Attendees; 41**]: John Flores, Adam Culpepper, Larry Adams, Carl Baker, Ben Brown, Bryan Coates, Allison Bryan, Christopher Parker, Chris Crew, Dianne Khin, Donna Goodman, Ed Ridpath, Emily Bateman, Eric Kulz, Erin Joseph, Grif Bond, Hannah DeLude, Kimberly Hansen, Jason Brown, Jennifer Mathis, Jon Olson, Joshua Creighton, Kymberly Kudla, Jessica Leins, Loren Cone, MaryBeth Spoehr, Matt Jacoby, John Mello, Abigail Moore, Nathan Slaughter, Pam Davison, Reginald Buie, Seamus Riley, Ranger Ruffins, Sasha Godwin, Shelly Mayo, Stacy Griffin, Steven Spruill, Taylor Sanchez, Terry Nolan, Brad West

I. Welcome and Introductions
    a. The Draft Plan has been sent to Sasha
        i. It will be available on Wake County website
    b. It will be available as a PDF
        i. If there are extensive comments, we can send a Word doc
        ii. General comments can be sent directly to Abby
        iii. Mitigation actions can be sent via Excel or clean copy in Word
    c. SG: We can ask the public to review the Draft Plan and bring comments to public meeting
    d. JL: On the comment process: We can contact Abby directly. However, we don't have a way to collect those comments from the public for those who are unable to attend the public meeting
        i. SG: To work with comms team, can submit publicly but anonymously
II. Meeting Objectives (3 key objectives)
    a. Educate and inform
    b. Review Draft Plan Items
    c. Discuss Finding
III. Planning Process Steps
    a. 10 step process (See ppt. for comprehensive list)
        i. Step 7 – Review possible activities (current)
        ii. Step 8 – Draft an Action Plan (current)
IV. Structure and Components Review
    a. Plan structure – TOB will look like this
    b. Plan components

i. Hazard profiles
    1. Included some additional hazards in this version
    2. Made changes to the risk assessment summary
        a. Review/make sure it reflects what's been discussed
    3. PRI results reviewed and revised based on mitigation meeting
ii. Capability assessment (Section 7)
    1. Revised slightly – stakeholders to review
iii. Goals and objectives in mitigation strategy
    1. No revision requests currently
iv. Mitigation action plan
    1. Large component of plan update
    2. Received from all participating communities
    3. Implementation status update narrative
    4. Handful of actions that stakeholders proposed for inclusion – make sure this information is accurately captured
        a. e.g. Holly Springs stormwater action for BRIC application
        b. Want to make sure these items are included

c. Sections overview including annexes/appendices
    i. JM: Plan adoption. Preadoption before the draft. Is this done?
        1. NS: From here, we will send a draft to NCEM, and they will start compliance review. Once NCEM is given cursory review from regulatory perspective, they will forward the plan to FEMA and tell us jurisdictions to move forward with adoption assuming review with the state moves expediently.
        2. JC: Ask Chris on timeline on this so we don't go back and forth with condition approvement with FEMA from the County perspective. County will do the adoption, send to FEMA, once approved, jurisdictions can go ahead and adopt.
        3. AM: We can go ahead and send for review. There shouldn't be a need to re-adopt regardless of any minor changes.
        4. NS: Ask each of you to complete your jurisdiction review – accurate/depicts what you want it to say. Any changes you have for us aren't going to change structurally or from a regulatory compliance perspective. Can be done in tandem/helps speed process up.
        5. SM: Is the draft going to be submitted to the state while we review?

6. CC: Feel free to contact us within the draft that you believe needs to be addressed before we send it off to FEMA. Once we get this to a point where we think it meets requirements, if you want to go ahead and adopt. We have an amendment process/incorporate new actions through a fairly simple process. There is always an opportunity to adjust once adopted if necessary.

V. Plan Implementation and Maintenance
   a. Role this group plays in implementation/maintenance
      i. Potentially meet annually
      ii. CRS communities – regular reviews is important to maximize credit
   b. Pursue implementation of actions
      i. AM: Check out details for mitigation actions (lead/schedule); team filled in some blanks so just make sure information aligns with what you're expecting
   c. Procedures to continue public involvement
   d. Integrate with other planning efforts
      i. How the previous plan has been integrated within jurisdiction
         1. Section within maintenance section
      ii. Comprehensive plan, CIP, EOP, other ordinances/policies
         1. Making mitigation more of a day-to-day activity
      iii. How to improve integration with future efforts
         1. Reflect any efforts you're hoping to do
   e. Update in 2029-2030

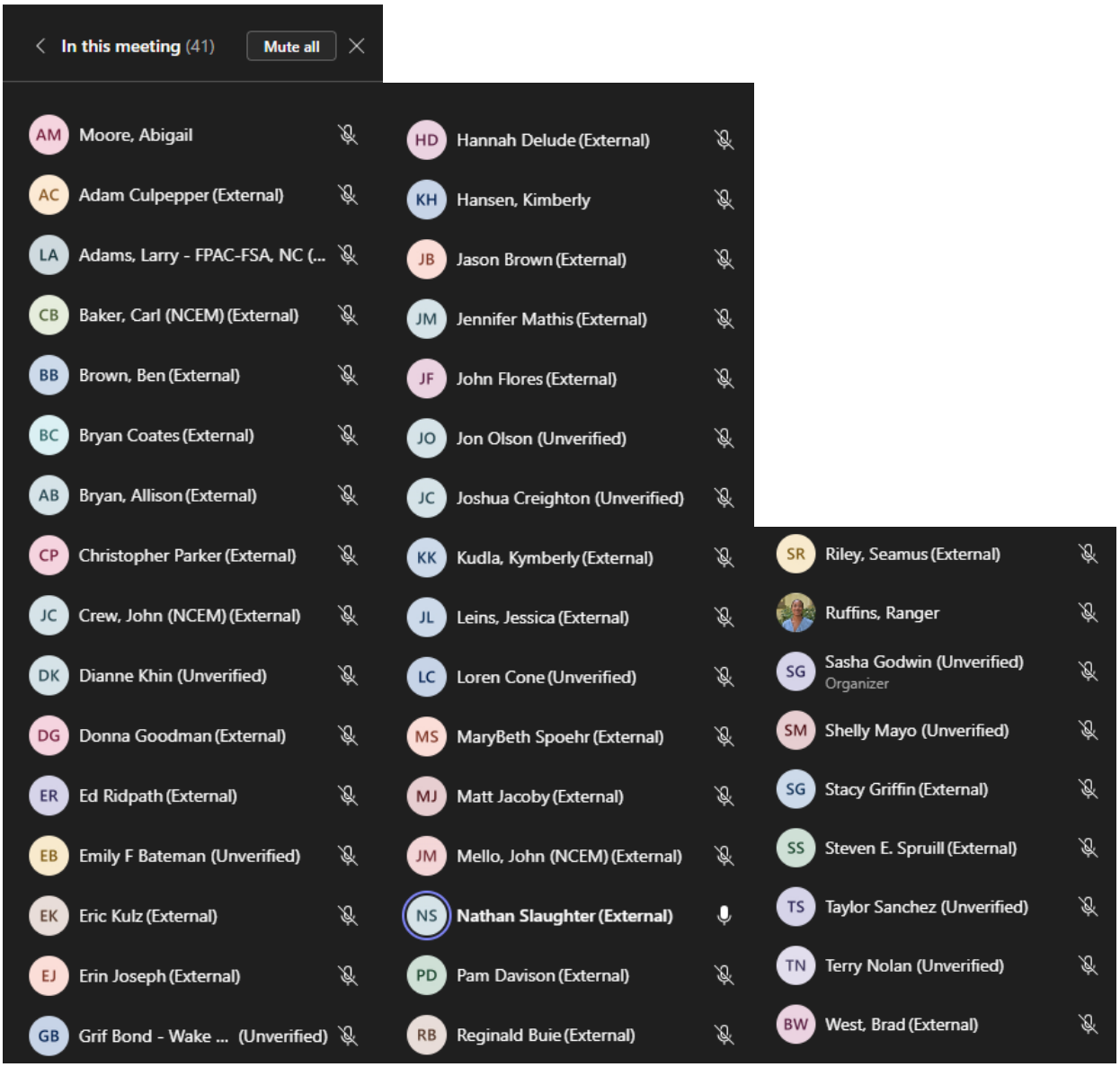
VI. Next Steps
   a. Track/report plan integration efforts
   b. Finalize mitigation actions
   c. Final Public Meeting
      i. Promote final meeting
      ii. Likely virtual/hybrid; looking to be late August 2024
      iii. Target socially vulnerable; historically underserved
         1. Opportunity for them to weigh in on draft version
         2. Provide recommendations on organizations that can assist
   d. Review draft plan
   e. Adoptions can begin as soon as we get green light from NCEM (simultaneous review)
      i. Revise based on all feedback
      ii. Send along to FEMA

1. Approval pending adoption
2. Now provide approval letter and list those who have already adopted plan

iii. All jurisdictions must adopt

VII. Questions

a. JL: Adoption piece. Depending on jurisdiction, who can adopt? Can take a while to get it to Council in Raleigh's case.
   i. CC: It needs to be City Council in Raleigh's case
b. CC: Reach out with any questions pertaining to grants/funding or mitigation actions. Comments on contractor team for state review team – welcome comments/let us know how we're doing. Any best practice or success story in this update process, please share and we will pass along to other communities.
c. MS: Still waiting to hear back from Holly Springs on stormwater addition. Is there a date we need to provide to you by?
   i. NS: Don't have a hard date in mind. The sooner the better so we can get all actions included. Abby – timeline on review?
      1. AM: Aiming for public meeting, maybe the end of that week. So 3-4 weeks for all revisions to get final draft compiled/adoptions.
      2. CC: Does not need to be detailed. General description of the activity will suffice, can work on details when you present a project proposal.


In this meeting (41)
Mute all
AM Moore, Abigail
AC Adam Culpepper (External)
LA Adams, Larry - FPAC-FSA, NC (...
CB Baker, Carl (NCEM) (External)
BB Brown, Ben (External)
BC Bryan Coates (External)
AB Bryan, Allison (External)
CP Christopher Parker (External)
JC Crew, John (NCEM) (External)
DK Dianne Khin (Unverified)
DG Donna Goodman (External)
ER Ed Ridpath (External)
EB Emily F Bateman (Unverified)
EK Eric Kulz (External)
EJ Erin Joseph (External)
GB Grif Bond - Wake ... (Unverified)
HD Hannah Delude (External)
KH Hansen, Kimberly
JB Jason Brown (External)
JM Jennifer Mathis (External)
JF John Flores (External)
JO Jon Olson (Unverified)
JC Joshua Creighton (Unverified)
KK Kudla, Kymberly (External)
JL Leins, Jessica (External)
LC Loren Cone (Unverified)
MS MaryBeth Spoehr (External)
MJ Matt Jacoby (External)
JM Mello, John (NCEM) (External)
NS Nathan Slaughter (External)
PD Pam Davison (External)
RB Reginald Buie (External)
SR Riley, Seamus (External)
Ruffins, Ranger
SG Sasha Godwin (Unverified)
Organizer
SM Shelly Mayo (Unverified)
SG Stacy Griffin (External)
SS Steven E. Spruill (External)
TS Taylor Sanchez (Unverified)
TN Terry Nolan (Unverified)
BW West, Brad (External)

PLANNING STEP 2: INVOLVE THE PUBLIC

Table B.2 – Public Meeting Topics, Dates, Locations

Meeting Title	Meeting Topic	Meeting Date	Meeting Location
Public Meeting #1	1) Introduction to mitigation techniques 2) Review of the plan update purpose and process	February 28, 2024	Lions Park Community Center, Raleigh, NC 27604
Public Meeting #2	1) Review "Draft" Hazard Mitigation Plan 2) Solicit comments and feedback	August 21, 2024	Virtual

PUBLIC MEETING AGENDAS, MINUTES, SIGN-IN SHEETS, AND ANNOUNCEMENTS

PUBLIC MEETING 1: FEBRUARY 28, 2024

Wake County Public Meeting # 1
2/28/2024, 5:30 PM – 7:00 PM
Lions Park Community Center, Raleigh, NC 27604
[Draft Notes]

[Online Participants] – Hannah DeLude, Seamus Riley (Stormwater Dept.), Holly Miller (Tetra Tech), Amber Williams, Satwana Hurdle (City of Raleigh), Michael Voiland (Town of Garner), Jamilia Elder (WRAL), Michelle Hunter (Raleigh's Community Response Team), Delores Holloway (citizen of Raleigh), Ranger Ruffins, Laurie Slaughter, Cynthia Daniels-Hall,

[In-person Participants] – See sign-in sheet

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1. Agenda
    a. Welcome & Introductions
    b. Meeting Objectives
    c. Mitigation Overview
    d. Purpose of Update
    e. Plan Update Process
    f. Next Steps
    g. Q&A Session
2. The meeting is being recorded and the county will be posting it on the website
3. Sign-in sheets passed around
4. In-person and online introductions
5. Meeting Objectives
    a. Engage the community
    b. Gather input
    c. Educate and inform
    d. Enhance plan relevance
    e. Plan required by FEMA and updates required to achieve these objectives
6. What is Mitigation? Definitions of mitigation/hazard mitigation
7. 2 Basic Types of Mitigation: reducing impacts on existing development and reducing the vulnerability of future development
8. Mitigation Techniques
    a. Prevention – plans, policies, procedures
    b. Property Protection – acquisitions, elevations, etc.
    c. Natural Resource Management – riparian buffers, WUI, etc.
    d. Structural Projects – public works side of the natural hazard problem
    e. Emergency Services – facilities are mitigated to provide services
    f. Education and Awareness – making the public aware of the process and how to contribute
9. Purpose of Update
    a. Reflect on changing risks

i. Increasing population and growth in Wake County – more buildings, roads, and infrastructure are all exposed
ii. Looking at manmade hazards to align with the updated State of NC Plan
iii. Emerging topic of climate change as a new FEMA requirement
iv. Development patterns can put more assets at risk

b. Increase community resilience (a big focus this time around)
i. Another new requirement is engaging socially vulnerable populations or those who have historically not participated in plan updates
ii. Adopting effective strategies to bring about real change

c. Compliance and funding
i. Ensure compliance with federal and state legislation requiring this planning
ii. Maintain eligibility for programs like HMGP, FMA, BRIC, CRS

d. Ensure preparedness
i. Addressing existing/emerging hazards, protect lives/property, sustain continuity of emergency services

10. Plan Update Process
a. Planning, Coordinating, Finalizing
i. This public meeting part of planning process
ii. Casting the net further at future meetings to get more stakeholders involved

b. Step 1: Organize Resources

c. Step 2: Risk Assessment
i. Hazard ID – what hazards can happen here
1. 14 previously identified hazards (2019) – going to see which new hazards to include or old ones to phase out
ii. Vulnerability Assessment – analysis using GIS and a lot of good data
iii. Capability Assessment – Wake County, City of Raleigh capabilities to do anything about this

d. Step 3: Develop a Mitigation Plan
i. Within existing plan there is a set of countywide goals steering the mitigation actions
ii. County and municipalities have a series of actions to implement over time, this is the opportunity to update these

e. Step 4: Adoption and Implementation
i. NCEM and FEMA review, come back with approved plan to ask participating jurisdictions to officially adopt
ii. Mitigation actions should be an ongoing process to work against hazards

f. Project Schedule
i. Kickoff Date: 1/4/24
ii. Public Meeting 1: 2/28/24
iii. Proposed Delivery of Draft: 6/2/24
iv. Public Meeting 2: Date TBD
v. Existing Plan Expiration Date: 12/2/24

g. Plan Website:

i. The Wake County website will continue to push out information and meeting agendas
ii. Public survey we are hoping to have filled out
iii. The website contains a variety of information as the process continues

h. Next Steps
i. Record and analyze the input received during Public Meeting #1
ii. Public survey to be posted on municipal and county websites
iii. Continue working on risk assessment

i. Public Survey
i. QR code to scan with phones
ii. Hannah to drop a link to the survey in the meeting chat
iii. Hard copies of the survey in the room today

j. Questions?
i. No questions reported

k. Brainstorming Questions
i. Key concerns or challenges that should be addressed?
ii. How can the community be better prepared for potential hazards or disasters?
1. MH – do you have a vision of how neighborhoods would be prepared?
a. SG – communities and preparedness, not sure if we touch on that in the mitigation plan, but we do have the emergency response team. If your community does not have one we can help get one set up. Autumn G. does a lot of outreach with communities on this topic, and a lot of spring season events where Wake County EM will be participating. As far as how it is tackled in HMP not sure about that.
b. NS – one of the mitigation techniques is awareness/education. Anything we can do to better prepare people and their properties plus larger communities could be seen as mitigation. One of the reasons we do public outreach as part of the process. Projects are not generally aimed at preparedness, mostly focused on brick-and-mortar physical improvements. However, public education/awareness is a big concern.
c. What is CERT?
i. SG – Community Emergency Response Teams. Trained in how to check on neighbors, evacuation routes, provide preparedness materials, etc. Can be essential for volunteer hands during an actual event like a hurricane.
ii. How do CERT teams coordinate with other recovery groups like the Red Cross?
1. MH – overlaps between membership, but often CERT would be a resource called in alongside them. Many people are trained to staff the same shelter. At the county level, any plan to

interact with the CERTs partnered with a fire department, etc.?
    a. SG – contact info provided and will follow up on this after the meeting.

iii. Any specific areas or infrastructure that you feel require further consideration?
    1. Does Walnut Creek fall into the mitigation grant category?
        a. BB – yes, other related areas are also being explored through watershed studies and other actions
        b. Pursuing any funding from any entity that can help out?
            i. BB – correct!
    2. NS – I encourage everyone involved to come up with the problems before seeking funding opportunities. FEMA is not the only player in the game. Need to roll out more solutions first.

iv. The other remaining 2 questions were mentioned but had no discussion.

