State of North Carolina

Hazard Mitigation Plan





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Section 1. INTRODUCTION

1.1 INTRODUCTION TO THE STATE HAZARD MITIGATION PLAN

1.1.1 What is the NC Enhanced Hazard Mitigation Plan?

The North Carolina Enhanced Hazard Mitigation Plan is a federally mandated plan that identifies hazards that could potentially affect North Carolina and identifies actions to reduce the loss of life and property from a disaster across the state. The plan is required to have the following components as mandated in the Disaster Mitigation Act of 2000: Planning Process, Risk Assessment, Mitigation Strategies, Coordination of Local Plans; Plan Maintenance; and Plan Adoption and Assurances. All of the requirements for each section are further defined in the 44 CFR §201.4, the FEMA State Plan Review Guide and the FEMA State Plan Review Tool.

The North Carolina Enhanced Hazard Mitigation Plan also serves as the Hazard Identification and Risk Assessment or HIRA that informs all other State Emergency Management Plans. While the Disaster Mitigation Act of 2000 only requires natural hazards to be identified in the 322 Plan, North Carolina Emergency Management has determined it will be the sole hazard identification and risk assessment source for all hazards. Therefore, the North Carolina Enhanced Hazard Mitigation Plan also includes technological, manmade and human caused hazards.

The 2018 version of this plan represents a shift in format and organization from previous versions. The intent of these changes is to help improve the readability and flow of the plan. Therefore, all sections of the plan have undergone revisions for the 2018 update.

The main body of the plan is comprised of the following sections: Planning Process, Risk and Vulnerability Assessment, Mitigation Capability, Mitigation Strategy, Plan Maintenance, Monitoring, and Implementation. The plan is supplemented with three Appendices that include State Enhanced Plan Review Tool, EMAP Accreditation, Supporting Documentation, and Plan Maintenance Records.

The **Planning Process** section describes how the plan was written and who was involved. This section contains the names of those on the planning teams, the agency they work for and the role each planning team member has for the update and maintenance of the plan. The Risk

Management Coordinating Council serves as the advisory committee for the planning process and plan maintenance of the North Carolina Enhanced Hazard Mitigation plan. There is also a North Carolina Emergency Management internal planning team that is responsible for the plan and coordinates its update and maintenance regularly. The Planning Process Section also documents meetings of the planning teams through minutes summaries, meeting attendance summaries and other important information as related to the planning process.

The **Risk and Vulnerability Assessment** section provides an identification, description and assessment all major natural, technological, manmade and human caused hazards that impact North Carolina. In this context, vulnerability is the extent to which people and property will be adversely affected by a given hazard. The state's degree of vulnerability depends upon the risk of a particular natural hazard occurring (including such factors as scope, frequency, intensity, and destructive potential), as well as the degree to which the population, structures and facilities, economic activity, or environmental resources are exposed. Vulnerability levels are also affected by mitigation policies that are in place to reduce hazard impacts, as well as by policies that may exacerbate the state's vulnerability by facilitating development in hazardous areas. The risk assessment compiles the best available information for use in hazard mitigation policy formulation for the State of North Carolina.

The State of North Carolina continues to make great investments in creating analyses that calculate hazard risk at the building level statewide. This is accomplished through a geospatial approach using multiple GIS datasets and intersecting building data with hazard data. Building footprints are intersected with the hazard areas most likely to be impacted in North Carolina. Based on the hazard, a damage curve (math problem that statistically shows how much damage can be expected due to a particular type of hazard event) is applied to each structure to give the percent damage. A cost based on the estimated structure value multiplied by the damage percentage illustrates the expected cost of damages. This approach for calculating vulnerability differs from previous versions of the plan which was more subjective based upon the subject matter expert’s opinion of a much larger geographical area of the state. The 2018 update of this plan represents the State’s initial attempt to begin integrating risk data into the Enhanced State Hazard Mitigation Plan.

The **Capability Assessment** provides an overview of the State’s capabilities to implement the Mitigation Strategy. It includes: an identification, review, and analysis of the current resources for reducing hazard impacts including an evaluation of State laws, regulations, policies, and programs related to hazard mitigation and development in hazard-prone areas; a discussion of State funding capabilities for hazard mitigation projects; and a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities. This section was totally revised for the 2018 plan update.

The **Mitigation Strategy** section consists of Goals, Objectives and specific Actions to address mitigation of all hazards and become as resilient as possible. The goals, objectives and actions are derived after the risk assessment to ensure that they address all hazards.

Coordination of local plans explains how North Carolina Emergency Management provides assistance to local governments to update the local hazard mitigation plans, including a description of how the state assists local governments with funding plan updates, the state's review process for local plan updates, and the prioritization process for pursuit of local mitigation grants.

The **Plan Maintenance, Monitoring and Implementation** section lays out a road map of how the plan will be maintained over the course of the five years cycle. It includes a description of how the process worked in the last five years and how it is changing to improve the process for the next five years. This includes who is responsible, the schedule of maintenance, and template documents to use for maintenance.

The requirements found in 44 CFR §201.4 are embedded into the North Carolina Enhanced Hazard Mitigation Plan as an aid to plan review and maintenance. The North Carolina Enhanced Hazard Mitigation Plan goes above the minimum plan standards to meet the Enhanced Plan requirements as well as all Emergency Management Accreditation Program standards, therefore there are additional sections in the plan that detail additional criteria.

1.1.2 What is the Purpose of the NC Enhanced Hazard Mitigation Plan?

In the year 2000, the 106th United States Congress passed the Disaster Mitigation Act of 2000 (DMA2K) into law to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The purpose of DMA2K is to lessen the vulnerability of citizens to the natural hazards affecting the United States through the strengthening of mitigation efforts at the state and local levels. Section 322 of the DMA2K conditions that each state create a natural hazard mitigation plan to be submitted for approval to the Federal Emergency Management Agency (FEMA). The North Carolina Enhanced Hazard Mitigation Plan has been updated three times since the initial plan was written and approved in 2004. The hazard mitigation plan was initially required by DMA2K to be updated and submitted to FEMA for review and approval every three years. However, in 2014 DMA2K was amended requiring the state plans to be updated and submitted for review and approval every five years.

The hazard mitigation plan ensures that the state remains eligible for Public Assistance Categories C-G and Unified Hazard Mitigation Assistance which consist of the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program. The Hazard Mitigation Grant Program is 15% of the total disaster declaration in additional funds received specifically for mitigation purposes following a Presidential Disaster Declaration. States that maintain "enhanced" hazard mitigation plans are eligible for 20% of the total disaster declaration funds. The Pre-Disaster Mitigation Program and the Flood Mitigation Assistance Program are both non-disaster grants appropriated annually by Congress. All of these funding sources are critical to the State for the purposes of advancing the goals, objectives and actions that comprise the Mitigation Strategy so it is critical that this plan remain a FEMA-approved and meaningful document.

The current approved plan, the North Carolina Enhanced Hazard Mitigation Plan, was submitted for review by FEMA in June of 2013 with final approval in October of the same year. In November of 2013 the “enhanced” portion of the review tool was submitted to FEMA for review and approval as an appendix to the plan. On February 28 of 2014 NCEM received the approval letter from FEMA approving the “enhanced” portion of the hazard mitigation plan. The “enhanced” designation is met when the State meets additional criteria which are defined in 44 CFR 201.5.

1.2 NORTH CAROLINA EMERGENCY MANAGEMENT AS THE RESPONSIBLE AGENCY

1.2.1 Authorities

The North Carolina Emergency Management Act (N.C.G.S. 166A), sets forth the authority and responsibilities of the Governor, state agencies, and local governments in the prevention and mitigation of, preparation for, response to, and recover from natural or manmade disasters.

The North Carolina Emergency Management Act of 1977 (N.C.G.S. 166A-5 (3) (b)), assigns the responsibility for the preparation and maintenance of State’s Hazard Mitigation Plan to North Carolina Emergency Management (NCEM).

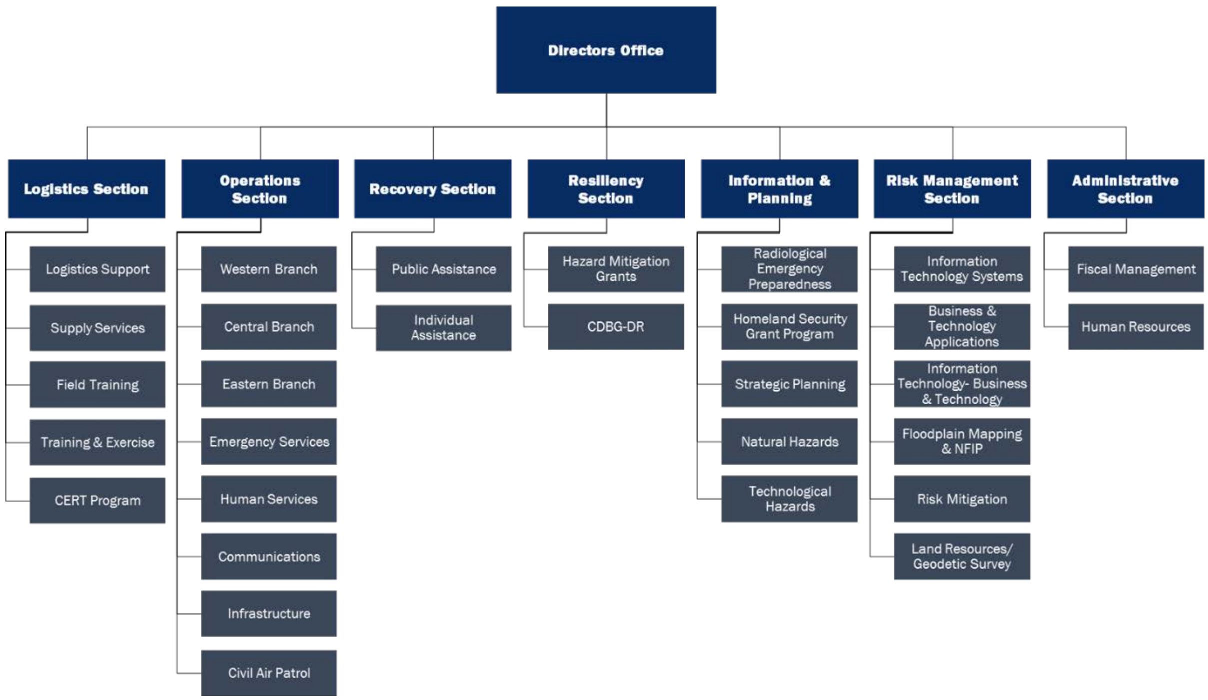
In June 2001, the North Carolina General Assembly passed Senate Bill 300 (SB 300): An Act to Amend the Laws Regarding Emergency Management (N.C.G.S. 166A) as Recommended by the Legislative Disaster Response and Recovery Commission. Among other provisions, Senate Bill 300 requires that local governments have an approved hazard mitigation plan in place and participate in the National Flood Insurance Program in order to receive State Public Assistance funding.