I. OTHER QUESTIONS

m. Some social media post comments were provided about items to ideally include in the plan. Have you seen these?
    i. Yes, we are aware of these, and feedback from NextDoor, Facebook, etc. will be collected as part of the planning process (NS)

n. What about population growth and climate change? (HM)
    i. NS discussed the changing dynamics of rapid population growth in Wake County and the overall increasing intensity of natural hazards due to climate change. Two important dynamics to plan for and the HMP will account for updated conditions.

o. Any guidance or information on developing a plan for storms? (MV)
    i. Don't think FEMA or the state is going to weigh in on recurrence intervals for storm planning. Comes back to local governments on what regulations are in place. Lots of data out there promoting the thought that more frequent/intense storms are happening. Have not seen a federal requirement come down yet to change floodplain risks (NS)
    ii. We have a process to update FIRMs on a rough 5-year cycle. NOAA is also working on Atlas 14 which is a rainfall intensity analysis, and that update should be coming up in 2025. Should provide additional information on this subject. (CC)
    iii. Feds updating their policies of investing federal dollars, they require the building of federal properties to meet a higher standard of floodplain management like 500-year (NS)

p. Regarding the mitigation plan, for the hurricane evacuation plan of the coast, is Wake County a point, what options for sheltering?
    i. SG – the state recently revisited the CREST shelter plan. Would normally pull counties and ask if they have a shelter come up. Many counties would normally just say no due to resource and spending constraints. New restructuring sets up a shelter anyway and frees up availability. Historically, the county runs it even

though the state drops it. In the future, it will be a county-supported coordinated effort.

ii. Is that done verbally or is there a signed agreement to be able to do that?
    1. SG – did not hear anything about a mutual agreement for shelters. It is an opt-in or opt-out thing at the moment. There is a document to fall back on for sharing equipment, personnel, shelters, etc.

iii. Chris Crew can provide contact with the state coordinating body (State Emergency Response Team, operations section at NCEM)

q. What have you mitigated to date?
    i. NS – HMP has been around since the early 2000s, and a pretty big number of mitigation actions completed since then, but I know for example City of Raleigh has done many projects through a mix of City/State/Federal funding
    ii. BB – since 2006 used utility funding, FMA grants, HMGP grants, etc. for acquisitions and floodplain mitigation hazards in City of Raleigh
        1. Was that City property or development sites?
            a. BB – many repetitive loss sites where people would be willing to sell the property and relocate elsewhere, would become preserved open spaces as a result
        2. CC – statewide the most common action has been acquisition followed by backup generators for critical facilities and then followed by elevation of structures. Grants generally flowed from Feds to State to local government.
            a. Is the State recommending elevation for flood projects?
                i. CC – cannot say either way. Each jurisdiction has its flood prevention ordinance designating the BFE also known as the 100-year flood height in previous years. New or improved construction in flood hazard areas needs to be above XYZ level.
    iii. SG – cannot say much since I am new to Wake County, but we are actively working with stakeholders to envision projects and initiatives that will leave the area better prepared.
        1. CC – FEMA generally steering away from single-family homes and onwards to larger stormwater management/civil engineering projects. Broadening the scope of what we do.
            a. SG – some of that funding Wake County is not eligible for too, such as programs setting a population size restriction

11. Wrapping up meeting and sharing contact information in chat
12. Encourage everyone to fill out the survey as it is pushed out more
    a. NS – record I have seen is Wilmington with 700+ responses, want Wake County to beat that
13. Sign-in sheet filled out before leaving and hard copies of survey available.

Wake County Multi-Jurisdictional Hazard Mitigation Plan
Public Meeting

February 28, 2024
5:30 PM - 7:00 PM

Name	Address	Phone Number	E-mail Address
CHRIS CREW	306 ELM ST	919 828 1127	CHEFDADDYO@YAHOO.COM
Antione Jordan	301 Brooks St	9194359581	AJordan@WakeForestNC.Gov
BENJAMIN JOHNSON	705 HILLANDALE LN	602 559 8751	benjammyjohnsongroup@gmail.com

WAKE COUNTY
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Hazard Mitigation Plan Public Meeting

About This Event

Wake County's Multi-Jurisdictional Hazard Mitigation Plan identifies, assesses and mitigates hazard risk to better protect the people and property from the effects of natural and human-caused hazards. We're in the process of updating and strengthening the plan to make our community safer and better prepared for emergencies.

In order for the plan to be successful, we need to hear from our community. Your thoughts, experiences and ideas are critical as we work to tackle Wake County's unique challenges. Join us to learn more about the project's goals and timelines, and share your thoughts on potential risks and hazards.

Space is limited. Register here to attend in-person.

Register here to receive a Zoom link to join us virtually.

February 28, 2024

5:30 pm to 7:00 pm

Lions Park Community Center Meeting Room
516 Dennis Ave.
Raleigh, NC 27604
United States

$ FREE

WAKE COUNTY
NORTH CAROLINA
Public Meeting
Help Make our Community Safer and Better Prepared for Emergencies
February 28
5:30 - 7:00 pm
Lions Park Community Center Meeting Room
VIRTUAL OPTION AVAILABLE DURING REGISTRATION
REGISTER FOR FREE:
WAKE.GOV/HMPUPDATE
SPACE IS LIMITED
townofwendell • Follow
townofwendell Join Wake County for the first public meeting on the Wake County Multi-Jurisdictional Hazard Mitigation Plan Update!
Your participation is vital to help identify risks, discuss past efforts, and shape the 2024 Plan to improve our community's resilience. Don't miss this chance to contribute your insights and feedback!
• Details: Wednesday, February 28, 2024 from 5:30 - 7:00 pm at the Lions Park CC Meeting Room, 516 Dennis Ave., Raleigh, NC, 27604
• Purpose: Engage with the community, provide project background, and gather input on hazards and risks.
5 likes
February 23
Log in to like or comment.

Raleigh NC CERT
February 21 ·
Interested in Hazard Mitigation?
Wake County is having a public meeting next Wednesday, the 28th, at 5:30 :
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Hazard Mitigation Plan Public Meeting
Wake County's Multi-Jurisdictional Hazard Mitigation Plan identifie...
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PUBLIC MEETING 2: AUGUST 21, 2024

Wake County Public Meeting #2
8/21/2024, 6 PM – 7:30 PM
Virtual Zoom meeting (Wake County)
[Online Participants] – See Zoom meeting registration spreadsheet

---

Nathan Slaughter, ESP Associates led the meeting and presented the following slides. Sasha Godwin from Wake County Emergency Management also provided information on behalf of the County at different times during the presentation.

1. [**Nathan Slaughter, presenting**] Agenda
    a. Welcome & introductions
    b. Meeting objectives
    c. Mitigation Overview
    d. Purpose of update
    e. Plan update process
    f. Plan structure
    g. Next steps
    h. Q&A session
2. Introductions
3. Meeting Objectives
    a. Engage the community
    b. Gather input
    c. Educate and inform
    d. Enhance plan relevance
4. What is Mitigation?
    a. Definitions of mitigate and hazard mitigation
5. Basic Types of Mitigation
    a. Mitigating against impacts on existing development
        i. Houses, businesses, critical facilities
    b. Ensuring future development does not increase vulnerability
        i. Plans, policies, procedures
6. Mitigation Techniques
    a. Prevention
    b. Property protection
    c. Natural resource management
    d. Structural projects
    e. Emergency services
    f. Education and awareness
7. Purpose of Update
    a. Reflect on changing risks
        i. Population increases and community growth = greater exposure to hazard risk
        ii. More hazards, especially manmade ones
        iii. Climate change = anticipated increase in frequency/magnitude and new FEMA requirement

iv. Development patterns = increased impermeable surfaces and more assets at risk

b. Increase community resilience
   i. Identification of new vulnerabilities and vulnerable populations
   ii. Adopting effective mitigation strategies

c. Compliance and funding
   i. Ensure compliance with both state and federal requirements
   ii. Maintain eligibility for disaster mitigation funding and assistance programs:
      1. HMGP
      2. FMA
      3. BRIC
      4. CRS

d. Ensure preparedness
   i. Address existing hazards, protect lives and property, sustain continuity of essential services

8. Plan Update Process – Step 1: Organize Resources
   a. Planning for public involvement
   b. Coordinating with departments/agencies
   c. Finalizing a list of stakeholders for involvement (HMPC)
9. Plan Update Process – Step 2: Risk Assessment
   a. Hazard identification
   b. Vulnerability assessment
   c. Capability assessment
   d. Hazards profiled: 12 natural and 4 technological/human-caused hazards
   e. PRI results:
      i. 2 high risk hazards (extreme heat and severe winter storm)
      ii. 12 moderate risk hazards
      iii. 2 low risk hazards
10. Plan Update Process – Step 3: Develop a Mitigation Plan
   a. Setting planning goals
   b. Reviewing mitigation alternatives
   c. Drafting an action plan
   d. Goals and objectives
      i. Goal 1: Protect public health, life, safety, and welfare by increasing public awareness and education of hazards and by encouraging collective and individual responsibility for mitigating hazard risks
      ii. Goal 2: Improve technical capability (including administrative resources, tools, data, and equipment) to implement hazard mitigation and respond to hazard events
      iii. Goal 3: Minimize threats to life and property by protecting the most vulnerable populations, buildings, and critical facilities through the implementation of cost-effective and technically feasible mitigation options
      iv. Goal 4: Incorporate resiliency into future growth by ensuring that hazard mitigation is considered for both new development and post-disaster redevelopment and recovery

11. Plan Update Process – Step 4: Adoption and Implementation
    a. Seeking review and approval from authorities
    b. Securing funding and managing resources of mitigation actions
    c. Executing identified mitigation actions
    d. Continuously monitoring the progress of mitigation actions
12. Project Schedule
    a. Kickoff date: 1/4/24
    b. Public meeting #1: 2/28/24
    c. Proposed delivery of draft: 6/2/24
    d. Public meeting #2: 8/20/24
    e. Existing plan expiration: 12/2/24
13. Plan Website
    a. Wake County website (Emergency Management plans page) is location for the Draft Plan, public can provide comments on the draft
14. Plan Structure – Overview
    a. Introduction
    b. Planning Process
    c. Planning Area Profile
    d. Risk Assessment
    e. Capability Assessment
    f. Mitigation Strategy
    g. Mitigation Action Plans
    h. Plan Maintenance
    i. Plan Adoption
15. Plan Structure – Sections
    a. Introduction
        i. Background
        ii. Purpose and Authority
        iii. Scope
        iv. References
        v. Plan Organization
    b. Planning Process
        i. Purpose and Vision
        ii. What's Changed in the Plan
        iii. Preparing the Plan
        iv. Hazard Mitigation Planning Committee
        v. Meetings and Workshops
        vi. Involving the Public
        vii. Outreach Efforts
        viii. Involving the Stakeholders
        ix. Documentation of Plan Progress
    c. Planning Area Profile
        i. Geography and Environment
        ii. Population and Demographics

iii. Parcels and Buildings
iv. Historic Properties
v. Housing
vi. Infrastructure
vii. Current and Future Land Use
viii. Employment and Industry
ix. Social Vulnerability
x. Jurisdiction Information

d. Risk Assessment
i. Overview
ii. Hazard Identification
iii. Assessment Methodology and Assumptions
iv. Asset Inventory
v. Hazard Profiles, Analysis, and Vulnerability
vi. Conclusions on Hazard Risk

e. Capability Assessment
i. Overview
ii. Methodology
iii. Capability Assessment Findings
iv. Conclusions on Local Capability

f. Mitigation Strategy
i. Goals and Objectives
ii. Identification & Analysis of Mitigation Activities

g. Mitigation Action Plans
i. Participating Jurisdiction Plans

h. Plan Maintenance
i. Implementation
ii. Monitoring, Evaluation, and Enhancement
iii. Continued Public Involvement

i. Plan Adoption

16. Plan Structure – Supporting Information
a. Community Annexes
i. Risk Assessment Maps and Tables
ii. Mitigation Action Plans

b. Appendices
i. Plan Review Tool
ii. Planning Process Documentation
iii. Mitigation Alternatives
iv. References

17. Next Steps
a. Record, analyze, and include input received during meetings and public comment opportunities
b. Await comments from County and municipalities
c. Await plan review/compliance comments from NCEM and FEMA

d. The County and each municipality will adopt the plan by resolution

18. Questions/Comments/Concerns
    a. [QUESTION]: Will this presentation be posted somewhere along with the draft plan for another chance to review?
        i. NS: Yes, the slides from this meeting will be posted online. Link with draft plan/presentation slides here: https://www.wake.gov/departments-government/fire-services-emergency-management/emergency-management/county-emergency-plans - we will receive comments on the draft plan until Sept 21, 2024 (one month)
    b. (QUESTION): Are nuclear threats such as the Shearon Harris Plant addressed in the plan?
        i. Sasha Godwin, Wake County: Yes and the County is constantly planning, prepping and monitoring the plant and conducts frequent exercises to prep for any type of event that could occur.

19. Meeting adjourned – Thank you!

Online Attendance

First Name	Last Name
Larry	Shelton
Chris	Crew
David	Markwood
Amit	Sachan
Dallas	Hoffman
Rachel	Thomas
Brittany	Cates
Stephanie	MacDurmon
Nancy	Daly
Matthew	Oztalay
Jane	Huband
Athena	Wollin
Ayesha	Holloman
Kate	Heath
Amy	Pierce
karen	delventhal
Melinda	Brown
Ron	Fontenot
Keith	Elder
R. Jay	Jayakrishnan
dianne	thomas
Elizabeth	Robinson
Michael	Bulat
Timothy	Whiteside
Nathan	Slaughter
Candler	Thornton
Sasha	Godwin
Eric	Kulz
Jessica	Leins
Ranger	Ruffins
Allison Bryan	
Seamus	Riley
Benjamin	Brown
Antione	Jordan
John	Flores
satwana	hurdle
Grif	Bond

Wake County Government
August 19 at 8:59 AM
Have you registered yet? 👀
#WakeCounty needs YOUR input on how we can better prepare our communities for emergencies like storms and floods
Fore more info https://ow.ly/CljJ50SZx82
Help Make Our Community Safer and Better Prepared for Emergencies
Wake County Regional Hazard Mitigation Plan: 2024 Update
PUBLIC MEETING
Let's Talk About Hazard Mitigation
Aug. 21 | 6 p.m.
Join us virtually!
Register today:
wake.gov/hmpupdate
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NORTH CAROLINA

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Hazard Mitigation Plan Public Meeting

About This Event

Wake County's Multi-Jurisdictional Hazard Mitigation Plan identifies, assesses and mitigates hazard risk to better protect the people and property from the effects of natural and human-caused hazards. We're in the process of updating and strengthening the plan to make our community safer and better prepared for emergencies.

In order for the plan to be successful, we need to hear from our community. Your thoughts, experiences and ideas are critical as we work to tackle Wake County's unique challenges. Join us to learn more about the project's goals and timelines, and share your thoughts on potential risks and hazards.

Register here to receive a Zoom link.

August 21, 2024

6:00 pm to 7:30 pm

$ FREE

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This event has passed.

Wake County Hazard Mitigation Public Meeting

August 21 @ 6:00 PM - 8:00 PM

Wake County Hazard Mitigation Public Meeting

The **Wake County Hazard Mitigation Plan** identifies, assesses, and mitigates hazard risk to better protect the people and property from the effects of natural and human-caused hazards. They are updating and strengthening the plan to make our community safer and better prepared for emergencies.

Join the **virtual public meeting** to learn more about the project's goals and timelines, and share your thoughts on potential risks and hazards.

Public Meeting Details

- **When:** Wednesday, August 21 at 6:00 pm
- **Register:** **wake.gov/hmpupdate**

Add to calendar

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Featured Events

Holly Springs Farmers Market 8:00-Noon
Details

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Event Details

Wake County Hazard Mitigation Plan Public Meeting (Community Event)

Wednesday, August 21, 2024

Date: August 21, 2024
Time: 6:00 PM - 7:30 PM
Location: Virtual

This is a Community Event organized by Wake County.

Wake County is updating its Multi-Jurisdictional Hazard Mitigation Plan and wants to hear your thoughts, experiences and ideas. The plan identifies, assesses, and mitigates hazard risk to better protect the people and property from the effects of natural and human-caused hazards.

Details and registration.

--

Select Language

Raleigh News Events Services Projects Departments

Your Input Needed: Wake County's Updating Plan to Better Prepare the Community for Emergencies

NEWS Published 8/13/2024 Updated 8/13/2024

Wake County is starting to update the Multi-Jurisdictional Hazard Mitigation Plan. Your input is crucial to strengthen the plan and make our community safer and better prepared for emergencies.

The purpose of the plan is to identify, assess, and mitigate hazard risk to better protect the people and property within Wake County from the effects of natural and human-caused hazards.

There are a few ways to participate:

- Give comments on the draft plan using this form ;
- Come to the virtual public meeting, Aug. 21 at 6 p.m. (registration required)

For more information, including a draft of the updated plan, visit Wake County's site .

Satwana Hurdle
Emergency Management
rfdemergencymanagement@raleighnc.gov
919-996-6115

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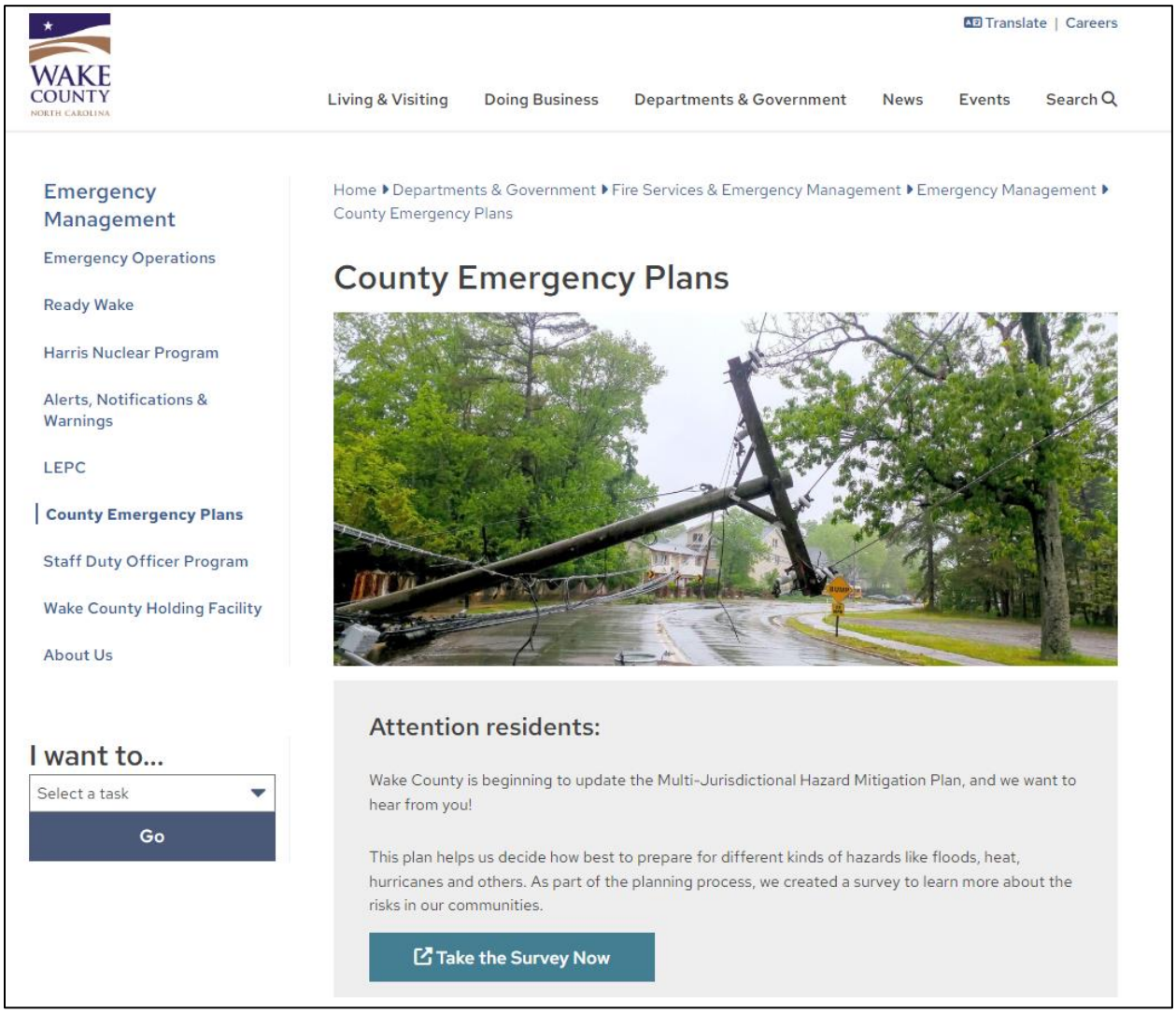

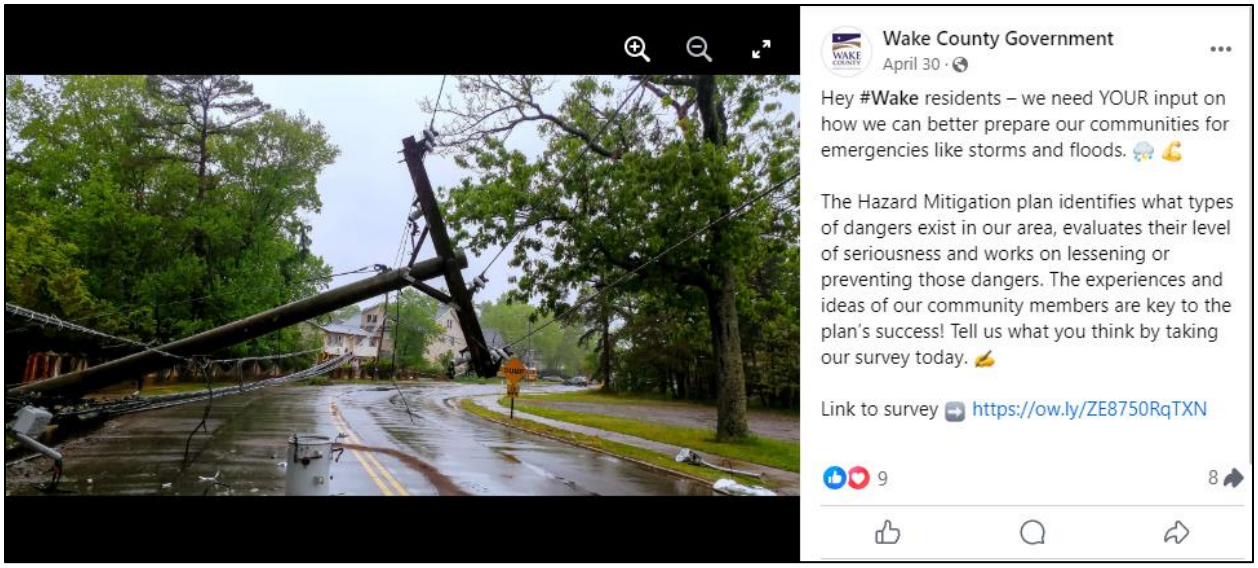
Wake County Government
April 30 ·
Hey #Wake residents – we need YOUR input on how we can better prepare our communities for emergencies like storms and floods.
The Hazard Mitigation plan identifies what types of dangers exist in our area, evaluates their level of seriousness and works on lessening or preventing those dangers. The experiences and ideas of our community members are key to the plan's success! Tell us what you think by taking our survey today.
Link to survey https://ow.ly/ZE8750RqTXN
9
8

APEX
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HOW DO I...
Interactive Development Map
Western Big Branch Area Plan
Apex Downtown Master Plan and Parking Study (PDF)
Advance Apex: The 2045 Land Use Map Update & The 2045 Transportation Plan
Hazard Mitigation Plan
2018 Trees & Stormwater Study
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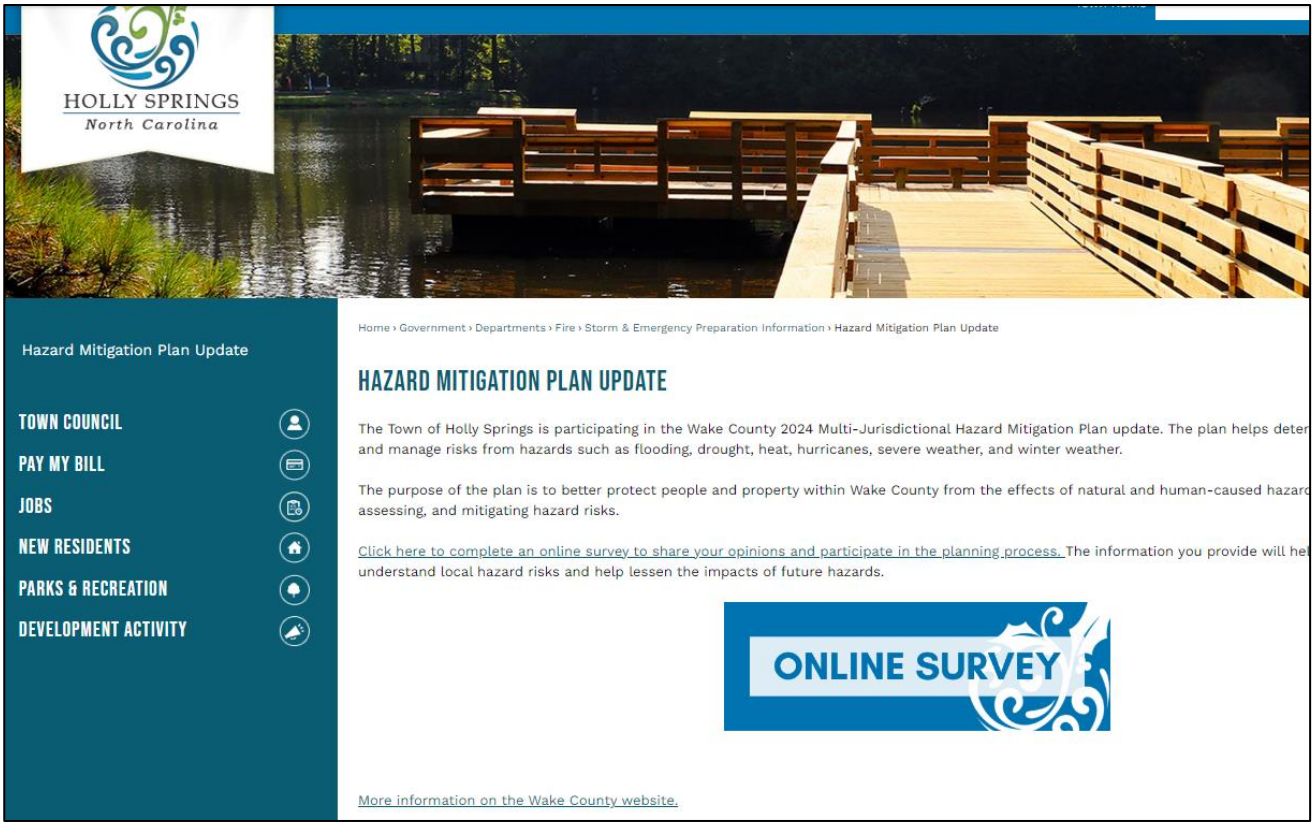
Hazard Mitigation Plan
Wake County Hazard Mitigation Plan Public Survey
Wake County is beginning to update the Multi-Jurisdictional Hazard Mitigation Plan to identify and assess our community's risks from hazards such as flooding, drought, heat, hurricane, severe weather, winter weather, and other hazards. This plan will help determine how to best minimize or manage those risks.
This survey is an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand local hazard risks and problems and can lead to mitigation activities that help lessen the impacts of future hazards. The survey will be available through May 31, 2024
Wake County Hazard Mitigation Plan Public Survey
Background:
In 2014, Wake County and the municipalities within the County joined together to develop the first Wake County Multi-Jurisdictional Hazard Mitigation Plan. Previously, each jurisdiction had developed its own, individual Hazard Mitigation Plan. Federal law requires that jurisdictions update their hazard mitigation plans every five years to remain eligible for certain federal grants.
The 2020-2025 update to the Wake County Multi-Jurisdictional Hazard Mitigation Plan was developed in a joint and cooperative manner by members of a Hazard Mitigation Planning Committee (HMPC) which included representatives of county and municipal departments, federal and state agencies, citizens, and other stakeholders. The 2020-2025 update was approved by Town Council on December 17, 2019 and will expire in January 2026.
The purpose of the plan is to better protect the people and property within Wake County from the effects of natural and human-caused hazards by identifying, assessing, and mitigating hazard risks. The 2020-2025 Wake County Multi-Jurisdictional Hazard Mitigation Plan: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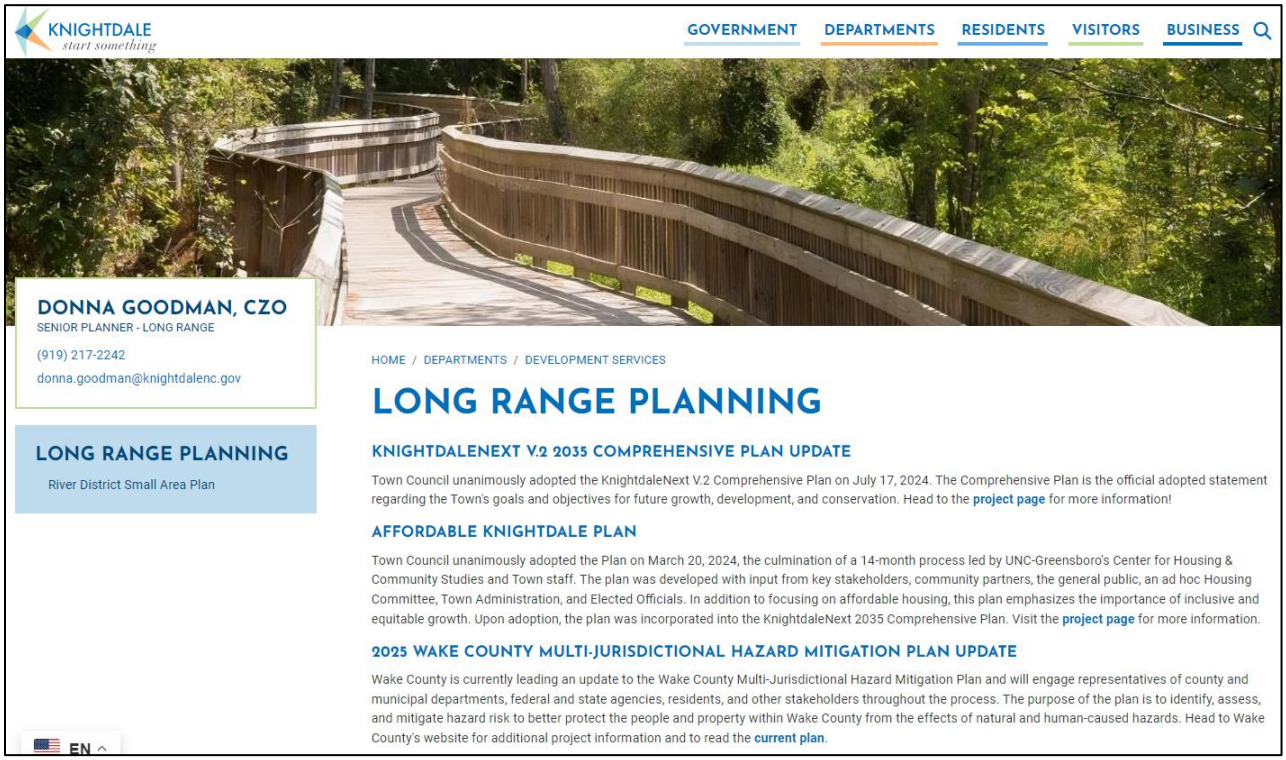
Home › Government › Departments › Fire › Storm & Emergency Preparation Information › Hazard Mitigation Plan Update
HAZARD MITIGATION PLAN UPDATE
The Town of Holly Springs is participating in the Wake County 2024 Multi-Jurisdictional Hazard Mitigation Plan update. The plan helps deter
and manage risks from hazards such as flooding, drought, heat, hurricanes, severe weather, and winter weather.
The purpose of the plan is to better protect people and property within Wake County from the effects of natural and human-caused hazard
assessing, and mitigating hazard risks.
Click here to complete an online survey to share your opinions and participate in the planning process. The information you provide will he
understand local hazard risks and help lessen the impacts of future hazards.
ONLINE SURVEY
More information on the Wake County website.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DONNA GOODMAN, CZO
SENIOR PLANNER - LONG RANGE
(919) 217-2242
donna.goodman@knightdalenc.gov
LONG RANGE PLANNING
River District Small Area Plan
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KNIGHTDALENEXT V.2 2035 COMPREHENSIVE PLAN UPDATE
Town Council unanimously adopted the KnightdaleNext V.2 Comprehensive Plan on July 17, 2024. The Comprehensive Plan is the official adopted statement regarding the Town's goals and objectives for future growth, development, and conservation. Head to the project page for more information!
AFFORDABLE KNIGHTDALE PLAN
Town Council unanimously adopted the Plan on March 20, 2024, the culmination of a 14-month process led by UNC-Greensboro's Center for Housing & Community Studies and Town staff. The plan was developed with input from key stakeholders, community partners, the general public, an ad hoc Housing Committee, Town Administration, and Elected Officials. In addition to focusing on affordable housing, this plan emphasizes the importance of inclusive and equitable growth. Upon adoption, the plan was incorporated into the KnightdaleNext 2035 Comprehensive Plan. Visit the project page for more information.
2025 WAKE COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
Wake County is currently leading an update to the Wake County Multi-Jurisdictional Hazard Mitigation Plan and will engage representatives of county and municipal departments, federal and state agencies, residents, and other stakeholders throughout the process. The purpose of the plan is to identify, assess, and mitigate hazard risk to better protect the people and property within Wake County from the effects of natural and human-caused hazards. Head to Wake County's website for additional project information and to read the current plan.