1.2.2 Overview of North Carolina Emergency Management

Organization of North Carolina Emergency Management

The North Carolina Division of Emergency Management (NCEM) was created by the Emergency Management Act of 1977 (N.C.G.S. 166-A) and is responsible for protecting the people of North Carolina from the effects of disasters, natural and manmade. NCEM was reorganized in 1997 following Hurricane Fran into functional units, using the national model for managing emergency operations, “Incident Command System” (ICS). This organizational structure mirrors the local incident command structure and the federal Emergency Response Team structure, thus streamlining and simplifying intergovernmental coordination. Since the major reorganization in 1997 following Hurricane Fran, NCEM has undergone several additional reorganizations shaping the agency into the comprehensive emergency management agency it is today.

The organization chart for NCEM depicting functional branches and programs can be found below:



The responsibilities and activities of each of these Sections are described in further detail below.

NCEM Responsibilities

The NCEM is responsible for administering many of the disaster assistance programs that are available to states and local governments from the Federal Emergency Management Agency (FEMA), including programs created by the Stafford Act and its amendments. NCEM is responsible for all state department resource coordination before, during and after events as part of the SERT response plan as defined in G.S.166A and furthered detailed in the North Carolina Emergency Operations Plan. NCEM is also the agency charged with administering Homeland Security Grant Program, Emergency Management Preparedness Grant, Recovery Planning and Operations (Individual Assistance and Public Assistance), Mitigation, Floodplain Mapping, National Flood Insurance Program and the Community Development Block Grant – Disaster.

NCEM Branch and Area Offices

In addition to main administrative offices and the State Emergency Operation Center in Raleigh, NCEM operates three Branch Offices which serve as the Regional Coordination Centers during State Emergency Operation Center activations. The Eastern Branch office is in Kinston, the Central Branch operates out of Butner, and the Western Branch is centered in

Conover. Each Branch has a manager who has overall responsibility for personnel within the Branch. Each Branch is divided into five Areas, each of which is assigned a coordinator who works directly with the counties within his or her Area to coordinate communication between municipalities, counties and the state, and to provide technical assistance with grants and other aid requests. In addition to the Manager, each Branch Office has a Program Assistant and a two Emergency Management Planners who also assist the counties with Emergency Management Preparedness Grant and Homeland Security Grant Program administration as well as providing technical assistance with maintenance and annual reviews of the local emergency operation plans. The Area Coordinators are capable of providing local emergency operations center overhead support, and are the local government's direct line to mutual aid and state resources upon request.

1.2.2.1 State Emergency Response Team (SERT)

The Division of Emergency Management is also responsible for coordinating the activities of the State Emergency Response Team (SERT). In the event of an emergency, the SERT directs on-site response activities and is capable of directing the total response effort. The SERT provides the technical expertise and coordinates the delivery of the emergency resources used to support local emergency operations. The SERT is composed of representatives of state, local, and federal agencies as well as non-governmental organizations through the North Carolina Voluntary Organization Active in Disasters (NC-VOAD) such as the American Red Cross, Salvation Army, and other groups who coordinate disaster relief and recovery activities. In this way, prompt assistance can be provided to individuals and communities in need following a disaster.

When disaster response and recovery is beyond the capability of local governments and communities, the Governor may use the full resources of the State to support recovery operations. When resource needs are beyond the capabilities of state agencies, mutual aid from other un-impacted local governments and states may be secured using the Statewide Mutual Aid Agreement and/or the Emergency Management Assistance Compact. When the disaster is beyond the capability of both the State and local governments, the Governor may request the President to declare the event a "Major Disaster." This designation authorizes federal financial assistance and resources to supplement state and local response and recovery efforts.

1.2.2.2 State Emergency Response Commission (SERC)

By Executive Order No. 6, dated April 20, 2017, Governor Roy Cooper ordered the continuation of the State Emergency Response Commission (SERC). This Executive Order supersedes and replaces all other executive orders on the subject. It shall remain in effect until December 31, 2019, pursuant to N.C. Gen. Stat.§ 147-16.2 or until rescinded.

The Commission is designated as the State Emergency Response Commission as defined in the Emergency Planning and Community Right-to-Know Act of 1986 enacted by the United States Congress and hereinafter referred to as the "Act." The Department of Public Safety shall provide administrative support and staff to the Commission as may be required. The Commission serves in three roles:

1) The Commission will perform all of the duties required under the Act and other advisory, administrative, regulatory, or legislative actions.
   a. Designate emergency planning districts to facilitate preparation and implementation of emergency plans as required under Section 301(b) of the Act.
   b. Appoint local emergency planning committees described under Section 301(c) of the Act and supervise and coordinate the activities of such committees for each planning district.
   c. Establish procedures for reviewing and processing requests from the public for information under Section 324 of the Act.
   d. Designate additional facilities that may be subject to the Act under Section 302 of the Act.
   e. Review the emergency plans submitted by the local emergency planning committees and recommend revisions of the plans that may be necessary to ensure their coordination with emergency response plans of adjacent districts and state plans.

2) The Commission will act in an advisory capacity to the Homeland Security Advisor to provide input regarding the activities of the North Carolina State Homeland Security Program and the Domestic Preparedness Regions. Specifically, the Commission will:
   a. Review the State Homeland Security Strategy to ensure it is aligned with local, state, and federal priorities as required by the United States Department of Homeland Security (DHS), and that its goals and objectives are being met in accordance with program intent.
   b. Review applications and subsequent allocations for state and regional homeland security projects funded by DHS grant programs.
   c. Review plans for preventing, preparing for, responding to, and recovering from acts of terrorism and all hazards, whether man-made or natural.

3) The Commission will act in an advisory capacity to provide coordinated stakeholder input to the Secretary of the Department of Public Safety/Emergency Management in the preparation, implementation, evaluation, and revision of the North Carolina emergency management program. To this purpose, the Commission will work to:
   a. Increase state and local disaster/emergency response capabilities; and
   b. Coordinate training, education, technical assistance, and outreach activities.

The Secretary of the North Carolina Department of Public Safety shall serve as the Homeland Security Advisor to the Governor and Chairperson of the Commission. The Commission shall consist of not less than 14 members and shall be composed of at least the following persons, or their designee as approved by the Commission Chairperson:

a. Director of Emergency Management, North Carolina Department of Public Safety, who shall serve as the Vice-Chairperson;
b. Director of the State Bureau of Investigation, North Carolina Department of Public Safety;
c. The Adjutant General of the North Carolina National Guard, North Carolina Department of Public Safety;
d. Commander of the State Highway Patrol, North Carolina Department of Public Safety;
e. Secretary of the North Carolina Department of Environmental Quality;
f. Secretary of the North Carolina Department of Transportation;
g. Chief of the Office of Emergency Medical Services, Division of Health Service Regulation, North Carolina Department of Health and Human Services;
h. Assistant State Fire Marshal, Office of the State Fire Marshal, North Carolina Department of Insurance;
i. State Chief Information Risk Officer, North Carolina Department of Information Technology;
j. Director, Division of Public Health, North Carolina Department of Health and Human Services;
k. Assistant Deputy Commissioner of Labor for Occupational Safety and Health, North Carolina Department of Labor;
l. President of the North Carolina Community College System; and
m. Director of the Emergency Programs Division, North Carolina Department of Agriculture and Consumer Services.

In addition to the foregoing, up to eight (8) at-large members from local government, private industry and the public may be appointed by the Governor and serve terms of two (2) years at the pleasure of the Governor. These members may consist of the following persons:

a. A Chief of Police;
b. A Sheriff;
c. A Fire Chief;
d. A representative of emergency medical services in North Carolina;
e. A representative of emergency managers in North Carolina;
f. A representative of medium or large sized public assembly venues in North Carolina;
g. A representative affiliated with the production, storage or transportation of hazardous materials;
h. A private citizen of the state of North Carolina.

In addition, the state is actively involved in critical legislative action in a number of ways. First, high level NCEM staff are in frequent communication with legislators and administrators in the executive branch to ensure that the state's needs are being met with regard to funding and other key resources. This was especially apparent after Hurricane Matthew in 2016 when these relationships resulted in a coordinated effort between NCEM and the legislature to pass the Disaster Recovery Act of 2016. Another way that the state is involved in legislative efforts is through the North Carolina Emergency Management Association which is a key organization in the state that includes many local and state level Emergency Managers and others in the field. In 2017, representatives from the NCEMA traveled to Washington D.C. to visit the offices of North Carolina representatives to discuss national-level emergency management topics and to provide Congressional representatives with opinions and concerns on important issues.

1.2.3 NCEM's Roles and Responsibilities Related to the North Carolina State Enhanced Hazard Mitigation Plan

Between the years of 2000 and 2014 the State Hazard Mitigation Officer (SHMO) held the responsibility of leading the State Hazard Mitigation Advisory Group (SHMAG) and the update process of the State's Hazard Mitigation Plan. In late 2013 a re-organization occurred within NCEM splitting the Hazard Mitigation Section into two parts. The new organization aligned the Risk Mitigation Planning Branch (formerly known as Hazard Mitigation Planning Branch) and the SHMO under the Risk Management Section of NCEM. The Risk Management Section houses Floodplain Mapping, National Flood Insurance Program (NFIP), Geographic Information Systems (GIS), Information Technology (IT), North Carolina Geodetic Survey and beginning in 2013, Risk Mitigation Planning. The Hazard Mitigation Branch was re-aligned under the Resilience Section of NCEM in 2018 under the supervision of the Hazard Mitigation Branch Section Manager.

Under the new organization the SHMO is responsible for Risk Mitigation Planning. The Risk Mitigation Supervisor, who is under the SHMO, oversees reviews of local plans and is responsible for leading the development and periodic update of the State's Hazard Mitigation Plan as determined by state and presidential disaster declarations, law, policy changes and innovations in hazard mitigations planning and activities. As part of the re-organization of NCEM the SHMAG was dissolved and the duties have been placed on the Risk Management Coordinating Council (RMCC). More details about the RMCC can be found in Section 2, Planning Process.