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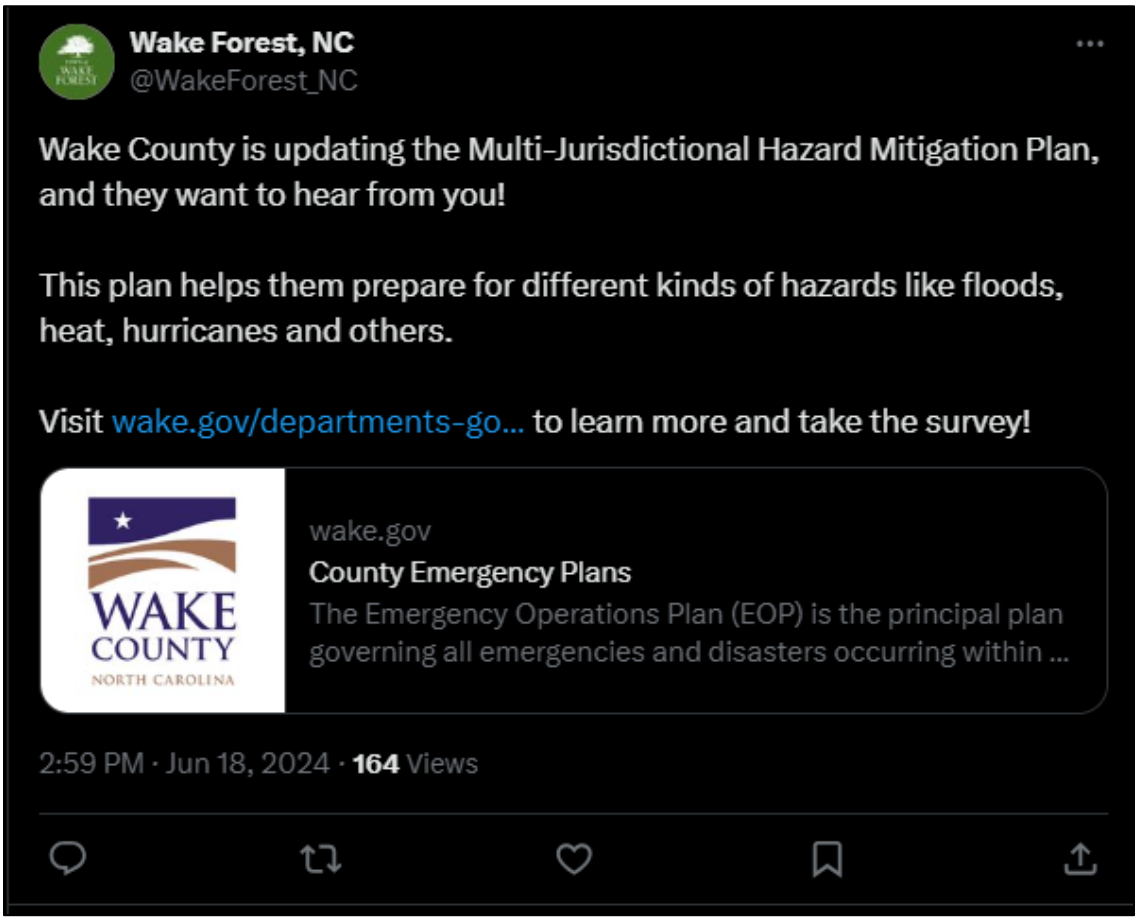
Wake County Hazard Mitigation Plan Public Survey Now Open
Post Date: 04/29/2024 10:00 am
Wake County is beginning to update the Multi-Jurisdictional Hazard Mitigation Plan to identify and assess our community's risks from hazards such as flooding, drought, heat, hurricane, severe weather, winter weather, and other hazards. This plan will help determine how to best minimize or manage those risks.
This survey is an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand local hazard risks and problems and can lead to mitigation activities that help lessen the impacts of future hazards.
You may view the survey here.
Return to full list >>


Wake Forest, NC
@WakeForest_NC
Wake County is updating the Multi-Jurisdictional Hazard Mitigation Plan, and they want to hear from you!
This plan helps them prepare for different kinds of hazards like floods, heat, hurricanes and others.
Visit wake.gov/departments-go... to learn more and take the survey!
WAKE COUNTY
NORTH CAROLINA
wake.gov
County Emergency Plans
The Emergency Operations Plan (EOP) is the principal plan governing all emergencies and disasters occurring within ...
2:59 PM · Jun 18, 2024 · 164 Views

Emergency Management

- Emergency Operations
- Ready Wake
- Harris Nuclear Program
- Alerts, Notifications & Warnings
- LEPC
- **County Emergency Plans**
- Staff Duty Officer Program
- Wake County Holding Facility
- About Us

I want to...

Select a task

Go

Home ▸ Departments & Government ▸ Fire Services & Emergency Management ▸ Emergency Management ▸ County Emergency Plans

County Emergency Plans

Attention residents:

Wake County is updating the Multi-Jurisdictional Hazard Mitigation Plan, and we want to hear from you!

While all public meetings for the update have now concluded, you can view the presentation online.

A draft of the updated plan is also available.

After reviewing the draft, you can use the button below to send us your comments.

Provide Feedback

PUBLIC SURVEY

Wake County distributed a public survey, shown below, that requested public input into the Hazard Mitigation Plan planning process and the identification of mitigation activities that could lessen the risk and impact of future flood hazard events. The survey was announced at the first public meeting, provided via a link on participating jurisdictions web and social media accounts, and made available online on the plan webpage.

Wake County Hazard Mitigation Plan Public Survey

Wake County is beginning to update the Multi-Jurisdictional Hazard Mitigation Plan to identify and assess our community's risks from hazards such as flooding, drought, heat, hurricane, severe weather, winter weather, and other hazards. This plan will help determine how to best minimize or manage those risks. This survey is an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand local hazard risks and problems and can lead to mitigation activities that help lessen the impacts of future hazards. **Please help us by completing this survey by April 12, 2024 and returning it to:**

WSP – Attn: David Stroud, 4021 Stirrup Creek Drive, Suite 100, Durham, NC 27703
Or by email to: david.stroud@wsp.com

1. Where do you live?

- ☐ Unincorporated Wake County
- ☐ Apex
- ☐ Cary
- ☐ Fuquay-Varina
- ☐ Garner
- ☐ Holly Springs
- ☐ Knightdale
- ☐ Morrisville
- ☐ Raleigh
- ☐ Rolesville
- ☐ Wake Forest
- ☐ Wendel
- ☐ Zebulon
- ☐ I live outside of Wake County but work or recreate in Wake County.
- ☐ Other: _____

2. Have you ever experienced or been impacted by a hazard or disaster in Wake County?

- ☐ Yes
- ☐ No

If yes, please explain your experience & where it occurred.

3. On a scale of 1-5, where 1 = not at all concerned and 5 = very concerned, how concerned are you about the possibility of your community being impacted by a hazard event?

4. Please review the list of hazards below and rate each hazard from 0-3 based on how much risk you think it poses to your community.
0 = no risk, 1 = low, 2 = moderate, 3 = high

___ Dam Failure
___ Drought
___ Earthquake
___ Extreme Heat
___ Flood
___ Hurricane
___ Landslide
___ Severe Weather
___ Winter Storm
___ Tornado
___ Wildfire
___ Hazardous Materials incident
___ Radiological Emergency
___ Terrorism

5. Is your home located in a floodplain?

- ☐ Yes
- ☐ No
- ☐ No, but I still experience flooding
- ☐ I don't know

6. Do you have flood insurance for your home and/or personal property?

- ☐ Yes
- ☐ No
- ☐ I don't know

Wake County Hazard Mitigation Plan Public Survey

7. If you do NOT have flood insurance, what is the reason?

- ☐ It's too expensive
- ☐ I never really considered it
- ☐ I don't need it because my home is elevated or otherwise protected
- ☐ Other: _____

8. Have you taken any actions to protect your home or neighborhood from hazards?

- ☐ Yes
- ☐ No

If yes, please explain what you implemented.

9. Do you know what government office to contact to learn more about your hazard risks and how to reduce vulnerability in your area?

- ☐ Yes
- ☐ No

10. What are some steps your local government could take to reduce the risk of future hazard damages in your neighborhood?

11. What is the best way for you to receive information about how to make your home or neighborhood more resistant to flood damage? Please select your top three choices.

- ☐ Newspaper
- ☐ TV Ads/Programming
- ☐ Radio Ads/Programming
- ☐ Public library
- ☐ Public workshop/meetings
- ☐ School meetings
- ☐ Mail
- ☐ Email
- ☐ Text message
- ☐ Local government website
- ☐ Local government social media

The County received 110 responses to the survey. The following bullet points summarize significant findings from the survey. All questions and responses are detailed in Figure B.1 through Figure B.14.

- 50% of respondents say they have experienced or been impacted by a hazard or disaster in Wake County.
- 9% of respondents live in a floodplain while 75% do not. 6% of respondents say they do not live in a floodplain but still experience flooding, and 9% of respondents do not know if their home is located in a floodplain.
- 74% of respondents do not have flood insurance for their home and/or personal property.
- 45% of respondents have taken actions to protect their home or neighborhood from hazards.
- Severe weather (thunderstorm, lightning, hail) was rated the most significant hazard, followed by hurricane, extreme heat, and tornados. Landslide was rated the least significant hazard, followed by dam failure and earthquake.
- Many respondents who reported having taken steps to mitigate risk at home reported preparedness actions such as removal of high-risk trees and acquiring emergency supplies such as a backup generator and non-perishable food. Others mentioned installing a French drain and waterproofing of basements.
- Respondents favored prevention projects and emergency services projects for mitigation.

Figure B.1 – Survey Response, Location of Survey Respondents

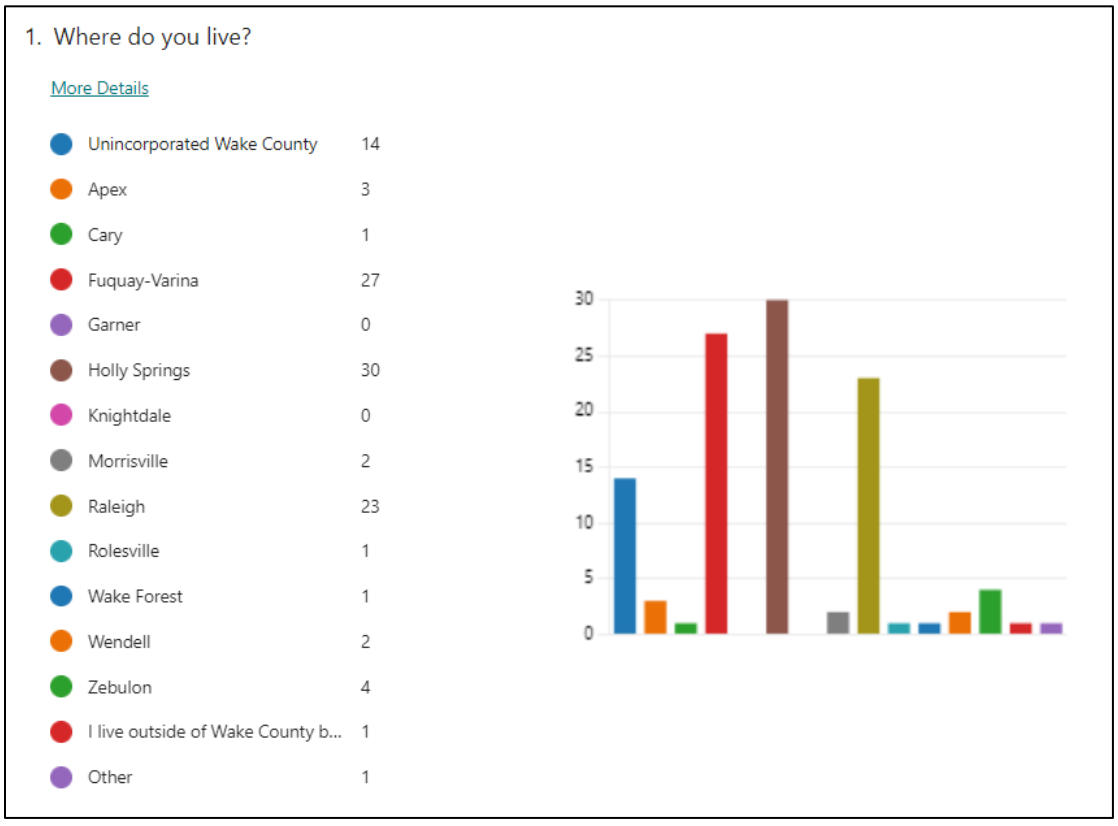


Figure B.2 – Survey Response, Impact from Hazards

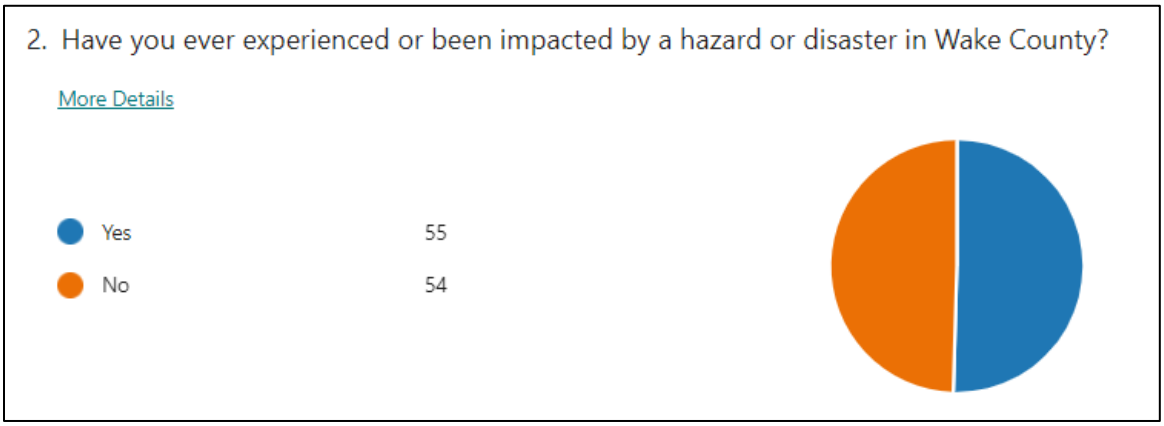


Figure B.3 – Survey Response, Experience from Hazards

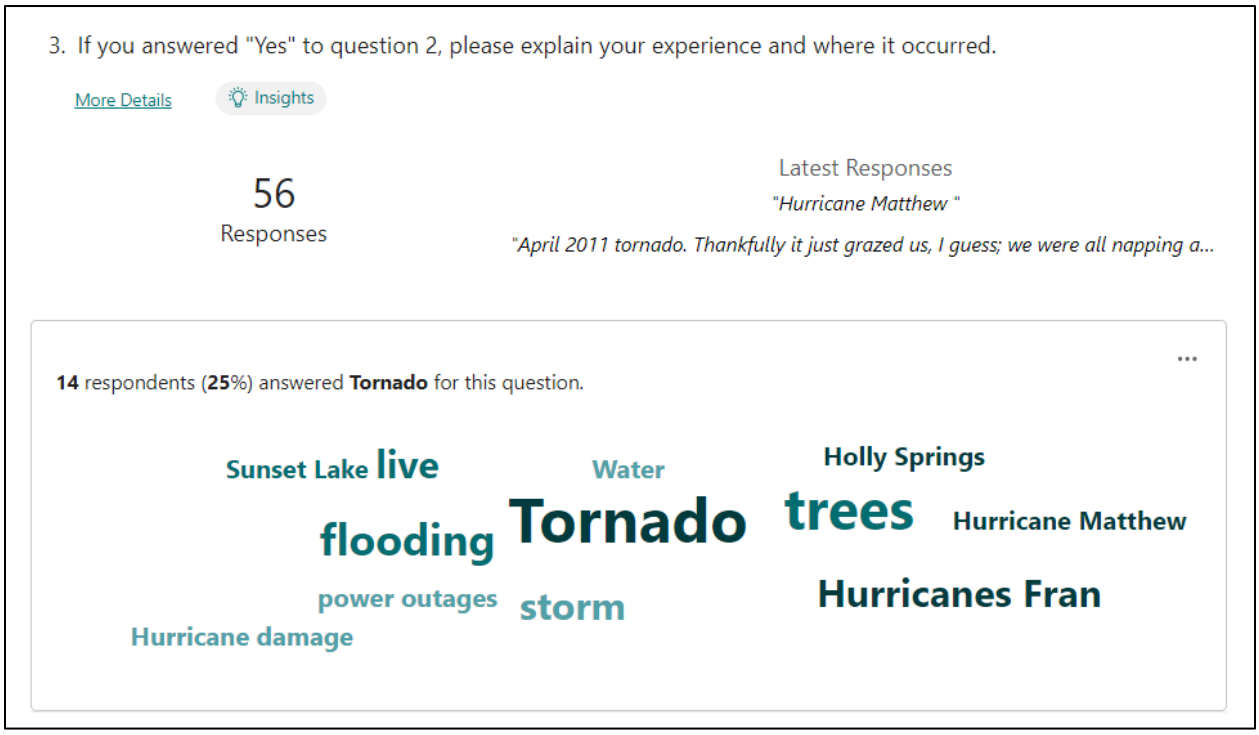


Figure B.4 – Survey Response, Concern of Hazard Impact on Community

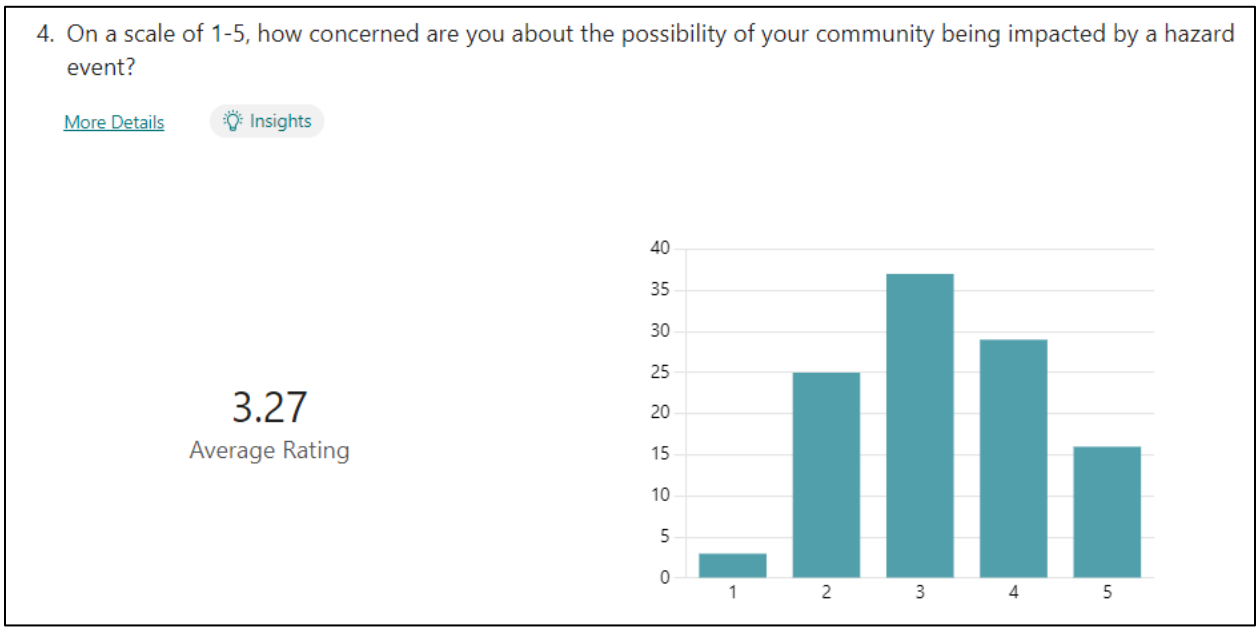


Figure B.5 – Survey Response, Hazard Significance Ratings

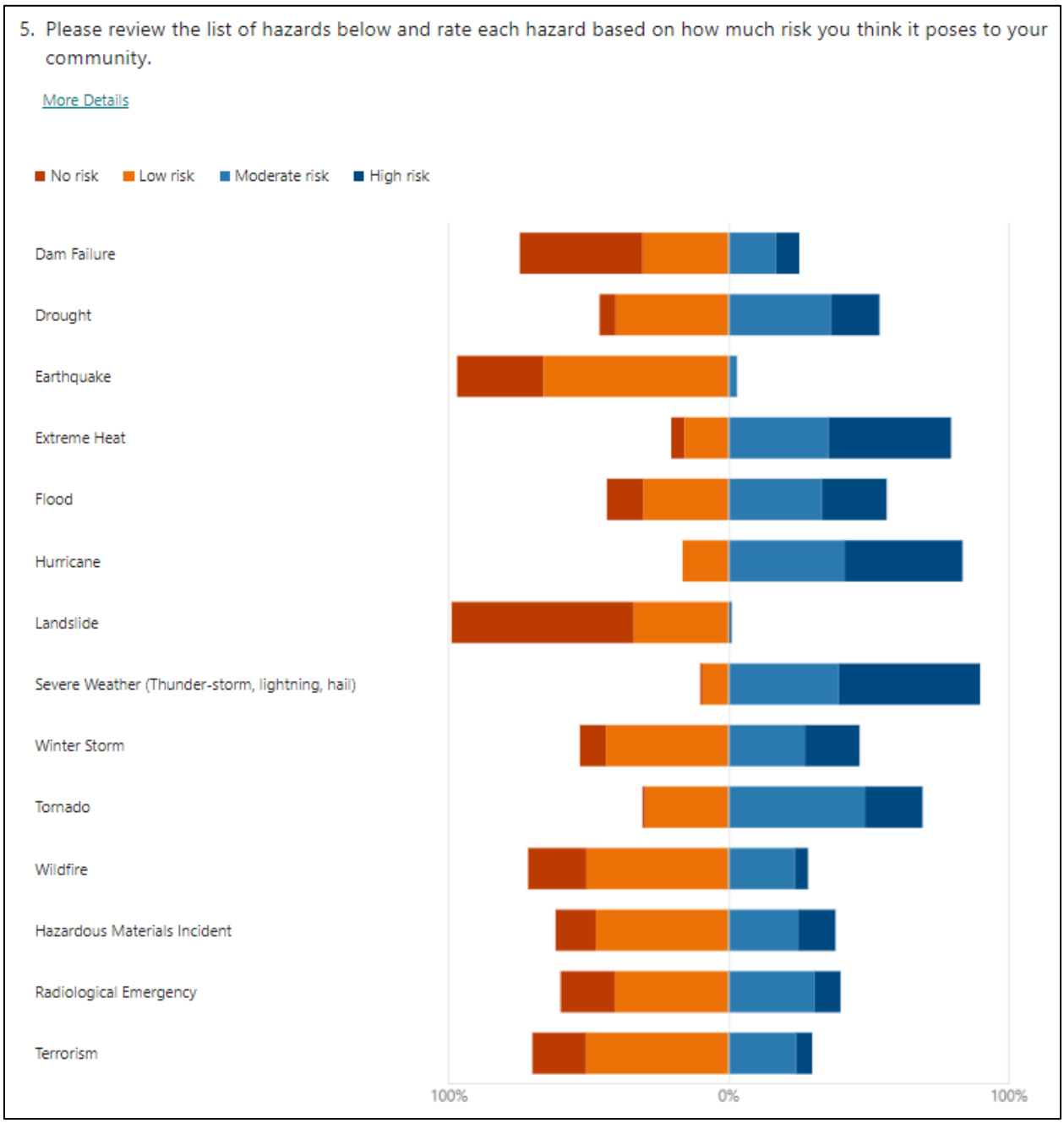


Figure B.6 – Survey Response, Respondents Located in a Floodplain

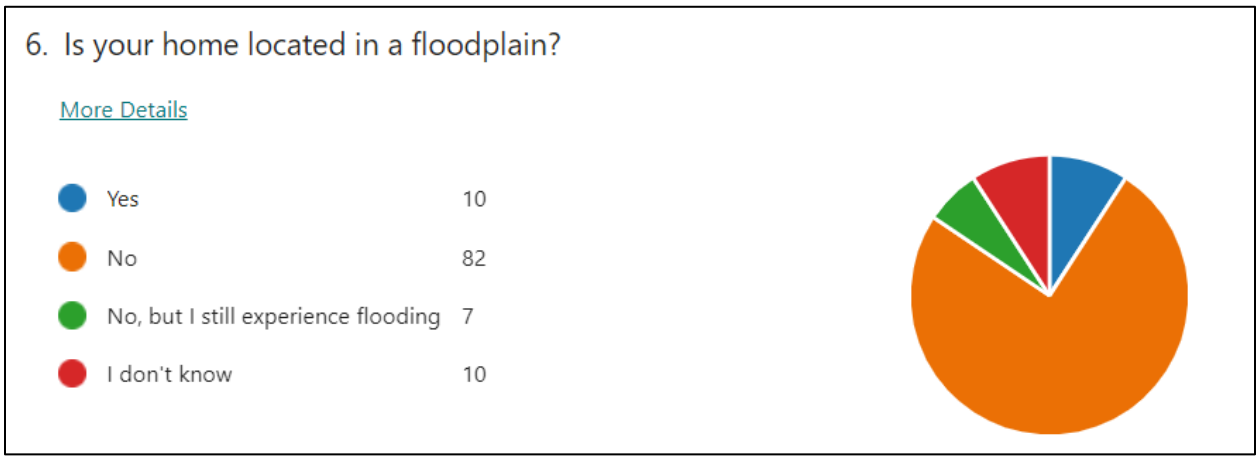


Figure B.7 – Survey Response, Flood Insurance

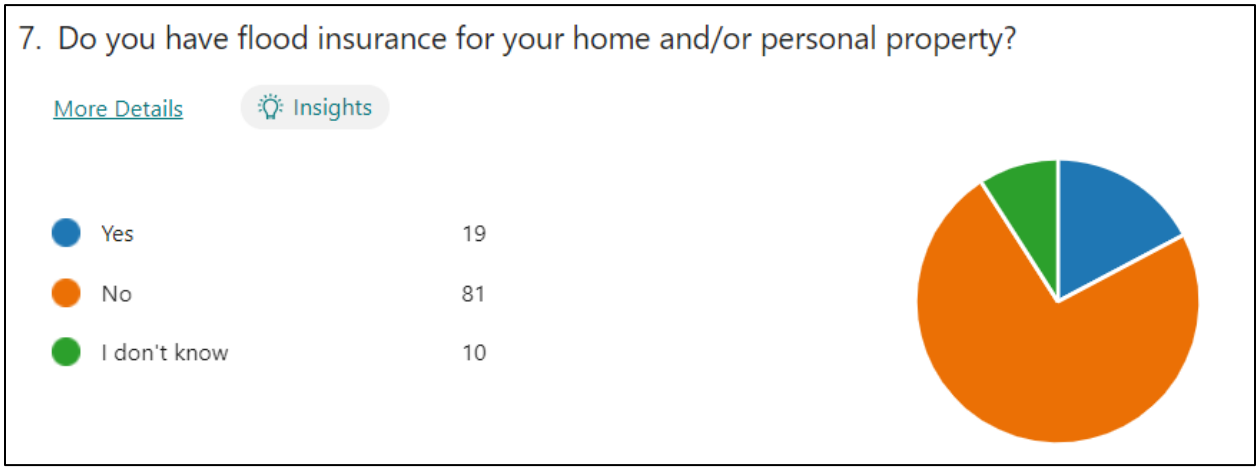


Figure B.8 – Survey Response, Reason for Not Obtaining Flood Insurance

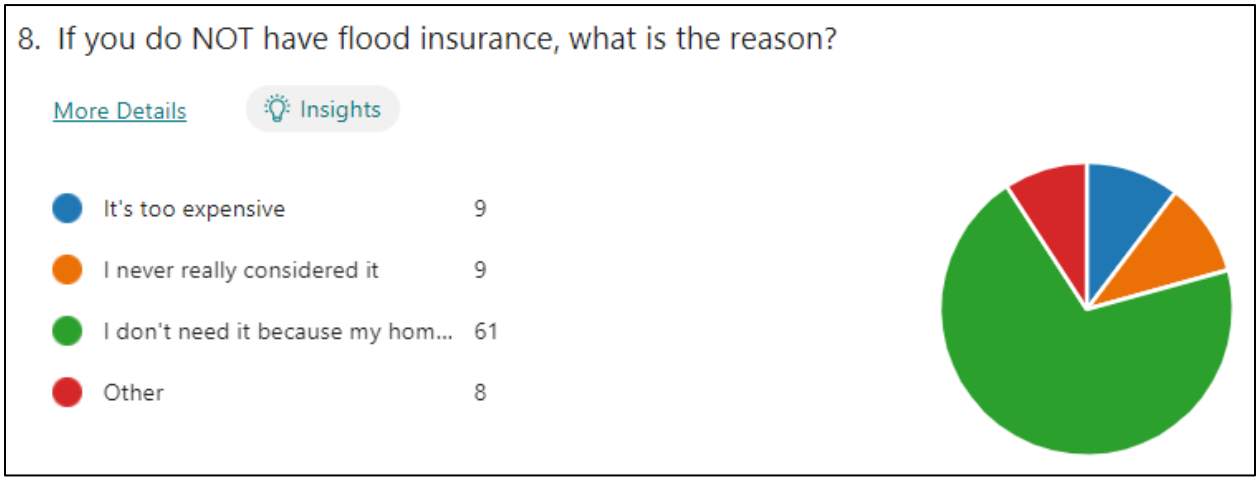


Figure B.9 – Survey Response, Protective Actions

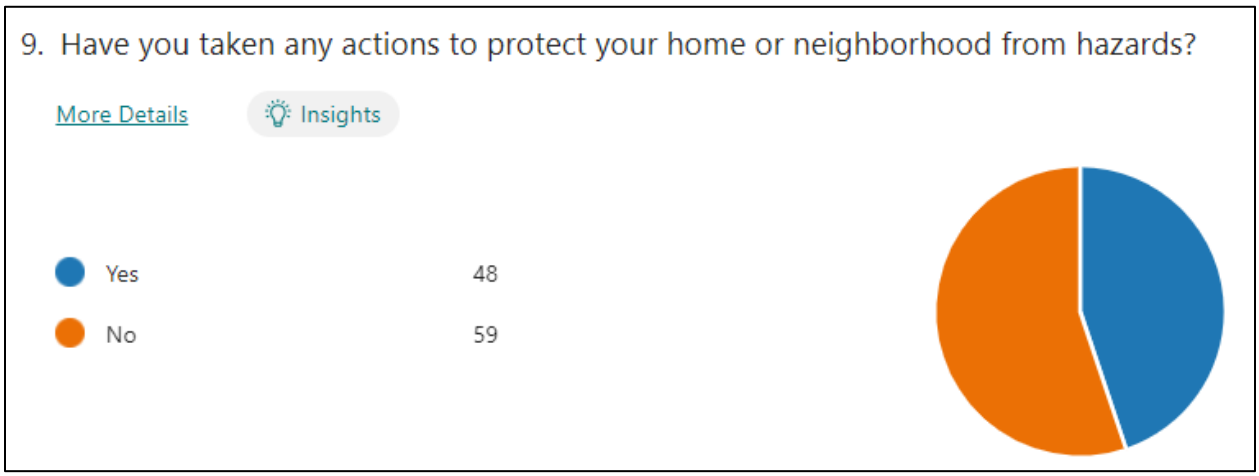


Figure B.10 – Survey Response, Implemented Actions

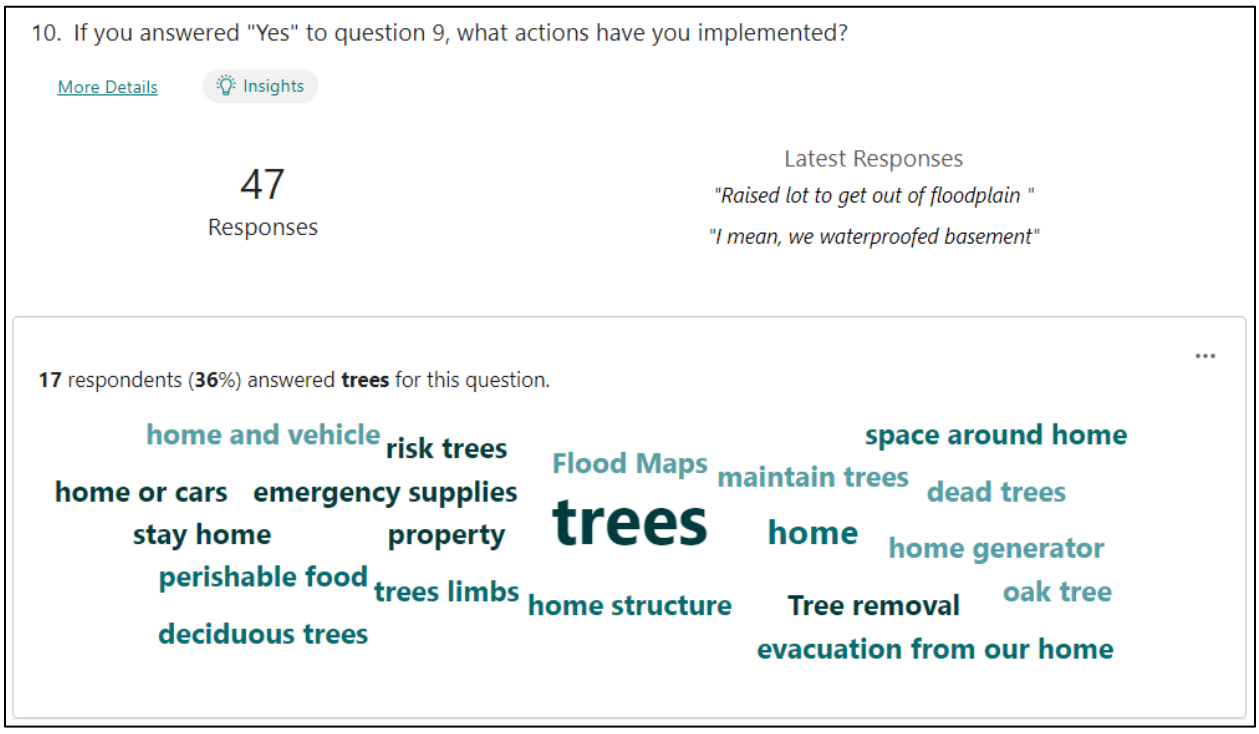


Figure B.11 – Survey Response, Knowledge of Government Contacts

11. Do you know what government office to contact to learn more about your hazard risks and how to reduce vulnerability in your area?

More Details

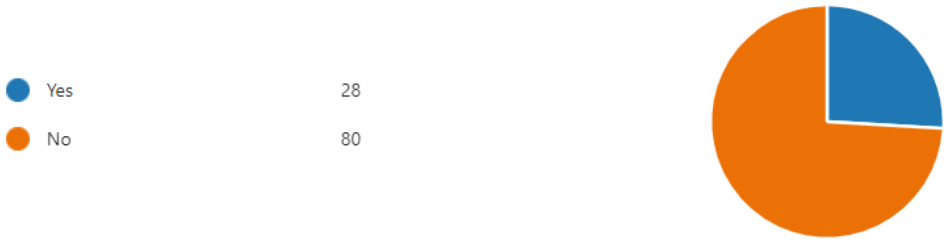


Figure B.12 – Survey Response, Steps for Local Government

12. What are some steps your local government could take to reduce the risk of future hazard damages in your neighborhood?