1.2.4 Plan Adoption and Approval

The State of North Carolina will formally adopt the North Carolina Enhanced Hazard Mitigation Plan upon receipt of Federal Emergency Management Agency's (FEMA) "Approved Pending Adoption" status. The plan will be formally adopted by the Governor or their designee. The FEMA Approval Letter and the formal adoption letter will then be integrated into the NC Enhanced Hazard Mitigation Plan.

1.2.5 Assurances

The NCEHMP update was drafted to meet the requirement for a Standard State Plan under Rule 44 CFR 201.4, and the requirements of the Enhanced State Plan under Rule 44 CFR 201.5 published by the Office of the Federal Register. The State currently meets and will continue to comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d). Continuing to meet the requirements of the regulations noted above keeps the state of North Carolina qualified to obtain all disaster assistance including Hazard Mitigation Grant Program funding available through the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288, as amended, and Unified Hazard Mitigation Assistance (UHMA) which includes the following funding streams: Hazard Mitigation Grant Program funding, Pre-Disaster Mitigation Program funding, and Flood Mitigation Assistance Program funding.

The State of North Carolina assures that it will continue to monitor all applicable Federal statutes and regulations as referred to on FEMA Approval Letters for each respective grant award, to include management cost projects. The State closely monitors federal compliance as it works to develop and implement current projects, and while closing previous disaster as well as non-disaster grants to ensure full programmatic compliance with federal requirements.

Section 2. PLANNING PROCESS

44 CFR Reference

Requirement §201.4(b) Planning process. An effective planning process is essential in developing and maintaining a good plan. The mitigation planning process should include coordination with other State agencies, appropriate Federal agencies, interested groups, and be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives.

Requirement §201.4 (c) Plan content. To be effective the plan must include the following elements: (1) Description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated.

2.1 GENERAL DESCRIPTION

This section serves as documentation of the planning process utilized to develop the 2018 update to the State of North Carolina's Hazard Mitigation Plan and Enhanced State Mitigation Plan as required for Standard State Mitigation Plans under the Disaster Mitigation Act of 2000 (DMA 2000), Sections 201.4(c)(1) and 201.4(b) of the Standard State Hazard Mitigation Plan criteria, which addresses Documentation of the Planning Process, Coordination Among Agencies, and Program Integration.

The Risk Mitigation Planning Branch began the update process in late 2016 with an internal review of each section of the current plan. Taking under advisement the FEMA reviewers' comments made during the last update, it was determined that the plan should be reorganized for better flow and ease of use. The Risk Mitigation Planning Supervisor wrote an entirely new table of contents for the plan and sent it out to stakeholders and NCEM staff for review and comment. After some revisions were made to the table of contents, Risk Mitigation staff members were assigned sections to transfer into the new format and review for necessary updates. Once each section was reviewed and analyzed, staff identified points of contact through the Risk Management Coordinating Council and coordinated the inclusion of any updated contributions to the mitigation plan by section.

In July of 2017, NCEM selected the team of ESP Associates and Atkins to provide consultant support for updating the planning and helping facilitate the planning process.

The following paragraphs generally summarize the revisions made to this plan during the 2018 update.

Planning Process

During the internal review process, it was determined that Risk Mitigation Planning staff would review and identify key processes that could be rewritten to clarify and streamline the planning process. Following the 2014 SHMAG meeting, the SHMAG was dissolved and the new Risk Management Coordinating Council (RMCC) was created as a type of steering committee for the entire Risk Management Section. This announcement was made on a conference call with the former SHMAG members in December of 2015. The scope of the RMCC is much broader than that of the SHMAG. It serves as the advisory group for the NCHMP, Risk MAP, and the NC Floodplain Mapping Program's discovery phase and fosters information and data sharing between state agencies.

Risk and Vulnerability Assessment

As part of the 2018 plan update process, NCEM Risk Mitigation staff and their consulting team reviewed the existing hazard identification, hazard descriptions, and the risk assessment. Through meetings with natural hazard experts from across the state (discussed in more detail in subsection 2.2) that provided a comprehensive representation of knowledge across all meteorological and geologic natural hazards that affect North Carolina, the risk and vulnerability assessment was completely reorganized. Through coordination with NCEM and these hazard experts, the consulting team collected preliminary information on previous occurrences, projections of future occurrences, and geographic locations of hazard events, which were later revised and supplemented with additional background research. With this information in hand, the planning team of NCEM and their consultants were able to develop a comprehensive analysis of risk across the state on a county by county basis.

Risk Mitigation Planning staff reviewed and made revisions to this section of the plan, including changes to hazard profiles and history. The HM staff, with the assistance of subject matter experts and NCEM-Risk Management, coordinated to revise text, identify state-owned facilities, perform new vulnerability assessments for hazards, and examine hazards as listed in the hazards section. This data was revised to include information on recent hazard events and new information on exposure, which ultimately made it necessary to update the overall vulnerability information in the plan.

Mitigation Strategy

The implementation of the new format of the North Carolina Enhanced Hazard Mitigation Plan changed the section number of the Mitigation Strategy Section of the plan to Section 5. It includes the Goals, Objectives, and Actions of the plan. To highlight some of the changes to the Mitigation Strategy Section, the single goal was changed and additional goals were added, the objectives were changed to be the milestones of the goals, and actions where reviewed for cost effectiveness, overall feasibility, availability of potential funding, political will, and to meet the SMART action criteria. SMART is an acronym for Specific, Measurable, Achievable, Relevant, and Time-Bound. This is a new concept to the North Carolina Enhanced Hazard Mitigation Plan for this update. Each action must meet all of the aforementioned criteria, either as it is or through revision, otherwise it was identified for deletion.

Risk Mitigation Planning staff reviewed the mitigation actions and made recommendations for revisions to the primary responsible agency through the RMCC members, various subject matter experts, and other stakeholders. After discussion with the responsible agencies, some actions have been identified for deletion and some new actions have been added. The deleted actions have been removed from the "Active" actions and put below in a new sub-section of the Mitigation Strategy Section.

Coordination of Local Mitigation Planning

The planning staff made some substantial changes to the part of the plan related to coordinating with local mitigation planning. This was especially notable in Risk and Vulnerability Assessment which includes a new methodology for evaluating local risk assessments (see section 3.4.5.1). That being said, the same basic process remains in place for coordinating local mitigation planning as described in Section 4. The major change over the past three years was that the planning staff became more adept at implementing the process and helping local governments develop their plans.

Plan Maintenance

Risk Mitigation Planning staff reviewed and made minimal grammatical revisions to this section of the plan. In this review, it made sure the plan maintenance process was still applicable and that it could be easily implemented.

Severe Repetitive Loss Strategy

Risk Mitigation Planning staff determined that the Severe Repetitive Loss Strategy would be integrated into all relevant sections of the plan, rather than having that information repeated and included in an Appendix.

2.2 TIMELINE AND MILESTONES

The State of North Carolina developed their first State Hazard Mitigation Plan in 2004. Updates to the plan have been completed in 2007, 2010, and 2013. Information about the planning processes used to develop previous version of this plan can be found within those plan documents, which are available upon request from NCEM. The process of updating the 2018 version of the plan began in January of 2017 with the first meeting of the RMCC.

Next, planning staff identified specific actions of representative agencies and coordinated with key points of contacts to address the status and validity of mitigation actions and objectives. Once information for various sources was collected, this information was incorporated into the plan and completed by the mitigation planning team members. Each updated section was combined into a complete document for review by the SHMO, the RMCC, and stakeholders. A point of contact was identified for each agency represented in the Capabilities section of the plan, and each agency was contacted and asked to review the material contained within the plan relevant to their agency for currency, accuracy, and continued relevance.

During the plan update, the SHMO and Risk Mitigation Planning staff participated in numerous conferences, workshops, meetings, and teleconference calls to discuss planning objectives, milestones, and improvements for both state and local plans.

Throughout the update process, important data was collected from a variety of sources, including the National Weather Service, National Centers for Environmental Information, NCEM-RM, and other local, state, and federal partners. This data was analyzed and incorporated into many different sections of the plan, including the risk assessment, capabilities assessment, and mitigation strategy. New data was included pertaining to population, economic activities, frequency of hazard events, and mitigation actions. Much of this information was obtained through meetings and communication with identified points of contact described below. Once all necessary new data was collected and integrated into the plan, it was submitted to stakeholders for final approval and then submitted to FEMA for review and approval.

2018 Update

The Risk Mitigation Planning Branch began the 2018 plan update process with an internal review of each section of the current plan after the 2017 planning team was chosen. Taking under advisement the FEMA reviewers' comments made during the last update, it was determined that the plan should be reorganized for better flow and ease of use. The Risk Mitigation Planning Supervisor wrote an entirely new table of contents for the plan and sent it out to stakeholders and NCEM staff for review and comment. After some revisions were made to the table of contents, Risk Mitigation staff members were assigned sections to transfer into the new format and review for necessary updates. Once each section was reviewed and analyzed, staff identified points of contact through the RMCC and coordinated the inclusion of any updated contributions to the mitigation plan by section.

The planning process was coordinated through the Risk Management Coordinating Council. More detail about specific meetings with the RMCC can be found in Section 2.3 below.

In July of 2017, NCEM selected the consulting team of ESP Associates and Atkins to provide consultant support for updating the planning and helping facilitate the planning process. An internal planning team made up of the Risk Mitigation staff and the consulting team began meeting on August 10, 2017 and met weekly until the plan draft was completed in late December 2017. Table 2-1 below provides a summary of the meetings held with NCEM Risk Mitigation staff and the consultant team during the update of this plan.