More Details Insights

71
Responses

Latest Responses

"*Take responsibility over for the Sunset Lake dam and lake. The homeowners as...*

"*DEMAND REDUCED IMPERVIOUS SURFACES! DEMAND DEVELOPERS SLOW D...*

9 respondents (**13**%) answered **needed** for this question.

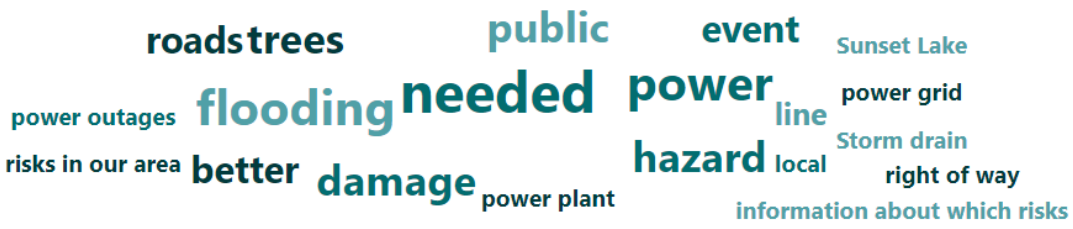


Figure B.13 – Survey Response, Preferred Mitigation Categories

13. Many community-wide activities can reduce our risk from hazards. These activities generally fall into one of the following six broad categories:

- **Prevention:** administrative and regulatory actions, plans, policies, and ordinances that influence how land is developed and buildings are built. *Examples include planning and zoning, building codes, open space preservation, land use, and floodplain regulations.*
- **Property Protection**: actions that involve the modification of existing buildings to protect them from a hazard or remove them from a hazardous area. *Examples include acquisition, relocation, elevation, structural retrofits, and storm shutters.*
- **Natural Resource Protection**: actions that minimize hazard losses and preserve or restore the functions of natural systems. *Examples include floodplain protection, habitat preservation, slope stabilization, stream buffers, wetland and marsh protection, and forest management.*
- **Structural Projects**: actions that lessen the impact of a hazard by modifying the natural progression of a hazard. *Examples include dams, levees, floodwalls, berms, drainage infrastructure, detention/retention basins, channel modifications, retaining walls, and storm sewers.*
- **Emergency Services**: actions that protect people and property during and immediately after a hazard event. *Examples include warning systems, evacuation planning, emergency response training, and protection of critical emergency facilities or systems.*
- **Public Education and Awareness**: actions to inform the public about hazards and techniques they can use to protect themselves and their property. *Examples include outreach projects, school education programs, library materials, and demonstration events.*

Please rank these categories by how important you think each one is for your community to consider pursuing.

More Details

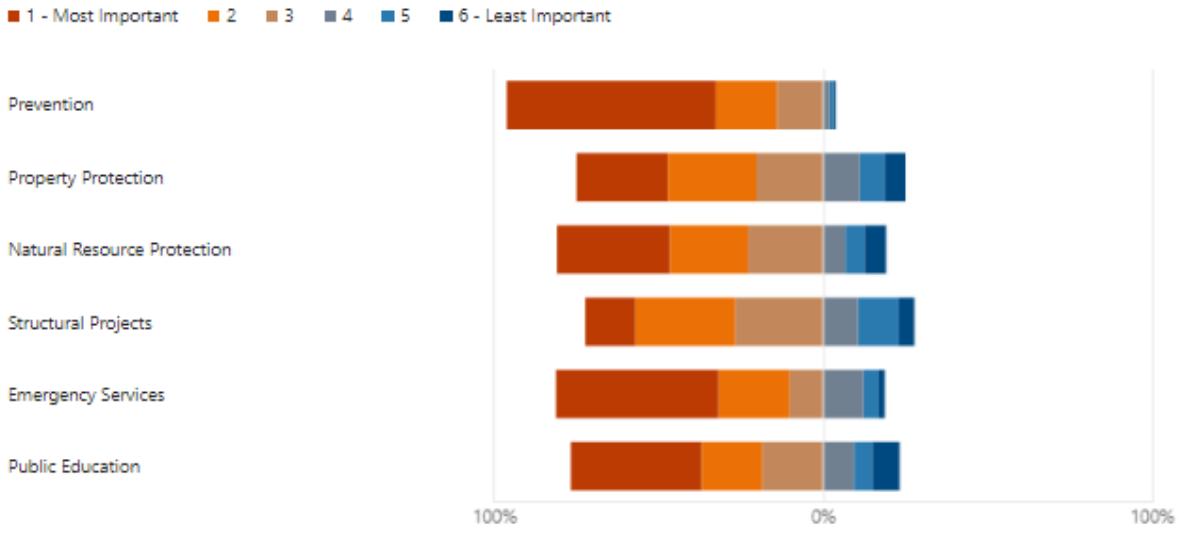
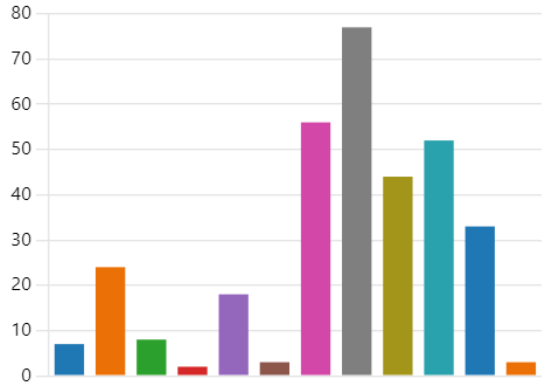


Figure B.14 – Survey Response, Preferred Public Outreach Methods

14. What is the best way for you to receive information about how to make your home or neighborhood more resistant to flood damage? Please select your top three choices.

More Details

Newspaper	7
TV Ads/Programming	24
Radio Ads/Programming	8
Public library	2
Public workshop/meetings	18
School meetings	3
Mail	56
Email	77
Text message	44
Local government website	52
Local government social media	33
Other	3

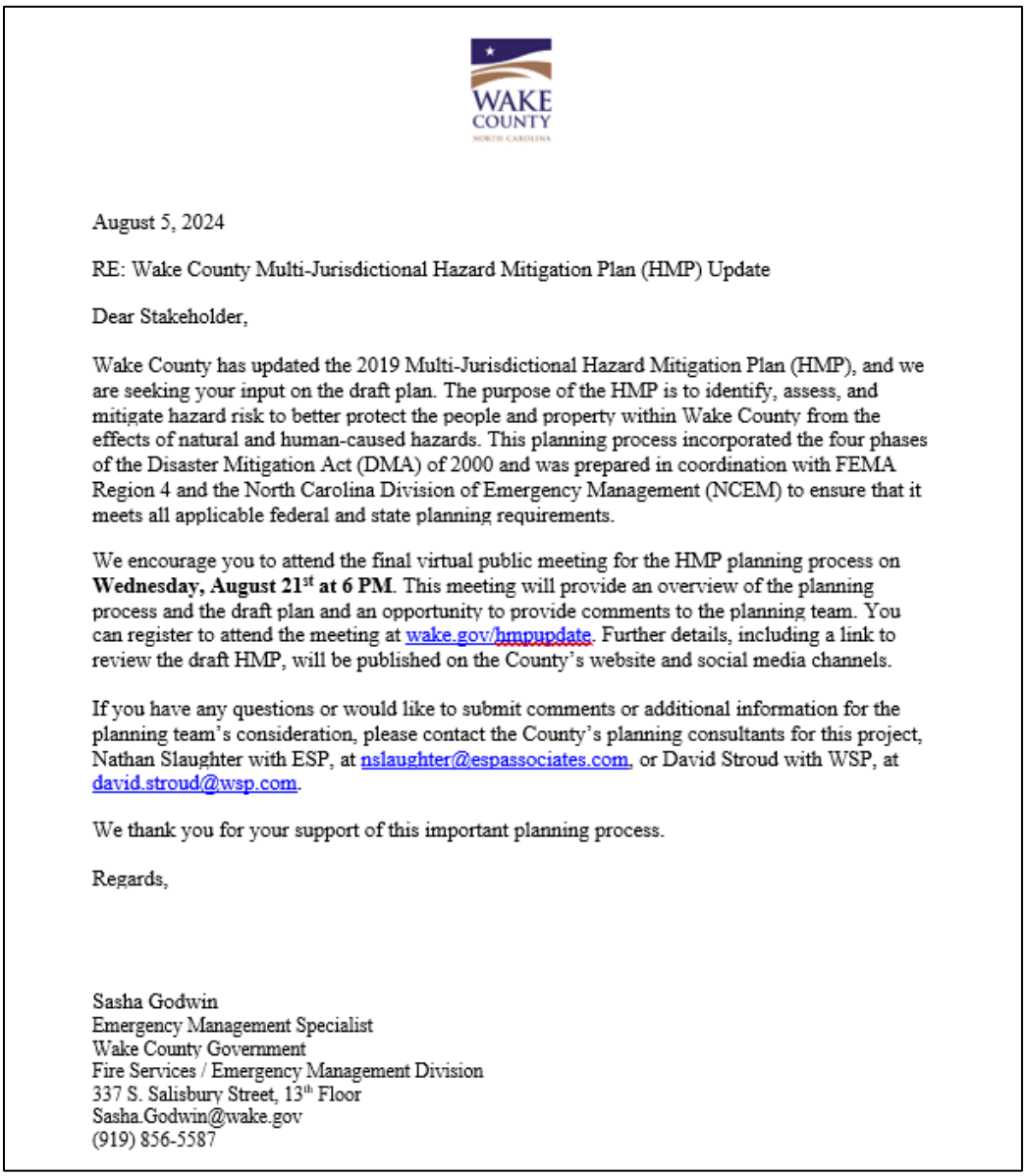


PLANNING STEP 3: COORDINATE

This planning step credits the incorporation of other plans and other agencies' efforts into the development of the Hazard Mitigation Plan. Other agencies and organizations must be contacted to determine if they have studies, plans and information pertinent to the Hazard Mitigation Plan, to determine if their programs or initiatives may affect the community's program, and to see if they could support the community's efforts. To incorporate stakeholder input into the plan, a variety of stakeholders were identified by the HMPC and sent an email inviting them to attend a public meeting, review the draft plan, and provide feedback and comments. An effort was made to identify and involve stakeholders that could represent the perspectives and needs of vulnerable populations and underserved communities.

The coordination letter that was sent via email is shown below. A list of stakeholders invited to participate in the plan is provided in Table B.3.

Stakeholders were also involved through specific requests for data to support the development of the plan.



WAKE COUNTY
NORTH CAROLINA

August 5, 2024

RE: Wake County Multi-Jurisdictional Hazard Mitigation Plan (HMP) Update

Dear Stakeholder,

Wake County has updated the 2019 Multi-Jurisdictional Hazard Mitigation Plan (HMP), and we are seeking your input on the draft plan. The purpose of the HMP is to identify, assess, and mitigate hazard risk to better protect the people and property within Wake County from the effects of natural and human-caused hazards. This planning process incorporated the four phases of the Disaster Mitigation Act (DMA) of 2000 and was prepared in coordination with FEMA Region 4 and the North Carolina Division of Emergency Management (NCEM) to ensure that it meets all applicable federal and state planning requirements.

We encourage you to attend the final virtual public meeting for the HMP planning process on **Wednesday, August 21st at 6 PM**. This meeting will provide an overview of the planning process and the draft plan and an opportunity to provide comments to the planning team. You can register to attend the meeting at wake.gov/hmpupdate. Further details, including a link to review the draft HMP, will be published on the County's website and social media channels.

If you have any questions or would like to submit comments or additional information for the planning team's consideration, please contact the County's planning consultants for this project, Nathan Slaughter with ESP, at nslaughter@espassociates.com, or David Stroud with WSP, at david.stroud@wsp.com.

We thank you for your support of this important planning process.

Regards,

Sasha Godwin
Emergency Management Specialist
Wake County Government
Fire Services / Emergency Management Division
337 S. Salisbury Street, 13th Floor
Sasha.Godwin@wake.gov
(919) 856-5587

Table B.3 – Stakeholder List

First Name	Last Name	Organization
Non-Profit Organizations		
Sandy	Sweitzer	Triangle Land Conservancy, Executive Director
Brian	Buzby	NC Conservation Network, Executive Director
Cynthia	Satterfield	Conservation Trust for North Carolina, Executive Director
Robyn Lake	Hamilton	Urban League of Central Carolinas, President & CEO
Patricia	Burch	Habitat for Humanity of Wake County, CEO
Laurie	Hughes	American Red Cross, Triangle Area Chapter, Executive Director
Educational Institutions		
Robert P.	Taylor	Wake County Public School System, Superintendent
Todd	Becker	NCSU Department of Emergency Management and Mission Continuity, Emergency Manager
Ann	Gleason	Meredith College, Dean of Students
Dr. Paulette	Dillard	Shaw University, President
Benita	Clark	Wake Tech, Vice President of HR and College Safety
Surrounding Municipalities		
Jason	Reavis	Granville County Emergency Management, Emergency Services Director
Nicholas	Thorpe	Franklin County Office of Emergency Services, Emergency Services Director
Charles	Bunn	Nash County Emergency Management, Emergency Services Assistant Director
Kevin	Hubbard	Johnston County Emergency Management, Emergency Management Director
Zach	Shean	Harnett County Emergency Management, Emergency Management Coordinator
Steve	Newton	Chatham County Emergency Management, Emergency Management Coordinator
Elizabeth	Schroeder	Durham County Emergency Management, Emergency Management Director
Federal Government		
Jason	Hunter	FEMA Region IV, Chief, Floodplain Management & Insurance Branch
Valerie	Anderson	FEMA Region IV, Natural Hazards Program Specialist
Dewana	Davis	FEMA Region IV, Insurance Specialist
Kymberly	Kudla	FEMA Mitigation Planning Specialist
David	Holcomb	ISO/CRS Specialist
Mike	Bratcher	ISO/CRS Specialist
Sherry	Harper	ISO/CRS Technical Coordinator
Katherine	Smith	USGS Climate Adaptation Science Center
State Government		
Steve	Garrett	State NFIP Coordinator
Steve	McGugan	State Hazard Mitigation Officer
Chris	Crew	State Hazard Mitigation Plans Manager
Andrea	Webster	Resilience Policy Advisor
Holly	White	Resilience Planner

First Name	Last Name	Organization
Helene	Weatherington	Resilient Communities Specialist
Hannah	Thompson-Welch	NC Forest Service, Wildfire Mitigation Specialist
Regional Planning Organization		
Lee	Worsley	Central Pines Regional Council, Executive Director
Emily	Barrett	Central Pines Regional Council, Environment & Resilience Director
Business Community		
Anna	Johnson	The News & Observer
Kevin	Dick	Carolina Small Business Development Fund, President/CEO
Other Vulnerable Population and Underserved Community Representatives		
Nannette	Bowler	Wake County Health and Human Services, Director
Verna	Best	Wake Social & Economic Vitality, Program Manager

C. MITIGATION ALTERNATIVES

44 CFR Subsection D §201.6(c)(3)(ii): [The mitigation strategy section shall include] a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new buildings and infrastructure. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.

As part of the process of developing the mitigation action plans found in Section 7, the HMPC reviewed and considered a comprehensive range of mitigation options before selecting the actions identified for implementation. This section summarizes the full range of mitigation measures evaluated and considered by the HMPC, including a review of the categories of mitigation measures outlined in the 2017 CRS Coordinator's Manual, a discussion of current local implementation and CRS credits earned for those measures, and a list of the specific mitigation projects considered and recommended for implementation.

Mitigation alternatives identified for implementation by the HMPC were evaluated and prioritized using the criteria discussed in Section 6 of this plan.

C.1 CATEGORIES OF MITIGATION MEASURES CONSIDERED

Once it was determined which flood hazards warranted the development of specific mitigation actions, the HMPC analyzed viable mitigation options that supported the identified goals and objectives. The HMPC was provided with the following list of mitigation categories which are utilized as part of the CRS planning process.

- Prevention
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Public Information and Outreach

C.2 ALTERNATIVE MITIGATION MEASURES PER CATEGORY

Note: the CRS Credit Sections are based on the 2017 CRS Coordinator's Manual.