Table 2-1. Summary of Meetings with NCEM Risk Mitigation Staff and the Consultant Team

NCEM Risk Mitigation Staff and Consultant Team Meetings		
Meeting Theme	**Date of Meeting**	
State Plan Update Kickoff	08/10/17	
Integration with EMAP	08/23/17	
NC Enhanced State HM Plan Weekly Meeting	08/24/17 08/31/17 09/07/17 09/14/17 09/21/17 09/28/17	10/05/17 10/12/17 10/19/17 11/02/17 11/09/17 12/21/17
Mitigation Strategy Discussion	08/30/17	
Risk Assessment Discussion with NCEM GIS Staff	10/19/17 and 12/18/17	

2.3 PLANNING TEAM

The process for coordinating with federal, state, local, and other interested groups involved the Risk Mitigation staff increasing outreach efforts to develop hazard-specific points of contact and subject matter experts. The SHMO led this effort with the maintenance and update of the RMCC list (Table 2-2) and by attending various conferences, work groups, and community meetings. These meetings allowed the state to highlight the importance of a state and local planning process and comprehensive program management. During the 2018 update, the planning team evaluated the process for coordinating with federal and state agencies and, although some changes to the process were noted, the coordination process remained basically the same.

Table 2-2. Risk Management Coordinating Council Membership (2018)

Name	Agency
Debora Antley	NC Department of Information Technology
Darryl Aspey	Department of Homeland Security
Tim Baumgartner	NC Division of Mitigation Services – Environmental Enhancement Program
Jacky Bell	FEMA Region IV
Gail Bledsoe	NC Department of Agriculture and Consumer Services
John Boland	Johns Hopkins University
Richard Bolyard	NC Department of Insurance
Scot Brooks	NC Emergency Management Association
Robert Carruth	NC Association of County Commissioners
Julie Casini	NC Department of Health and Human Services
Shane Cook	NC Division of Energy, Mineral and Land Resources, NC Dam Safety
Lee Cox	NC Department of Health and Human Services
Ryan Cox	NCEM – Risk Management
Chris Crew	NCEM – Risk Management
Todd Davidson	NOAA Coastal Hazards Center
Tracy E. Davis	NC Division of Energy, Mineral and Land Resources
Matthew Dolge	NC Association of Regional Councils of Government
John Dorman	NCEM – Risk Management
Ryan Draughn	NC League of Municipalities
Rebecca Ellin	NC Coastal Reserve & National Estuarine Research Reserve
Edward Finley	NC Utilities Commission
Matt Flint	USDA
James Fox	UNC Asheville, National Environmental Modeling
Gerald Galloway	University of Maryland
Wayne Goodwin	NC Department of Insurance
Frank Gorham	NC Department of Environment Quality, Coastal Resource Commission
Brent Herron	UNC Campus Safety & Emergency Operations
Shelia Holman	NC Department of Environmental Quality
John Howard	NC Department of Agriculture & Consumer Services
Frank Jennings	NC Division of Coastal Management
Michael Kelly	NC Association of County Commissioners
Jamie Kruse	ECU, Center for Natural Hazards Research
David Lane	NC Department of Agriculture & Consumer Services
Steve Lewis	NC Department of Environment Quality
Mike Lopazanski	NCDCM
Rick Luettich	UNC-Marine Sciences
Nancy Marsh	EPA (Region 4) Ground Water
Carl Martin	NC Department of Insurance
Dr. R. Douglas Meckes	NC Department of Agriculture & Consumer Services
Tancred Miller	NC Division of Coastal Management
Hope Morgan	NCEM - Risk Management
Jesse Munoz	FEMA Region IV
Burt Neily	NC Department of Administration - State Construction

Name	Agency
Lee Padrick	NC Department of Commerce
Louis Panzer	NC 811
Nick Petro	NOAA/NWS, Raleigh Weather Forecast Office
Brandon Puckett	NC Coastal Reserve & Nat'l Estuarine Research Reserve
Terry Quarreles	FEMA Region IV - Public Assistance (406)
Stan Riggs	ECSU
Linda Rimer	EPA
Jeanne Robbins	USGS
Spencer Rogers	NC Sea Grant (NC State)
Terri Ruch	USDA-NRCS
Cindy Safrit	NC Department of Ag & Consumer Services
Mina Shehee	NC Department of Health and Human Services
Aaron Sims	NC State Climate Office
Matt Slagel	NCDCM
Gavin Smith	UNC Chapel Hill
Dianne Suess	NOAA/NWS Space Weather Prediction Center
Ken Taylor	NC Geologic Survey
Maria Thompson	NC Department of Information Technology
Jay Twisdale	NCDOT - Hydraulics
Chris Vaughn	FEMA
Toby Vinson	NC Division of Energy, Mineral, and Land Resources, NC Dam Safety
Chad Wagner	USGS North Carolina Office
Rebecca Ward	NC State Climate Office
J Curtis Weaver	USGS South Atlantic Water Science Center

The first meeting with the RMCC for the 2018 plan update was held on January 12, 2017. The purpose of the meeting was to lay out the vision of the council and to introduce the concept of a biennial risk management plan that helps identify the current state of Risk Management in North Carolina and identifies priorities, resources, and needs in the areas of hazards, data, models, applications, and plans. These priorities, resources, and needs became the goals and objectives for the updated Enhanced State Hazard Mitigation Plan.

2.4 STAKEHOLDER INVOLVEMENT

2.4.1 Governmental Agencies

As described above, the RMCC served as the official stakeholder group for coordinating the 2018 plan update process. In addition to the meetings described in Section 2.3, Risk Mitigation staff and the consulting team held meetings with individual State and Federal agencies that serve on the RMCC to collect feedback on the plan in a more personal setting. Separate meetings were held with representatives from the following governmental agencies:

- North Carolina Forest Service
- North Carolina Dam Safety Program
- United States Army Corps of Engineers
- North Carolina Geological Survey
- North Carolina Department of Health and Human Services
- North Carolina Housing Finance Agency
- North Carolina Department of Agriculture
- North Carolina Department of Environmental Quality: Division of Coastal Management
- North Carolina State Historic Preservation Office
- State Climate Office of North Carolina
- North Carolina Department of Insurance
- North Carolina Office of State Fire Marshall
- North Carolina Department of Transportation

The purpose of the meetings was to review specific information from those stakeholders related to the risk assessment (discussion of data needs and identification of any new data relevant for the plan update), capability assessment (updating existing capability assessment narratives and providing any new relevant information), and mitigation strategy (updating existing actions and providing any new actions). These meeting were very productive as these stakeholders provided information and led to new data being incorporated into the plan, mitigation action updates and new mitigation actions and updated capability assessment information.

Table 2-3 below provides a summary of these meetings including the stakeholder, main topic discussed at the meetings and the dates of the meetings.

Table 2-3. Summary of Stakeholder Meetings

Summary of Stakeholder Meetings	
Stakeholder (Discussion Topic)	Date of Meeting
North Carolina Forest Service (Wildfire)	9/27/17
NC DEQ: Dam Safety (Dam Failure)	10/3/17 and 10/10/17
USACE (Dam Failure, Levees)	10/10/17
NC DEQ: NC Geological Survey (Geological Hazards)	10/11/17
NC Department of Health and Human Services (Infectious Disease)	10/13/17
Housing Finance Agency (Housing Mitigation Programs/Mitigation Capabilities)	11/7/17
State Historic Preservation Officer (Historic and Cultural Resources)	11/8/17
NC Department of Agriculture (Mitigation Capabilities)	11/14/17
NC DEQ: Division of Coastal Management (Coastal Hazards, Mitigation Capabilities)	11/15/17
State Climate Office (Hazard Profiles, Risk Assessment Data)	11/20/17
NC Department of Insurance: State Fire Marshall's Office (Mitigation Capabilities, Building Codes, State-Owned Facilities)	11/20/17

In addition to regular RMCC representatives, state and local government representatives, emergency management practitioners, and subject matter experts were invited to comment on the plan.

2.5 REVIEW AND INTEGRATION OF OTHER PLANNING FUNCTIONS

The State of North Carolina continues to be proactive in developing, implementing, and sustaining hazard mitigation planning and activities with federal, tribal, state, local, and nongovernmental agencies and programs. Through partnerships with RMCC members and participation on various panels and work groups, risk mitigation planning efforts have been integrated to provide solutions to hazards identified in the State Enhanced Hazard Mitigation Plan and to become more disaster resilient. To maintain a high level of performance, knowledge of mitigation trends, and technology, the SHMO and Risk Mitigation Staff attend various trainings, conferences, and local meetings to augment ability to provide technical assistance to customers, RMCC members, and mitigation partners statewide. Risk Mitigation Staff coordinates with locals through 3 regional branches, with a total of 15 area specific coordinators who serve as intermediaries between local governments and staff in the office.

A summary of how Risk Mitigation staff works with local, State and Federal agencies to integrate hazard mitigation into other State planning processes and planning initiatives is found below.

2.5.1 Integration with State Planning Programs

Division of Emergency Management Planning Section

The State Risk Mitigation Branch coordinates regularly and works very closely with the State Planning and Homeland Security Branch. This branch of NCEM is responsible for the State Emergency Operations Plan, THIRA, Radiological Emergency Plans, Strategic Plan, Division Directives, SARA Title III (Emergency Planning Community Right to Know Act), and the Continuity of Operations Plan. While their focus is generally Response and Preparedness statewide, staff works closely with them to ensure all hazards are identified as part of the All Hazards approach adopted by NCEM. The mitigation plan serves as the single Hazard Identification and Risk Assessment (HIRA) for all plans within NCEM. During review and update of all NCEM Plans and After-Action Reports, staff look at response and vulnerability to population, property, infrastructure, and development which is integrated using the HIRA from the NCHMP. Goals, risk assessments, threat assessments, and hazard identification efforts in local communities and statewide are also utilized in this effort.

State Floodplain Mapping Program

The State Risk Mitigation Planning Branch coordinates regularly and works very closely with the Floodplain Mapping program. This program is the basis by which many communities assess their flood hazards and how the state, as a whole, looks at flooding vulnerability to existing and future structures and development. Floodplain Mapping works across the state to help communities plan for development and avoid flooding in their communities, which is tied very closely to mitigation planning efforts in local communities and statewide. The efforts made by floodplain administrators have led to changes in the International Building Code to include freeboard for development in floodplains across North Carolina. The risk and vulnerability assessment utilized in this plan identifies areas that are subject to NFIP requirements.

Division of Coastal Management (A Division of NC Department of Environmental Quality)

The SHMO provides courtesy reviews of Coastal Area Management Act (CAMA) Land Use Plan updates for the 20 coastal counties upon request from DEQ. The review is designed to ensure that CAMA plans and hazard mitigation plans are consistent. Also, the State Risk Mitigation Branch coordinates with the Division of Coastal Management (DCM) when it comes to working in designated CAMA counties. For projects planned in these counties, staff coordinated with DCM to ensure that work will not conflict with an area of Environmental Concern according to CAMA regulations.

North Carolina Department of Transportation Coordination

The State Risk Mitigation Branch coordinates with NCDOT's Project Development Unit any time there is a potential hazard mitigation project underway. NCEM sends NCDOT information about the location of the project, and they review it against their future plans to ensure no future conflict with deed restricted property and future road projects. Additionally, NCEM and NCDOT coordinate regularly to share data related to hazards and hazard impacts for pre-event and post-event planning purposes.

North Carolina State Geologist

Since the development of the 2004 State Hazard Mitigation Plan, North Carolina has attempted to gain funding to support mapping of landslides. However, recently much of the funding that had been allocated to that purpose was de-obligated, so efforts have more or less stopped as of 2018.

Other recent work with the State Geologist has included outreach about the earthquake hazards in the western part of NC. The State Risk Mitigation Branch has worked with the State Geologist to develop a curriculum about earthquake hazards in NC to help communities and the state as a whole plan for earthquakes.

North Carolina Housing Finance Agency

Since its creation in 1973 by the General Assembly, the North Carolina Housing Finance Agency (NCHFA) has financed more than 255,000 affordable homes and apartments for North Carolina citizens. Its mission is to create affordable housing opportunities for North Carolinians whose needs are not met by the market.

NCHFA is a self-supporting public agency. The Agency operates federal and state housing programs including the Low-Income Housing Tax Credit Program and the North Carolina Housing Trust Fund and provides financing through the sale of tax-exempt bonds and mortgage-backed securities. NCHFA also administers the federal HOME program for North Carolina, a block grant from the Department of Housing and Urban Development to finance affordable homes and apartments developed by local governments, nonprofits, and private entities.

Using these and other sources of funds, including its own earnings, the Agency provides a variety of services ranging from low—cost mortgages and down payment assistance for qualified home buyers, helping local governments, non-profit organizations, and private entities develop affordable homes and apartments, financing the development of supportive housing for those with unique housing needs, financing the rehabilitation of substandard owner-occupied homes statewide, and providing foreclosure prevention help in partnership with HUD-approved housing counseling agencies.

In response to damage from Hurricane Matthew and Tropical Storms Julia and Hermine the Essential Single-Family Rehabilitation Loan Pool – Disaster Recovery was created. The source of funds includes specially-appropriated loan funds from the NC General Assembly. The NCHFA is working closely with NCEM and NC Department of Commerce.

Post Hurricane Matthew, Resilient Redevelopment Planning Initiative

In October 2016, Hurricane Matthew caused widespread destruction in the State of North Carolina. At least 26 people lost their lives, and 100,000 homes, businesses, and government buildings sustained damage estimated at $4.8 billion.[1] At the storm's peak, 3,744 individuals fled to 109 shelters across the region. More than 800,000 households lost power and 635 roads were closed, including the major east-west and north-south corridors.

In December 2016, the North Carolina General Assembly established the North Carolina Resilient Redevelopment Planning (NCRRP) program as part of the 2016 Disaster Recovery Act (*Session Law 2016-124*). The purpose of the program is to assist the communities that were damaged by the hurricane by providing a roadmap for community rebuilding and revitalization. The program empowers communities to prepare locally driven recovery plans that identify redevelopment strategies, innovative reconstruction projects, and other necessary actions to allow each community not only to survive, but also to thrive in an era when natural hazards are increasing in severity and frequency. The NCRRP consists of planning and implementation phases and was managed through NCEM.

[1] *State of North Carolina Supplemental Request for Federal Assistance Hurricane Matthew Recovery, https://governor-new.s3.amazonaws.com/s3fs-public/documents/files/Hurricane%20Matthew%20Relief--2017%20Federal%20Request%20%28002%29.pdf.*

These planning documents provided a snapshot of the current needs of the impacted counties with regard to holistic recovery and redevelopment. The plans will evolve as the counties analyze the risk to its assets, identify needs and opportunities, determine the potential costs and benefits of projects, and prioritize projects. As projects are more fully defined, the potential impact on neighboring communities and the region may lead to modifications.

Risk Mitigation Branch staff attended many of the meetings that were held during the development of the Resilient Redevelopment Plans (RRP). They provided input and technical assistance (particularly in how hazard mitigation should be related and integrated into the RRPs) that was used by the stakeholder groups as they developed their plans.

Health and Social Services

The North Carolina Department of Public Health and Human Service, Division of Public Health, Office of Public Health Preparedness and Response provides representation on the Risk Management Coordinating Council and has contributed their knowledge and expertise to the development of the Enhanced State Hazard Mitigation Plan. Their participation in the RMCC opened new channels of communication between NCEM and the Division of Public Health to address the critical issues of communicable disease and bioterrorism and other public health hazards that are being integrated into this plan.

Coordination with Local Governments

A tool that is used to help the state promote mitigation efforts at the local level is for Risk Mitigation staff to provide outreach, technical assistance, and guidance to local governments to ensure that information contained in their individual hazard mitigations plans meets the requirements set forth in the 44 CFR and is consistent with the state's mitigation goal.

Our office has adopted an outreach strategy that helps communities to produce viable and relevant hazard mitigation plans and establishes relationships that continue throughout the local and state hazard mitigation plan update cycle.

Through amplified outreach activity, the Hazard Mitigation Branch staff provides technical assistance to community officials through scheduled meetings, conferences, and trainings to provide information on the annually available non-disaster mitigation program funding: the Pre-Disaster Mitigation (PDM) and Floodplain Mitigation Assistance (FMA) program. The outcome of this effort is the development of mitigation activity that may be funded through these programs, thus making the community more resilient to natural hazards.

NCEM, FEMA, and various state and local government officials work to develop and implement project management efforts based on information from communities that have identified mitigation opportunities. This coordination effort provides an opportunity for the Risk Mitigation Branch to share information to help expedite the development and implementation of mitigation projects as well as recovery from events.

2.5.2 Integration with FEMA Mitigation Program and Other Federal Initiatives

The state of North Carolina Division of Emergency Management has and will continue to seek federal partners that can assist the state with improving the quality of life for its citizens through administration of mitigation activities. We believe that coordination and planning with our federal partners will help make our state resilient to all hazards. The FEMA and federal programs that we administer and/or provide assistance include:

- The Hazard Mitigation Grant Program (HMGP)
- The Flood Mitigation Assistance (FMA) Program
- The Pre-Disaster Mitigation (PDM) Program
- Public Assistance (PA)
- Individual Assistance (IA)
- Earthquake Consortium Grant
- Emergency Management Performance Grants Program (EMPG)
- Homeland Security Grant
- Disaster Unmet Needs
- Increased Cost of Compliance (ICC)
- National Floodplain Management Program (NFIP)

Given the ever-changing climate, communities are looking for ways to incorporate whole community concepts while maintaining open space property to help reduce vulnerability. As such, we coordinate with FEMA on requests for variances from communities to utilize properties as farms, parks and various other uses allowed under 44 CFR.

Public Assistance, Individual Assistance and Various Stakeholders

After a presidential declaration, NCEM, FEMA, SBA, and various federal, state, and non-profit organizations operate in a Joint Field Office (JFO) setting. The state's Resiliency Section consists of the Public Assistance, and Individual Assistance Branches. The Resiliency Section coordinates closely with FEMA in those situations to cultivate a cooperative approach for outreach, identification, development, and implementation of potential mitigation opportunities.

Potential applicants are briefed on mitigation opportunities that are available under the Hazard Mitigation Program. Risk Mitigation staff also works with our FEMA, state, and local partners to complete Preliminary Damage Assessments (PDA) as well as mitigation planning and outreach efforts to identify 406 and 404 mitigation opportunities.

Emergency Management Accreditation Program (EMAP)

Developed through the collaboration of the International Association of Emergency Managers (IAEM), National Emergency Management Association (NEMA), Federal

Emergency Management Association (FEMA), and other related agencies, EMAP is a voluntary accreditation process for federal, state, county, and municipal emergency response agencies. The accreditation process was developed to provide a framework for accountability and continuous improvement at the state and local level.

The North Carolina Division of Emergency Management gained EMAP initial accreditation in November of 2008, received re-accreditation 2013, and will be going through the reaccreditation process again in the spring of 2018. Risk Mitigation coordinated with the Division's Planning and Homeland Security Section to update the Mitigation Standards required for continued accreditation. Risk Mitigation has been included in the overall evaluation of the division as a whole and is an integral part of the NCEM EMAP Working Group which is the team that leads the process of developing proof of compliance documentation of the EMAP standards of accreditation. Risk Mitigation's contribution to the EMAP process was the update of 2 standards and 7 sub-standards of the 73 required for EMAP accreditation. The EMAP process evaluates emergency management program elements compliance based on the NFPA 1600 Standard. Additionally, Risk Mitigation has improved its information on Mitigation's Standard Operating Procedures and Best Practices.

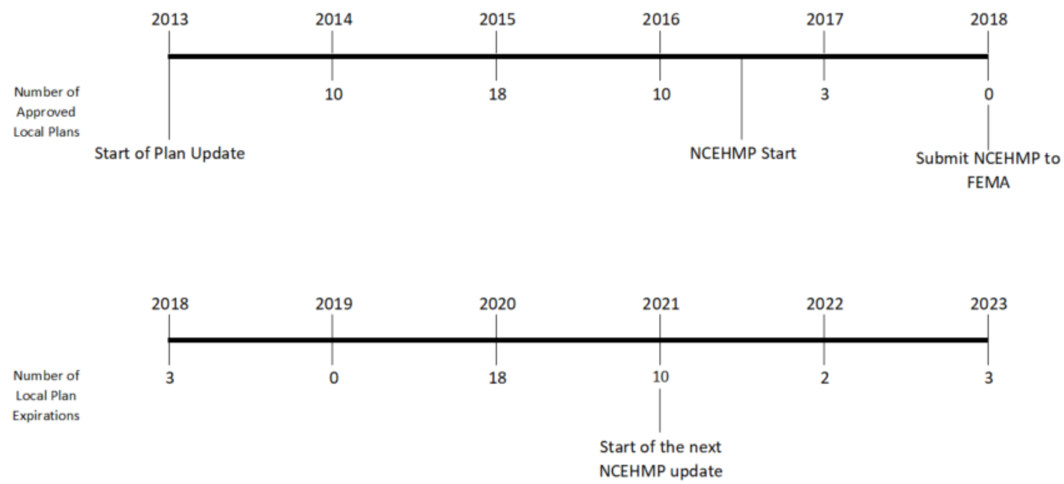
The National Integrated Drought Information System (NIDIS)

Risk Mitigation staff also participates in workgroups with entities such as the National Drought Mitigation Center (NDMC) to promote the impact of drought on communities and the ecosystem. Our charge is to help develop activities that will help to mitigate the effects of drought on people and property. NIDIS was envisioned to be a dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and the associated risks they bring and the decision support tools needed to better prepare for and mitigate the effects of drought. In this, NIDIS forms the backbone of a national Drought Early Warning System in the U.S.