C.2.1 PREVENTATIVE AND REGULATORY MEASURES

Preventative measures are designed to keep a problem - such as flooding - from occurring or from getting worse. The objective of preventative measures is to ensure that future development is not exposed to damage and does not cause an increase in damages to other properties. Building, zoning, planning and code enforcement offices usually administer preventative measures. Some examples of types of preventative measures include:

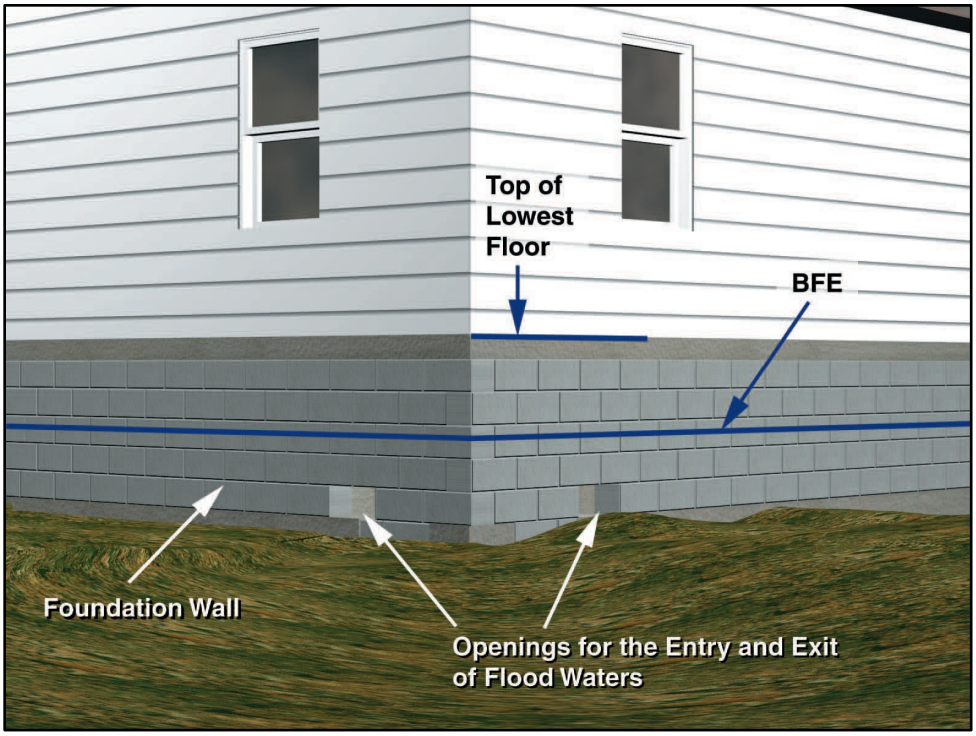
- Building codes
- Zoning ordinance
- Comprehensive or land use plan
- Open space preservation
- Floodplain regulations
- Subdivision regulations
- Stormwater management regulations

BUILDING CODES

Building codes provide one of the best methods for addressing natural hazards. When properly designed and constructed according to code, the average building can withstand many of the impacts of natural hazards. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. Building codes can ensure that the first floors of new buildings are constructed to be higher than the elevation of the 100-year flood (the flood that is expected to have a one percent chance of occurring in any given year). This is shown in Figure C.1.

Just as important as having code standards is the enforcement of the code. Adequate inspections are needed during the course of construction to ensure that the builder understands the requirements and is following them. Making sure a structure is properly elevated and anchored requires site inspections at each step.

Figure C.1 – Building Codes and Flood Protection Elevations



Source: FEMA Publication: *Above the Flood: Elevating Your Floodprone House, 2000*

ASCE 24 is a referenced standard in the International Building Code (IBC). Any building or structure that falls within the scope of the IBC that is proposed in a flood hazard area is to be designed in accordance with ASCE 24. Freeboard is required as a function of the nature of occupancy and the flood zone. Dwellings and most other buildings have 1-foot of freeboard; certain essential facilities have 2-3 feet;

only agricultural facilities, temporary facilities and minor storage facilities are allowed to have their lowest floors at the BFE.

North Carolina has state mandated building codes overseen by the North Carolina Building Code Council. The current codes are the 2018 codes, which are based on the 2015 IBC.

COMPREHENSIVE OR LAND USE PLAN

Building codes provide guidance on how to build in hazardous areas. Planning and zoning activities direct development away from these areas, particularly floodplains and wetlands. They do this by designating land uses that are compatible with the natural conditions of land that is prone to flooding, such as open space or recreation. Planning and zoning activities can also provide benefits by simply allowing developers more flexibility in arranging improvements on a parcel of land through the planned development approach.

All communities in Wake County have comprehensive land use plans in place to manage growth and development.

OPEN SPACE PRESERVATION

Keeping the floodplain and other hazardous areas open and free from development is the best approach to preventing damage to new developments. Open space can be maintained in agricultural use or can serve as parks, greenway corridors and golf courses.

Comprehensive and capital improvement plans should identify areas to be preserved by acquisition and other means, such as purchasing an easement. With an easement, the owner is free to develop and use private property, but property taxes are reduced, or a payment is made to the owner if the owner agrees to not build on the part set aside in the easement.

Although there are some federal programs that can help acquire or reserve open lands, open space lands and easements do not always have to be purchased. Developers can be encouraged to dedicate park land and required to dedicate easements for drainage and maintenance purposes.

Open space preservation is already pursued in several of the participating jurisdictions. For example, the City of Raleigh has an extensive park and greenway system and defines a broad vision for the entire park and greenway system primarily through two documents: the City of Raleigh 2030 Comprehensive Plan and the City of Raleigh Parks, Recreation and Cultural Resources System Plan. The documents provide a vision, goals, objectives and policies that guide staff. The System Plan is a supplemental document to the Comprehensive Plan and is the strategic system plan that guides the growth and development of the City's park and greenway system. Future park needs are compared with an existing inventory of park facilities over a twenty to thirty-year horizon. Included within this plan are recommendations for new park development, maintenance and continued renovation of existing parks and facilities, and guidelines that will allow the system to provide ample recreational opportunities for all citizens while remaining flexible to change with recreational trends, significant development opportunities and Raleigh’s growing population. A system plan is developed every five to ten years.

ZONING ORDINANCE

All participating communities have zoning ordinances in place as part of unified development ordinances (UDO) designed to consolidate all development related regulations and procedures in a single ordinance. Zoning regulations divide the jurisdictions into zoning districts, including various residential, commercial, mixed-use and industrial districts, and describe what type of land use and specific activities are permitted in each district and how to regulate how buildings, signs, parking, and other construction may be placed on a lot. Zoning regulations also provide procedures for rezoning and other planning applications.

FLOODPLAIN REGULATIONS

Flood damage prevention ordinances establish standards for new construction or substantial improvements to minimize flood related damages. These ordinances are required to meet NFIP minimum standards for communities to participate and comply with the NFIP. The North Carolina state model ordinance recommends a two foot freeboard.

Vegetation along a stream bank is extremely beneficial for the health of the stream. Trees and other plants have an extensive root system that strengthen stream banks and help prevent erosion.

Vegetation that has sprouted up near streams should remain undisturbed unless removing it will significantly reduce a threat of flooding, or further destruction of the stream channel.

North Carolina regulations prohibit the removal of vegetation within 50 feet of all streams in the Wake County area. These are known as the Neuse River Riparian Buffer Rules and the North Carolina Division of Water Resources should be consulted before any activities are undertaken in these areas.

All communities enforce reconstruction regulations to ensure that mitigation is integrated into recovery. Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to reenter and repair. There is a special requirement to do this in floodplains, regardless of the type of disaster or the cause of damage. The NFIP requires that local officials enforce the substantial damage regulations. These rules require that if the cost to repair a building in the mapped floodplain equals or exceeds 50% of the building's market value, the building must be retrofitted to meet the standards of a new building in the floodplain.

STORMWATER MANAGEMENT REGULATIONS

Stormwater runoff is increased when natural ground cover is replaced by urban development. Development in the watershed that drains to a river can aggravate downstream flooding, overload the community's drainage system, cause erosion, and impair water quality. There are three ways to prevent flooding problems caused by stormwater runoff:

1) Regulating development in the floodplain to ensure that it will be protected from flooding and that it won't divert floodwaters onto other properties;
2) Regulating all development to ensure that the post-development peak runoff will not be greater than it was under pre-development conditions; and
3) Set construction standards so buildings are protected from shallow water.

REDUCING FUTURE FLOOD LOSSES

Zoning and comprehensive planning can work together to reduce future flood losses by directing development away from hazard prone areas. Creating or maintaining open space is the primary way to reduce future flood losses.

Planning for open space must also be supplemented with development regulations to ensure that stormwater runoff is managed, and that development is protected from flooding. Future flood losses will be reduced through the implementation of the building code, flood damage prevention ordinances, and stormwater management ordinances. Enforcement of freeboard requirements will provide an extra level of protection for buildings.

Stormwater management and the requirement that post-development runoff cannot exceed pre-development conditions is one way to prevent future flood losses. Retention and detention requirements also help to reduce future flood losses.

LOCAL IMPLEMENTATION RECOMMENDATIONS

The CRS encourages strong building codes. It provides credit in two ways: points are awarded based on the community's Building Code Effectiveness Grading Schedule (BCEGS) classification and points are awarded for adopting the International Code series. The HMPC was concerned about the State Building Code Council and the implementation of the most current version of the International Building Code.

CRS credits are available for regulations that encourage developers to preserve floodplains or other hazardous areas away from development. There is no credit for a plan, only for the enforceable regulations that are adopted pursuant to a plan. Communities could receive credit for Activity 430 – Higher Regulatory Standards and for Activity 420 – Open Space Preservation for preserving parcels within the SFHA as open space. Preserving flood prone areas as open space is one of the highest priorities of the Community Rating System. Communities could also receive credit for Activity 450 – Stormwater Management for enforcing regulations for stormwater management and soil and erosion control. The HMPC did not recommend any new higher standards but did propose several plan and policy updates to integrate hazard mitigation.

Table C.1 – Prevention Mitigation Options and Recommended Projects

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Prevention Measures Considered by HMPC and Not Recommended			
-	Encourage voluntary compliance with floodplain development regulations.	Could save money on enforcement but would not guarantee compliance with standards.	n/a
-	Adopt a lower substantial damage and improvement threshold	Would be difficult to get political or public support for this measure.	n/a
Prevention Measures and Funding Recommended for Implementation			
P-3	Develop a local floodplain mapping program to produce regular mapping updates to flood hazard maps.	Raleigh is gathering information on how data produced through ongoing detailed basin studies can be used for mapping updates, outlining criteria for where and how often mapping updates will be conducted, and evaluating potential budgetary and resource needs.	Local & Federal
P-7	CRS membership	Cary will undertake floodplain management activities beyond the NFIP minimum requirements to seek membership in the CRS program.	Operating Budget
P-6	Neuse River Buffer Rules Implementation	Fuquay-Varina will work to implement and enforce the Neuse River Buffer Rules to reduce flooding and improve water quality.	Operating Budget

C.2.2 PROPERTY PROTECTION MEASURES

Property protection measures are used to modify buildings or property subject to damage. Property protection measures fall under three approaches:

- Modify the site to keep the hazard from reaching the building;

- Modify the building (retrofit) so it can withstand the impacts of the hazard; and
- Insure the property to provide financial relief after the damage occurs.

Property protection measures are normally implemented by the property owner, although in many cases technical and financial assistance can be provided by a government agency.

This low floodwall has landscaping to minimize the adverse impact on the property's appearance.

KEEPING THE HAZARD AWAY

Generally, natural hazards do not damage vacant areas. As noted earlier, the major impact of hazards is to people and improved property. In some cases, properties can be modified so the hazard does not reach the damage-prone improvements. For example, a berm can be built to prevent floodwaters from reaching a house.

Small, wood frame buildings are the easiest to relocate

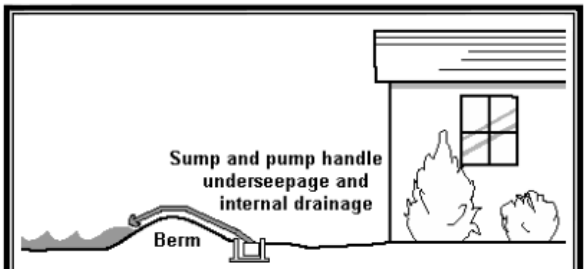
Source: Kennedy House Movers, Huntsville, AL

FLOODING

There are five common methods to keep a flood from reaching and damaging a building:

- Erect a barrier between the building and the source of the flooding.
- Move the building out of the flood-prone area.
- Elevate the building above the flood level.
- Demolish the building.
- Replace the building with a new one that is elevated above the flood level.

The latter three approaches are the most effective types to consider in the planning area.



Small barriers can be effective against shallow flooding.

BARRIERS

A flood protection barrier can be built of dirt or soil (a "berm") or concrete or steel (a "floodwall"). Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on how porous the ground is, if floodwaters will stay up for more than an hour or two, the design needs to account for leaks, seepage of water underneath, and rainwater that will fall inside the perimeter. This is usually done with a sump or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier. Barriers can only be built so high. They can be overtopped by a flood higher than expected. Barriers made of earth are susceptible to erosion from rain and floodwaters if not properly sloped, covered with grass, and properly maintained.

RELOCATION

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost increases for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.

BUILDING ELEVATION

Raising a building above the flood level can be almost as effective as moving it out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

DEMOLITION

Some buildings, especially heavily damaged or repetitively flooded ones, are not worth the expense to protect them from future damages. It is cheaper to demolish them and either replace them with new, flood protected structures, or relocate the occupants to a safer site. Demolition is also appropriate for buildings that are difficult to move – such as larger, slab foundation or masonry structures – and for dilapidated structures that are not cost-beneficial to protect.

Demolishing a repetitively flooded home

PILOT RECONSTRUCTION

If a building is not in good shape, elevating it may not be worthwhile or it may even be dangerous. An alternative is to demolish the structure and build a new one on the site that meets or exceeds all flood protection codes. FEMA funding programs refer to this approach as "pilot reconstruction." It is still a pilot program, and not a regularly funded option. Certain rules must be followed to qualify for federal funds for pilot reconstruction.

RETROFITTING

An alternative to keeping the hazard away from a building is to modify or retrofit the site or building to minimize or prevent damage. There are a variety of techniques to do this, as described below.

- **Dry Floodproofing**

  Dry floodproofing means making all areas below the flood protection level watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows and vents, are closed, either permanently, with removable shields, or with sandbags. Dry floodproofing of new and existing nonresidential buildings in the regulatory floodplain is permitted under state, FEMA and local regulations. Dry floodproofing of existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Owners of buildings located outside the regulatory floodplain can always use dry floodproofing techniques.

  Dry floodproofing is only effective for shallow flooding, such as repetitive drainage problems. It does not protect from the deep flooding along lakes and larger rivers caused by hurricanes or other storms.

- **Wet Floodproofing**

  The alternative to dry floodproofing is wet floodproofing: water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater and laundry facilities are permanently relocated to a higher floor. Where the flooding is not deep, these appliances can be raised on blocks or platforms.

INSURANCE

Technically, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild, and hopefully afford to incorporate some of the other property protection measures in the process. Insurance offers the advantage of protecting the property, so long as the policy is in force, without requiring human intervention for the measure to work.

- **Private Property**

  Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the NFIP. Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area. Most people purchase flood insurance because it is required by the bank when they get a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents. Contents coverage can be purchased separately. Renters can buy contents coverage, even if the owner does not buy structural coverage on the building. Most people don't realize that there is a 30-day waiting period to purchase a flood insurance policy and there are limits on coverage.

- **Public Property**

  Governments can purchase commercial insurance policies. Larger local governments often self-insure and absorb the cost of damage to one facility, but if many properties are exposed to damage, self-insurance can drain the government's budget. Communities cannot expect federal disaster assistance to make up the difference after a flood.

LOCAL IMPLEMENTATION RECOMMENDATIONS

The CRS provides the most credit points for acquisition and relocation under Activity 520, because this measure permanently removes insurable buildings from the floodplain. Communities could receive credit for Activity 520 – Acquisition and Relocation, for acquiring and relocating buildings from the SFHA. The HMPC recommended the purchase of repetitive loss buildings and other flood prone buildings through Hazard Mitigation Assistance grant funding in order to return this land to open space.

The CRS also credits barriers and elevating existing buildings under Activity 530. The credit for Activity 530 is based on the combination of flood protection techniques used and the level of flood protection provided. Points are calculated for each protected building. Bonus points are provided for the protection of repetitive loss buildings and critical facilities. It may not be likely that communities would receive credit for Activity 530 – Flood Protection, but communities could receive credit for Activity 360 – Flood Protection Assistance. There is capable staff at the County and communities with the technical expertise to provide advice and assistance to homeowners who may want to floodproof their home or business. Advice could be provided both on property protection techniques and on financial assistance programs to help fund mitigation.

There is no credit for purchasing flood insurance, but the CRS does provide credit for local public information programs that, among other topics, explain flood insurance to property owners. The CRS also reduces the premiums for those people who do buy NFIP coverage. Flood insurance information for all communities is provided in Section 5.

Table C.2 – Property Protection Mitigation Options and Recommended Projects

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Property Protection Measures Considered by HMPC and Not Recommended			
-	Identify locations to install berms or floodwalls.	Other methods of property protection are preferred.	n/a

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Property Protection Measures and Funding Recommended for Implementation			
PP-2	Require minimum finished floor elevation in known FEMA flood hazard zones be minimum 2' above base flood elevation.	Freeboard reduces flood risk for new development in flood prone areas.	Operating Budget
multiple	Pursue acquisition or elevation of repetitive loss buildings and other flood prone structures.	Acquisition and elevation projects are eligible for FEMA HMA grant funding and reduce or eliminate flood risk for existing structures.	HMGP, FMA, BRIC
PP-1	Respond to requests and questions from citizens regarding actions they may take to improve drainage, halt erosion, and to relocate, renovate or retrofit structures being flooded.	Garner staff assist property owners in identifying property protection measures to mitigate flood risk to existing structures.	Operating Budget
Multiple	Install backup generators for critical facilities.	This action will support continuity of operations of critical government and emergency response services during hazard events.	Operating Budget

C.2.3 NATURAL RESOURCE PROTECTION

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. These activities enable the naturally beneficial functions of fields, floodplains, wetlands, and other natural lands to operate more effectively. Natural and beneficial functions of watersheds, floodplains and wetlands include:

- Reduction in runoff from rainwater and stormwater in pervious areas
- Infiltration that absorbs overland flood flow
- Removal and filtering of excess nutrients, pollutants and sediments
- Storage of floodwaters
- Absorption of flood energy and reduction in flood scour
- Water quality improvement
- Groundwater recharge
- Habitat for flora and fauna
- Recreational and aesthetic opportunities

As development occurs, many of the above benefits can be achieved through regulatory steps for protecting natural areas or natural functions. This section covers the resource protection programs and standards that can help mitigate the impact of natural hazards, while they improve the overall environment. Six areas were reviewed:

- Wetland protection
- Erosion and sedimentation control
- Stream/River restoration

- Best management practices
- Dumping regulations
- Farmland protection

WETLAND PROTECTION

Wetlands are often found in floodplains and topographically depressed areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and they provide habitat for many species of fish, wildlife and plants.