2.5.3 Integration with Local Planning Functions

Local governments often reference the NCEHMP plan for assistance in identifying hazards, profiling hazards and for vulnerability assessment information to support their local mitigation planning efforts. The local plans and the single tribal plan in North Carolina are all generally updated early in the five-year cycle of the North Carolina Enhanced Hazard Mitigation plan. This would be in years one through three of the state plan update cycle. While there are four plans that are in the update process at the time we begin the state plan process, they are far enough into the process for the NCEM and RMCC to review those plans for coordination and linkage purposes. The planning team for the state plan review the local plans to ensure goals, objectives, actions, risk assessment and local capabilities are aligned to the extent necessary. Figure 2-1 below provides a graphical representation of the interconnectedness between NCEHMP update cycle and the local plan update and expiration schedule.

Figure 2-1. Local Plan Approvals and Expirations and their Connection with the State Plan Update Cycle



2.6 RISK MANAGEMENT TOOL

The Risk Management Tool (RMT) was developed by NCEM-RM as a tool to simplify hazard mitigation plan development into a single, automated, tool-based format to include geospatially based risk assessment data, also developed by the NCEM-RM. The RMT is a twofold system used to create and/or update a local and state hazard mitigation plan. The two parts of the RMT are a step-by-step system that will prompt a user to input information and narrative as well as upload pictures, documents and other information as needed. The second part of the system is the Risk Tool. The Risk Tool will run a risk assessment at the building level for each hazard selected based on predetermined calculations for each hazard. Some hazards will have a single return period and others have multi-return periods. The availability of multi-returns periods are based on the availability of datasets for each hazard and the degree of detail in each dataset.

The Risk Assessment produced by the Risk Tool will also identify high-risk structures in the planning area and estimate cost by types of mitigation projects (wind retrofits, elevation, acquisition, mitigation reconstruction) and benefit-cost estimates by type of mitigation. The mitigation tool is only meant to begin the process of thinking about problem areas where mitigation may be of interest to the jurisdiction and property owners. It is also designed to drive mitigation actions that are specific, measurable, attainable, realistic and timely.

Once all of the information is input into the system, a hazard mitigation plan can then be exported into multiple document formats. The system will also store the plan so that when it is time to update the plan, the information is already in the system.

The RMT was originally developed as part of the Integrated Hazard Risk Management (IHRM) pilot project which included Durham, Edgecombe, Macon and New Hanover counties. The pilot was successful and it was determined that there is a need and interest in a system designed to be used statewide and potentially nationwide in the future. NCEM is in the final stages of building out Version 2 of the RMT.

Section 3. RISK AND VULNERABILITY ASSESSMENT

44 CFR Reference

Requirement §201.4(c): [The Standard State Plan Maintenance Process must include a]

(2) Risk assessments that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments. The risk assessment shall include the following:

(i) An overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate;

(ii) An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed;

(iii) An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

This section is primarily divided into two main topics: Natural and technological hazard Identification and subsequent hazard profiles (found in Sections 3.2-3.5) and, Vulnerability assessment (found in Section 3.6).

3.1 OVERVIEW OF HAZARDS IDENTIFIED

The hazards identified in this document are all hazards that could potentially affect the state of North Carolina. These hazards span several categories including natural hazards, technological hazards, manmade hazards, public health hazards, and agricultural hazards. It is important to note that the Disaster Mitigation Act of 2000 only requires states to address natural hazards in the hazard mitigation plan; however, technological hazards are being included in this section because of the interconnectivity between hazards and because the State wishes this document to serve as the Hazard Identification and Risk Assessment (HIRA) for all state-level emergency management planning efforts.

The hazards have been identified by a working group of subject matter experts (SME) from across state agencies, academia, and the private sector. For the 2018 update of this plan, this list was reviewed, discussed in detail, in coordination with the EMAP working group which is made up of representatives from each branch of NCEM. It was then presented to the Risk Management Coordinating Council as the official list of hazards pending any additional input and/or comments. There was not any additional input or comments received, therefore it was deemed to be the official list to include in this plan.

Natural Hazards	Technological Hazards
Flooding	Hazardous Substances
Hurricanes and Coastal Hazards	— Hazardous Materials
Severe Winter Weather	— Hazardous Chemicals
Excessive Heat	— Oil Spill
Earthquakes	Radiological Emergency – Fixed Nuclear Facilities
Wildfires	Terrorism
Dam Failures	— Chemical
Drought	— Biological
Tornadoes/Thunderstorms	— Radiological
Geological	— Nuclear
— Landslides/Rock Fall	— Explosive
— Sinkholes	Cyber
Infectious Disease	Electromagnetic Pulse

The list of hazards above represents a significant change in the number and types of hazards identified in the previous version of the plan. The table below provides a summary of the hazards included in this plan and how those hazards were represented in the previous plan.

2018 Hazards	Hazards from 2013 Plan Covered Under 2018 Hazard	Subhazards from 2013 Plan Covered Under 2018 Hazard
Flooding	Flooding	
Hurricanes and Coastal Storms	Hurricanes, Rip Current, Nor'easters	Storm Surge associated with Hurricanes and Nor'easters, High Wind associated with Hurricanes and Nor'easters, Torrential Rain, Tornadoes Associates with Hurricanes, Severe Winter Weather associated with Nor'easters
Severe Winter Weather	Severe Winter Weather	Freezing Rain, Snowstorms, Blizzards, Wind Chill, Extreme Cold
Excessive Heat	Heat Wave	

2018 Hazards	Hazards from 2013 Plan Covered Under 2018 Hazard	Subhazards from 2013 Plan Covered Under 2018 Hazard
Earthquakes	Earthquakes	
Wildfires	Wildfires	
Dam Failures	Dam Failure	
Drought	Drought	Agricultural Drought, Hydrological Drought
Tornadoes/Thunderstorms	Tornado, Severe Thunderstorm	Hailstorm, Torrential Rain associated with Severe Thunderstorms, Thunderstorm Wind, Lightning, Waterspout, High Wind
Geological Hazards (Landslides/Rock Fall, Sinkholes, Coastal Erosion)	Debris Flow/Landslide, Sinkholes, Coastal Erosion	
Infectious Disease (new to 2018 plan)		

3.1.1 Hazard Identification and Hazard Profiles Methodology

The Hazard Profiles subsections follow the same general format throughout the plan to provide the user with consistent information for each hazard. Each hazard profile is made up of a Description, Extent (as defined by FEMA), Location, Hazard History, Changing Future Conditions, Impact, Future Probability, and Emergency Operation Plan reference. Each one of the subsections are included to give the user an extensive understanding of the hazard and how it could affect North Carolina. As part of the methodology description of the hazard profile, each one of the subsections are further defined below.

The hazard description provides a definition or scientific description of the hazard. Hazards often have multiple categories they will fall into depending on where or how the hazard affects North Carolina. These descriptions will also be examined in detail as part of the hazard description subsection. Natural hazard definitions were obtained primarily from National Oceanic and Atmospheric Administration and the National Weather Service.

The Extent of a hazard as defined by FEMA is the strength or magnitude of the hazard. This subsection will define the scale of which the hazard is measured as well as the worst-case event to affect North Carolina. Extent should not be confused with the impact of a hazard. Extent is solely based on the scale of which the hazard is measured and not the effects of the hazard. To provide an example of extent for the purposed of this plan, a hurricane is measured on the Saffir-Simpson Scale with categories one through five. The extent subsection will define the Saffir-Simpson Scale in detail and provide information of the highest category hurricane event to affect North Carolina. Natural hazard extent data was obtained primarily from National Oceanic and Atmospheric Administration and the National Weather Service.

Location is a description of the geographical area that could potentially be affected by a hazard. Every hazard identified in this plan could affect North Carolina however it may not affect all geographic regions of North Carolina. To provide an example, a landslide is a hazard for the mountainous region but it is not a hazard for the coastal plains region due to the topographical differences of the two regions.

The Hazard History will provide a list of previous occurrences of the hazard. It will also go into greater detail of the more significant events that have affected the state. This is also where a detailed list of previous State and Federal disasters declarations have occurred. Information can be found for each event regarding property losses, economic losses, crop losses, and injuries and deaths attributed to a specific event. Historical data for the hazard profiles was obtained from National Centers for Environmental Information (NCEI). The historical data was used to capture previous occurrences of the hazards.

Changing Future Conditions is a description of how the hazard's impact, frequency, and magnitude could potentially change in the future due to a variety of factors. These factors could be but are not limited to changing global weather patterns, future development in both the urban and rural areas, and changing local and global environmental conditions.

Impact is the description of the effects or consequences of the hazard on the state. The description will include the potential effects or consequences of the hazard on state owned assets and the jurisdictions within the state. Effects of the hazard vary greatly depending up the capability to mitigate, prepare for, respond to, and recover from the event. This is also where a discussion can be found on the exposed population to the hazard.

Future Probability describes the likelihood of a hazard event happening within the geographical boundaries of North Carolina in any given year. This is expressed by a scale that has been determined to be appropriate through the analysis of all hazards. The scale has been determined by reviewing the return periods of all of the hazards, historical occurrence data, the geographical area at risk for the hazard, and consideration of changing future conditions. The planning team, including subject matter experts, then assigned a general descriptor to each hazard. The general descriptors used are Unlikely, Likely and Highly Likely. The table below shows how these general descriptors correlate to a percentage range of probability however there is not a specific percentage determined for each hazard due to the subjectivity of the aforementioned factors. It is important to note the method used to determine the future probability is qualitative and not quantitative as well as the impact of a hazard is not factored into future probability. While some hazard's impacts are far greater that others, it does not increase or decrease the likelihood of a significant hazard event occurring. Historical data for the hazard profiles was obtained from National Centers for Environmental Information (NCEI).

Category of Likelihood	Correlating Percentages of Probability
Unlikely	1% to 33.3%
Likely	33.4% to 66.6%
Highly Likely	66.7% to 100%

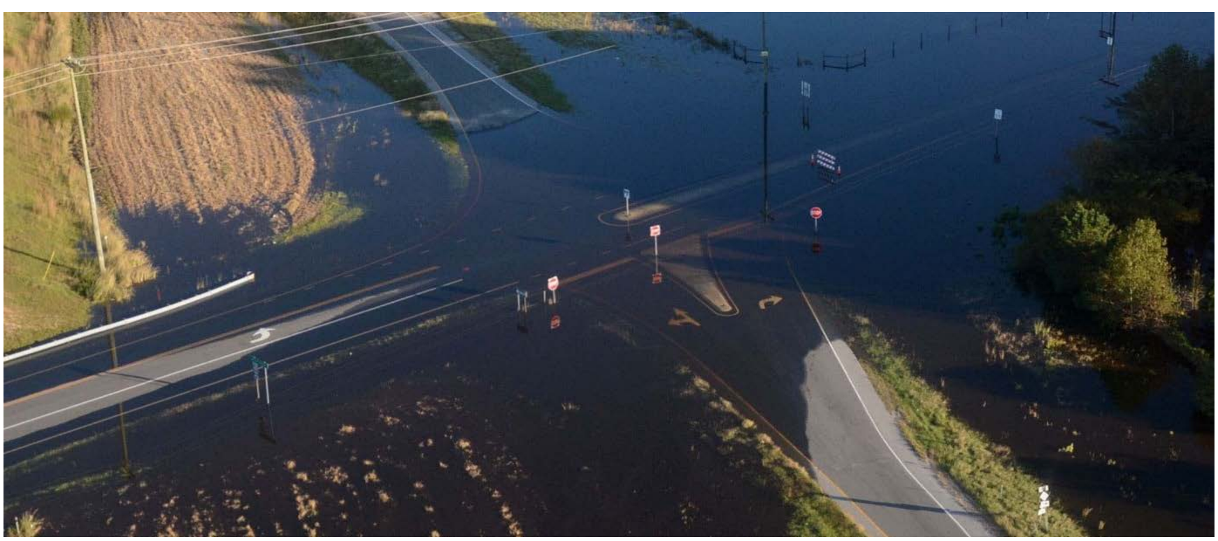
The North Carolina Emergency Operations Plan (NCEOP) Reference subsection is new to the 2018 update of the NCEHMP. While it is not a requirement of state planning guidance, it was determined that this addition would increase transparency among documentation. Planning efforts are coordinated among all staff within the agency in an effort to support an all-hazards approach using the operating procedures outlined in the NCEOP. The NCEOP may contain additional annexes that identify operating procedures for other cascading impacts. These annexes have been developed in regards to frequency of regional occurrence, the potential impact of a hazard, and the need for abnormal response procedures. Conversely, some hazards identified in Section 3.2 of this Hazard Mitigation Plan fall under the response outlined within the Basic Plan or other annexes of the NCEOP. For more information on the NCEOP, please visit the North Carolina Department of Public Safety website.

3.2 NATURAL HAZARD IDENTIFICATION

3.2.1 Flooding

3.2.1.1 Description

Flooding is a localized hazard that generally results from excessive precipitation. Floods are generally considered to fall in one of two categories: **flash floods**, which are the product of heavy localized precipitation that occurs within a short period of time at a given location; and **general floods**, caused by precipitation that occurs during a longer period of time over a particular river basin.



Flooding is the most common environmental hazard to affect the United States, due to the widespread geographical distribution of river valleys and coastal areas, and the attraction of human settlements to these areas. Most recent presidential declarations concerning major disasters have been associated with flash floods and general flooding.

Flash floods occur shortly after a heavy accumulation of rainfall or result from a dam or levee failure or from a sudden release of water held by an ice jam. Flash floods can destroy buildings and bridges, uproot trees, and scour out new drainage channels. Heavy rains that produce flash floods can also trigger mudslides. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in one local area, or by heavy rains generated by hurricanes and tropical storms. Although flash flooding occurs often along western mountain streams, it is also common in urban areas throughout the state, especially in areas where much of the ground is covered by impermeable surfaces. Roads and buildings impervious to water infiltration generate greater amounts of runoff than typical forested land. Fixed drainage channels in urban areas may be unable to contain the runoff that is generated by relatively small but intense rainfall events.

A combination of river basin physiography, local thunderstorm movement, past soil moisture conditions, and the degree of vegetative clearing and creation of impervious surfaces resulting from development determines the severity of a flooding event. Abnormal weather patterns may also contribute to the flooding of a local area. Large-scale climatic events (such as the El Nino-Southern Oscillation in the Pacific Ocean) have been linked to increased storm activity and flooding in the United States.

Nationally, July is the month in which most flash flooding events occur in the United States, and nearly 90 percent of flash floods occur during the months of April through September (Frazier, 1979). While flash floods occur within hours of a rain event, general flooding is a longer-term event, and may last for several days or weeks. The primary types of flooding are riverine flooding, coastal flooding, and urban flooding.

The periodic flooding of lands adjacent to non-tidal rivers and streams is a natural and inevitable occurrence. When stream flow exceeds the capacity of the normal water course, some of the above-normal stream flow spills over onto adjacent lands located within the floodplain.

Floodplains are relatively low-lying areas adjacent to streams, lakes, rivers, or coast commonly prone to flooding. Floodplains are part of the natural hydrologic system, serving the important function of carrying and temporarily storing excess floodwater or dampening the energy of torrential rain or coastal storms. In addition, floodplains are useful for maintaining water quality, preserving groundwater supply, supporting natural vegetation and providing natural habitats, as well as offering many kinds of recreational and educational activities. Floodplain boundaries are designated and routinely updated through Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) reports and these revisions are then shown on Flood Insurance Rate Maps (FIRMs), according to various flood hazard zones. Flood hazard zone designations will depend upon local conditions and the date when the map was issued, but all will show the 100-year or base floodplain (1-percent annual chance), as well as areas of the 500-year floodplain (0.2-percent annual chance).

Riverine flooding is a function of precipitation levels and water runoff volumes within the watershed of the stream or river. The recurrence interval of a flood is defined as the average time interval (in years) expected to take place between the occurrence of one flood of a particular magnitude and the occurrence of a flood of equal or larger magnitude. Generally, flood magnitude increases as recurrence intervals decrease.

Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by tropical systems during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push seawater up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forestlands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts.

Urban flooding occurs where there has been development within stream floodplains or in coastal areas where there are high levels of development. This is partly a result of the use of waterways for transportation purposes in earlier times. Sites adjacent to rivers and coastal inlets provided convenient places to ship and receive commodities. The ultimate price of this accessibility was the increased flooding of ensuing urban areas. Urbanization increases the magnitude and frequency of floods by increasing the number of impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land and occasionally overwhelming sewer systems by infiltration and inflow.

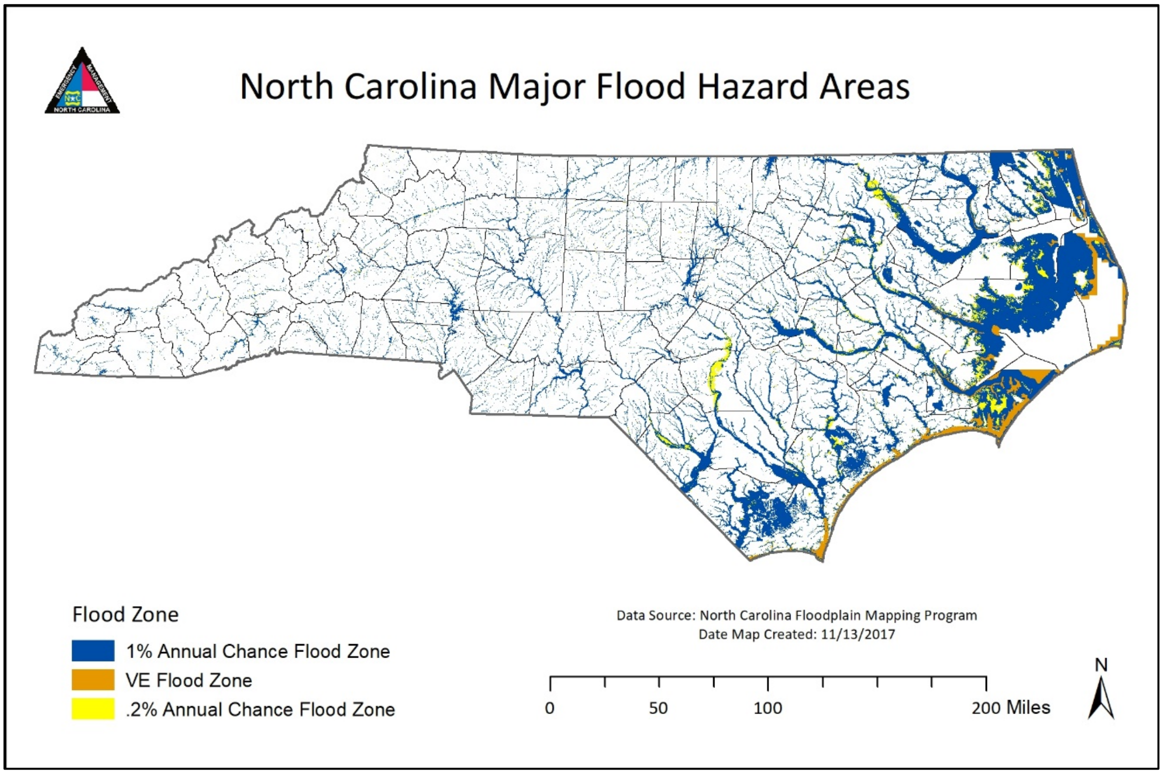
3.2.1.2 Extent

Flood extent can be measured by the amount of land in the floodplain as well as by flood height and velocity. According to the North Carolina Floodplain Mapping Program, the amount of land in the floodplain in North Carolina accounts for about 18.2 % of the total land area in the state.

3.2.1.3 Location/Spatial Extent

The North Carolina Floodplain Mapping Program is currently in the process of developing and updating digital flood hazard data for the entire state of North Carolina. Currently, new digital flood hazard data exists for all of the state’s 100 counties which are summarized in Figure 3-1. The figure also includes the delineation of Coastal High Hazard Areas which is that part of the coastal floodplain where wave heights during the base flood event will be three feet or more (also designated by FEMA as "V Zones"). Based on historical events, flooding in some areas of the state could be up to 20 feet in depth and flooding generally could occur in any county in the state.