EROSION AND SEDIMENTATION CONTROL

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along stream banks and shorelines as the volume and velocity of flow or wave action destabilize and wash away the soil. Sediment suspended in the water tends to settle out where flowing water slows down. This can clog storm drains, drain tiles, culverts and ditches and reduce the water transport and storage capacity of river and stream channels, lakes and wetlands.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing practices.

STREAM/RIVER RESTORATION

There is a growing movement that has several names, such as "stream conservation," "bioengineering," or "riparian corridor restoration." The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration," which restores native indigenous plants and animals to an area.

A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve retrofitting the shoreline with willow cuttings, wetland plants, or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

In all, restoring the right vegetation to a stream has the following advantages:

- Reduces the amount of sediment and pollutants entering the water
- Enhances aquatic habitat by cooling water temperature
- Provides food and shelter for both aquatic and terrestrial wildlife
- Can reduce flood damage by slowing the velocity of water
- Increases the beauty of the land and its property value
- Prevents property loss due to erosion
- Provides recreational opportunities, such as hunting, fishing and bird watching
- Reduces long-term maintenance costs

BEST MANAGEMENT PRACTICES

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by the US EPA. Nonpoint source pollutants come from non-specific locations and harder to regulate. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, other chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

The term "best management practices" (BMPs) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff rates and volumes, prevent erosion, protect natural resources and capture nonpoint source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, preserve beneficial natural features onsite, maintain natural base flows, minimize habitat loss, and provide multiple usages of drainage and storage facilities.

DUMPING REGULATIONS

BMPs usually address pollutants that are liquids or are suspended in water that are washed into a lake or stream. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' abilities to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels. Regular inspections to catch violations should be scheduled.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard without realizing that is needed to drain street runoff. They may not understand how regarding their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

FARMLAND PROTECTION

Farmland protection is an important piece of comprehensive planning and zoning throughout the United States. The purpose of farmland protection is to provide mechanisms for prime, unique, or important agricultural land to remain as such, and to be protected from conversion to nonagricultural uses.

Frequently, farm owners sell their land to residential or commercial developers and the property is converted to non-agricultural land uses. With development comes more buildings, roads and other infrastructure. Urban sprawl occurs, which can lead to additional stormwater runoff and emergency management difficulties.

Farms on the edge of cities are often appraised based on the price they could be sold for to urban developers. This may drive farmers to sell to developers because their marginal farm operations cannot afford to be taxed as urban land. The Farmland Protection Program in the United States Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to state, tribal, and local governments as well as nonprofit organizations to help purchase easements on agricultural land to protect against the development of the land.

LOCAL IMPLEMENTATION RECOMMENDATIONS

There is credit for preserving open space in its natural condition or restored to a state approximating its natural condition. The credit is based on the percentage of the floodplain that can be documented as wetlands protected from development by ownership or local regulations. Communities could receive credit for Activity 420 – Open Space Preservation for preserving a portion of the SFHA as open space.

Additionally, communities could receive credit for Activity 540 – Drainage System Maintenance. By having a portion of the drainage system inspected regularly throughout the year and maintenance performed as needed would earn credit. Communities could also get credit under this activity for

identifying problem sites that are inspected more frequently, and for implementing an ongoing Capital Improvements Program.

Credit is available for the Erosion and Sediment Control (ESC) element under Activity 450 for regulating activities throughout the watershed to minimize erosion on construction sites that could result in sedimentation and water pollution.

Table C.3 – Natural Resource Protection Mitigation Options and Recommended Projects

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Natural Resource Protection Measures Considered by HMPC and Not Recommended			
-	Enact deed restrictions and other growth management tools to preserve wetland and natural resource areas and conserve their natural and ecological functions.	Limited support for growth restrictions. Open space preservation will be pursued instead.	n/a
Natural Resource Protection Measures and Funding Recommended for Implementation			
NRP-1	Buffer and UTB Protection	Cary will enforce extra 50-foot buffers on USGS streams to reduce flood risk and protect water quality.	n/a
NRP-4	Enforce standards for tree protection and control of clear cutting	Fuquay-Varina has received legislative authority to enact tree protection and control of clearcutting standards to reduce flood, wildfire, and landslide risk.	n/a
NRP-3	Conserve natural resources and open space especially in the key areas of Buffalo Creek and Little River.	Open space preservation will prevent increased exposure to flood risk and will provide ecological and recreation benefits in Wendell.	Town Budget

C.2.4 EMERGENCY SERVICES MEASURES

Emergency services measures protect people during and after a disaster. A good emergency management program addresses all hazards, and it involves all local government departments. This section reviews emergency services measures following a chronological order of responding to an emergency. It starts with identifying an impending problem (threat recognition) and continues through post-disaster activities.

THREAT RECOGNITION

The first step in responding to a flood is to know when weather conditions are such that an event could occur. With a proper and timely threat recognition system, adequate warnings can be disseminated.

The National Weather Service (NWS) is the prime agency for detecting meteorological threats. Severe weather warnings are transmitted through NOAA's Weather Radio System. Local emergency managers can then provide more site-specific and timely recognition after the Weather Service issues a watch or a warning. A flood threat recognition system predicts the time and height of a flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

On smaller rivers and streams, locally established rainfall and river gauges are needed to establish a flood threat recognition system. The NWS may issue a "flash flood watch." This is issued to indicate current or developing hydrologic conditions that are favorable for flash flooding in and close to the watch area, but the occurrence is neither certain nor imminent. These events are so localized and so rapid that a "flash flood warning" may not be issued, especially if no remote threat recognition equipment is available. In the absence of a gauging system on small streams, the best threat recognition system is to have local personnel monitor rainfall and stream conditions. While specific flood crests and times will not be predicted, this approach will provide advance notice of potential local or flash flooding.

WARNING

The next step in emergency response following threat recognition is to notify the public and staff of other agencies and critical facilities. More people can implement protection measures if warnings are early and include specific detail.

The NWS issues notices to the public using two levels of notification:

- Watch: conditions are right for flooding, thunderstorms, tornadoes or winter storms.
- Warning: a flood, tornado, etc., has started or been observed.

A more specific warning may be disseminated by the community in a variety of ways. The following are the more common methods:

- CodeRED countywide mass telephone emergency communication system
- Commercial or public radio or TV stations
- The Weather Channel
- Cable TV emergency news inserts
- Telephone trees/mass telephone notification
- NOAA Weather Radio
- Tone activated receivers in key facilities
- Outdoor warning sirens
- Sirens on public safety vehicles
- Door-to-door contact
- Mobile public address systems
- Email notifications

Just as important as issuing a warning is telling people what to do in case of an emergency. A warning program should include a public information component.

STORMREADY

The National Weather Service (NWS) established the StormReady program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive severe weather warnings and forecasts and to alert the public
- Create a system that monitors weather conditions locally
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises

Being designated a NWS StormReady community is a good measure of a community's emergency warning program for weather hazards.

RESPONSE

The protection of life and property is the most important task of emergency responders. Concurrent with threat recognition and issuing warnings, a community should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- Activating the emergency operations center (emergency preparedness)
- Closing streets or bridges (police or public works)
- Shutting off power to threatened areas (utility company)
- Passing out sand and sandbags (public works)
- Holding children at school or releasing children from school (school superintendent)
- Opening evacuation shelters (the American Red Cross)
- Monitoring water levels (public works)
- Establishing security and other protection measures (police)

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to ensure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and of changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner possible.

EVACUATION AND SHELTER

There are six key components to a successful evacuation:

- Adequate warning
- Adequate routes
- Proper timing to ensure the routes are clear
- Traffic control
- Knowledgeable travelers
- Care for special populations (e.g., disabled persons, prisoners, hospital patients, schoolchildren)

Those who cannot get out of harm's way need shelter. Typically, the American Red Cross will staff a shelter and ensure that there is adequate food, bedding, and wash facilities. Shelter management is a specialized skill. Managers must deal with problems like scared children, families that want to bring in their pets, and the potential for an overcrowded facility.

LOCAL IMPLEMENTATION RECOMMENDATIONS

Flash flood warnings are issued by National Weather Service Offices, which have the local and county warning responsibility. Flood warnings are forecasts of coming floods, are distributed to the public by the NOAA Weather Radio, commercial radio and television, and through local emergency agencies. The warning message tells the expected degree of flooding, the affected river, when and where flooding will begin, and the expected maximum river level at specific forecast points during flood crest. The County has a Flood Incident Management (FIM) plan, as part of the Emergency Operations Plan. The FIM plan includes flood threat recognition, emergency warning dissemination, flood response operations, and critical facilities planning.

Communities could receive credit for Activity 610 – Flood Warning Program for maintaining a program that provides timely identification of impending flood threats, disseminates warnings to appropriate floodplain residents, and coordinates flood response activities (based on Wake County's Emergency Management Program). Community Rating System credits are based on the number and types of warning media that can reach the community's flood prone population. Depending on the location, communities can receive credit for the telephone calling system and more credits for additional measures, like telephone trees. Being designated as a StormReady community also provides additional credits.

Table C.4 – Emergency Services Mitigation Options and Recommended Projects

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Emergency Services Measures Considered by HMPC and Not Recommended			
-	Develop post-disaster mitigation procedures that assign responsibilities for public information, code enforcement, planning, and other efforts that encourage loss reduction.	To avoid redundancy, these responsibilities are identified in the County's Emergency Operations Plan, and the other mitigation projects identified in this FMP can be used as a guide for flood loss reduction in post-disaster mitigation.	n/a
Emergency Services Measures and Funding Recommended for Implementation			
multiple	Provide and enhance technical rescue capabilities.	Ensure proper training of first responders to reduce danger during flooding events.	Operating Budget
multiple	Continue to conduct disaster tabletop exercise program.	Training and exercises must be conducted so staff are properly trained on all possible issues that may arise in various events.	Operating Budget
ES-1	See that all nursing homes and assisted living facilities have backup generators.	Wake Forest will support generator implementation at critical facilities to protect vulnerable populations.	Property Owners, Federal grants

C.2.5 STRUCTURAL PROJECTS

Four general types of flood control projects are reviewed here: levees, reservoirs, diversions, and dredging. These projects have three advantages not provided by other mitigation measures:

- They can stop most flooding, protecting streets and landscaping in addition to buildings.
- Many projects can be built without disrupting citizens' homes and businesses.
- They are constructed and maintained by a government agency, a more dependable long-term management arrangement than depending on many individual private property owners.

However, as shown below, structural measures also have shortcomings. The appropriateness of using flood control depends on individual project area circumstances.

- Advantages
  - They may provide the greatest amount of protection for land area used
  - Because of land limitations, they may be the only practical solution in some circumstances

  - They can incorporate other benefits into structural project design, such as water supply and recreational uses
  - Regional detention may be more cost-efficient and effective than requiring numerous small detention basins
- Disadvantages
  - They can disturb the land and disrupt the natural water flows, often destroying wildlife habitat
  - They require regular maintenance
  - They are built to a certain flood protection level that can be exceeded by larger floods
  - They can create a false sense of security
  - They promote more intensive land use and development in the floodplain

LEVEES AND FLOODWALLS

Probably the best-known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour.

RESERVOIRS AND DETENTION

Reservoirs reduce flooding by temporarily storing flood waters behind dams or in storage or detention basins. Reservoirs lower flood heights by holding back, or detaining, runoff before it can flow downstream. Flood waters are detained until the flood has subsided, and then the water in the reservoir or detention basin is released or pumped out slowly at a rate that the river can accommodate downstream.

Retention pond

Reservoirs can be dry and remain idle until a large rain event occurs. Or they may be designed so that a lake or pond is created. The lake may provide recreational benefits or water supply (which could also help mitigate a drought).

Flood control reservoirs are most commonly built for one of two purposes. Large reservoirs are constructed to protect property from existing flood problems. Smaller reservoirs, or detention basins, are built to protect property from the stormwater runoff impacts of new development.

DIVERSION

A diversion is a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. Diversions can be surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel. During floods, the floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving lake or river.

LOCAL IMPLEMENTATION RECOMMENDATIONS

Structural flood control projects that provide at least 100-year flood protection and that result in revisions to the Flood Insurance Rate Map are not credited by the CRS so as not to duplicate the larger premium reduction provided by removing properties from the mapped floodplain. Other flood control projects can

be accepted by offering a 25-year flood protection. Regardless of CRS credit eligibility, many stormwater improvements were identified to mitigate flooding throughout the planning area.

Table C.5 – Structural Projects Mitigation Options and Recommended Projects

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Structural Project Measures Considered by HMPC and Not Recommended			
-	Develop new detention and retention facilities to provide flood protection.	Developers are already required to retain water on site through either detention or retention systems for new developments.	n/a
Structural Project Measures and Funding Recommended for Implementation			
SP-1	Conduct stream mitigation projects on Old Mill Stream, Richland Creek, and others subject to flooding or erosion.	Stream restoration projects will reduce erosion and flood risk and support natural and beneficial floodplain functions	Local funds, State and federal grants
Multiple	Undertake drainage improvements to increase conveyance capacity and reduce stormwater related flooding	These projects will reduce flood damages, prevent street flooding, protect life safety and reduce disruptions related to localized flooding.	Capital Improvement Funds, FEMA HMA grants

C.2.6 PUBLIC INFORMATION

OUTREACH PROJECTS

Outreach projects are the first step in the process of orienting property owners to the hazards they face and to the concept of property protection. They are designed to encourage people to seek out more information in order to take steps to protect themselves and their properties.

Awareness of the hazard is not enough; people need to be told what they can do about the hazard. Thus, projects should include information on safety, health and property protection measures. Research has shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

Community newsletters/direct mailings: The most effective types of outreach projects are mailed or distributed to everyone in the community. In the case of floods, they can be sent only to floodplain property owners.

News media: Local newspapers can be strong allies in efforts to inform the public. Local radio stations and cable TV channels can also help. These media offer interview formats and cable TV may be willing to broadcast videos on the hazards.

LIBRARIES AND WEBSITES

The two previous activities tell people that they are exposed to a hazard. The next step is to provide information to those who want to know more. The community library and local websites are obvious places for residents to seek information on hazards, hazard protection, and protecting natural resources.

Books and pamphlets on hazard mitigation can be given to libraries, and many of these can be obtained for free from state and federal agencies. Libraries also have their own public information campaigns with displays, lectures and other projects, which can augment the activities of the local government. Today, websites are commonly used as research tools. They provide fast access to a wealth of public and private sites for information. Through links to other websites, there is almost no limit to the amount of up to date information that can be accessed on the Internet.

In addition to online floodplain maps, websites can link to information for homeowners on how to retrofit for floods or a website about floods for children.

TECHNICAL ASSISTANCE

HAZARD INFORMATION

Residents and business owners that are aware of the potential hazards can take steps to avoid problems or reduce their exposure to flooding. Communities can easily provide map information from FEMA's FIRMs and Flood Insurance Studies. They may also assist residents in submitting requests for map amendments and revisions when they are needed to show that a building is located outside the mapped floodplain.

Some communities supplement what is shown on the FIRM with information on additional hazards, flooding outside mapped areas and zoning. When the map information is provided, community staff can explain insurance, property protection measures and mitigation options that are available to property owners. They should also remind inquirers that being outside the mapped floodplain is no guarantee that a property will never flood.

PROPERTY PROTECTION ASSISTANCE

While general information provided by outreach projects or the library is beneficial, most property owners do not feel ready to retrofit their buildings without more specific guidance. Local building department staffs are experts in construction. They can provide free advice, not necessarily to design a protection measure, but to steer the owner onto the right track. Building or public works department staffs can provide the following types of assistance:

- Visit properties and offer protection suggestions
- Recommend or identify qualified or licensed contractors
- Inspect homes for anchoring of roofing and the home to the foundation
- Explain when building permits are needed for home improvements.

PUBLIC INFORMATION PROGRAM

A Program for Public Information (PPI) is a document that receives CRS credit. It is a review of local conditions, local public information needs, and a recommended plan of activities. A PPI consists of the following parts, which are incorporated into this plan:

- The local flood hazard
- The property protection measures appropriate for the flood hazard
- Flood safety measures appropriate for the local situation
- The public information activities currently being implemented within the community, including those being carried out by non-government agencies
- Goals for the community's public information program
- The outreach projects that will be done each year to reach the goals
- The process that will be followed to monitor and evaluate the projects

LOCAL IMPLEMENTATION RECOMMENDATIONS

Communities could receive credit under Activity 330 – Outreach Projects as well as Activity 350 – Flood Protection Information. Credit is provided for general outreach projects including publications in local newspapers and expos at fairs and for publications relating to floodplain management which are available in the reference section of local libraries. Credit is also provided for floodplain information displayed on communities' websites.

Table C.6 – Public Information and Outreach Mitigation Options and Recommended Projects

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Funding
Public Information and Outreach Measures Considered by HMPC and Not Recommended			
-	Develop a multi-jurisdictional Program for Public Information	Communities each undertake public information activities and can better tailor information to their unique needs this way.	n/a
Public Information and Outreach Measures and Funding Recommended for Implementation			
PEA-1	Require disclosure of flood hazard in real estate transactions.	Zebulon will seek to require flood hazard disclosure to improve flood risk awareness for new homebuyers.	Operating Budget
multiple	Increase public awareness and participation in the Ready Wake program and resources.	Create a public information campaign to keep all residents of Wake County aware of natural disaster and other weather-related events in order to better protection people.	Operating Budget and Federal Funding

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