Figure 3-1 North Carolina Mapped Flood Hazard Areas Through 2017



3.2.1.4 Hazard History

Many North Carolina counties have experienced major catastrophic flooding in recent years, and some have experienced multiple major flooding disasters. Since 1977, North Carolina has received Federal aid from the Small Business Administration (SBA) and/or FEMA for 23 major disasters that produced substantial flood damage to one or more counties. These major disasters are listed in Table 3-1.

Table 3-1 Presidential Flooding Disasters Since 1977

Event	Location	Damages
1977 Floods (11/1977)	Western North Carolina	$14,189,210
1979 Floods	Surry County	$56,084
Hurricane Diana (09/1984)	Coast	$67,000,000
Hurricane Gloria (09/1985)	Coast	$8,500,413
1989 Floods (09/1989)	Fayetteville	$10,000,000
1992 Flood (09/1992)	Swain County	$2,186,000
Hurricane Emily (08/1993)	Dare County	$12,500,000
Hurricane Opal (10/1995)	Mountain Counties	$9,400,000
Western Flooding (01/1998)	Western North Carolina	$7,000,000
Hurricane Bonnie (08/1998)	Eastern North Carolina	$22,000,000
Hurricane Dennis (08/1999)	Eastern North Carolina	$10,000,000
Hurricane Floyd (09/1999)	Mid/East North Carolina	$3,403,839,436
Hurricane Isabel (09/2003)	Mid/East North Carolina	$372,500,000
Tropical Storm Frances (09/2004)	Western North Carolina	$20,500,000
Hurricane Ivan (09/2004)	Western North Carolina	$13,800,00
Hurricane Ophelia (10/2005)	Coastal North Carolina	$70,000,000
Tropical Storm Hanna (10/08/2008)	Beaufort, Brunswick, New Hanover and Person Counties	$10,000,000
Severe Winter Storm and Flooding (02/02/2010)	Western North Carolina	$10,000,000
Tropical Storm Nicole (10/14/2010)	Eastern North Carolina	$5,431,477 (IA only)
Hurricane Irene (08/31/2011)	Eastern and Central North Carolina	$115,431,919 (IA and PA)
Eastern Cherokee Flooding (01/14/2013)	Western North Carolina	$3,161,875
2013 Flooding (07/2013)	Western North Carolina	$14,217,743
Hurricane Matthew (08/07/2016)	Eastern and Central North Carolina	$1,500,000,000

Source: FEMA.gov

Flooding in Western North Carolina

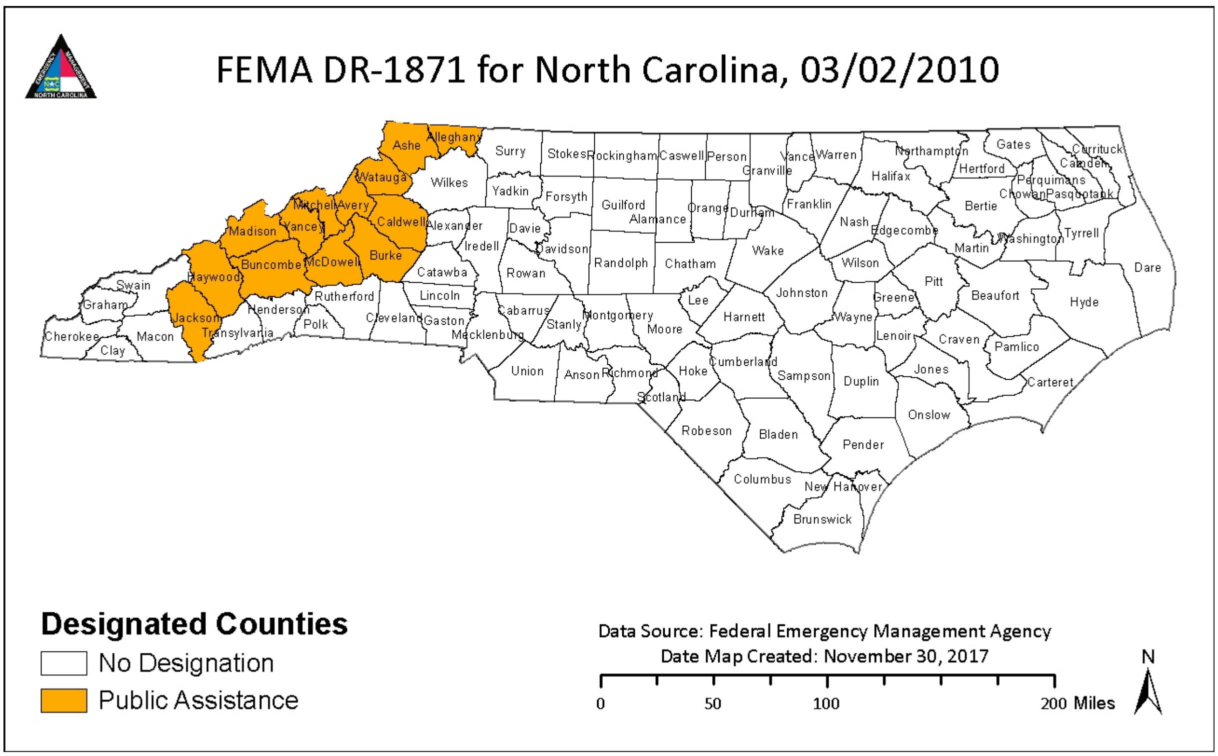
Only five of these disasters were stand-alone flood events, and nine occurred in the mountains of Western North Carolina. Among these flooding-only disasters was a devastating flood that impacted several counties in early Nov. 1977—the beginning of this documented history. Storms for this event produced 8 to 14 inches of rain in 33 counties; the 17 counties most impacted by these storms were designated in (or later added to) a presidential disaster declaration.

Another significant flood event was the Western Flooding that occurred in January 1998, caused by a weather system that also devastated communities in bordering Tennessee. Heavy rains fell on snow-pack in the higher elevations and the resulting runoff caused flash flooding in streams below. Numerous homes, public buildings, and public and private infrastructure were lost within a very short span of time.

In 2004, the remnants of Tropical Storm Frances and Hurricane Ivan caused major flooding in Western North Carolina, where rainfall estimates from both storms ranged from 6 to 20 inches within a 10-day period. This unprecedented event caused significant flood and debris-flow damages, economic losses, environmental damages, and took 11 lives. The communities of Asheville, Biltmore Village, Brevard, Clyde, Canton, Newland, Morganton, Hendersonville, and Mountain Island Lake were heavily impacted, as well as other rural communities.

Two weeks of snow and sleet beginning December 14, 2009 led to runoff and flash flooding in the 13 counties of Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Haywood, Jackson, Madison, McDowell, Mitchell, Watauga, Yancey and the tribal lands of the Eastern Band of Cherokee Indians in Western NC. A PDA conducted in the last two weeks of January, 2010 led to a federal declaration for ice damage and flash flooding. A map of this data is pictured in Figure 3-2 below.

Figure 3-2 Counties Declared in FEMA DR-1871



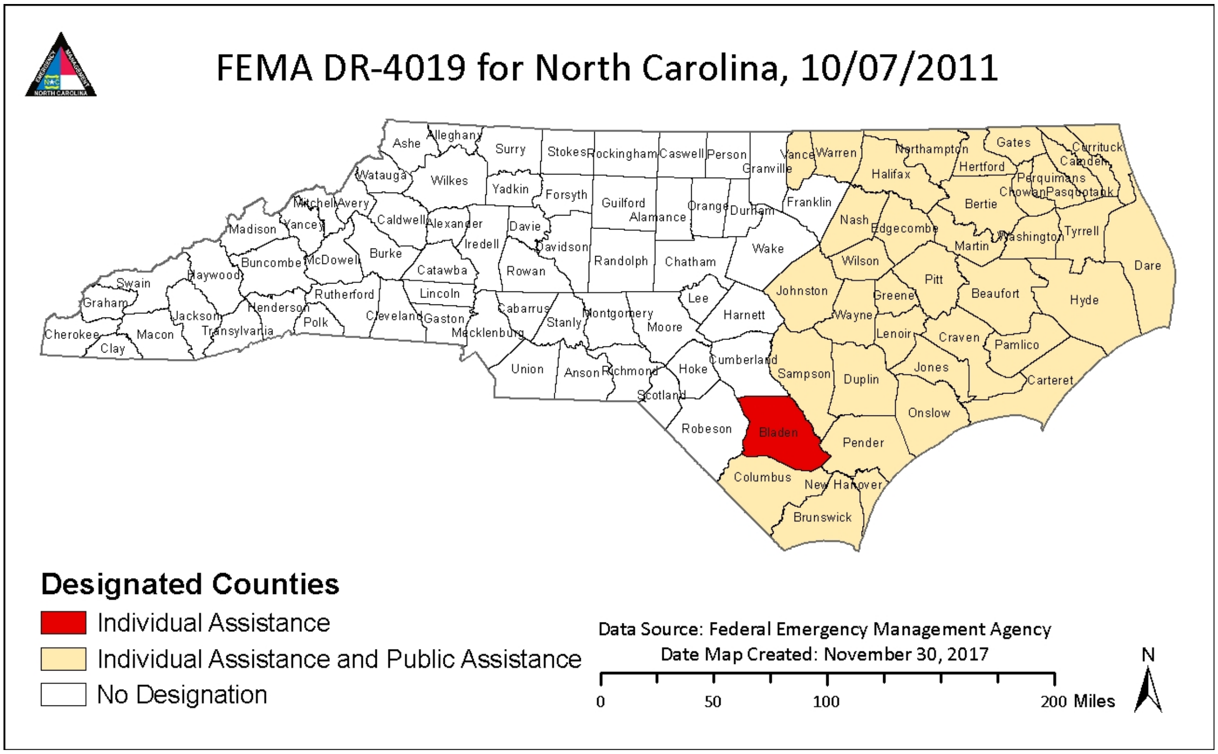
Flooding in Eastern and Central North Carolina

Flooding remains one of the major destructive forces of land-falling tropical storms and hurricanes, which have affected all parts of North Carolina, but have historically caused the largest impacts in the Eastern and Central parts of the state. Fifteen of the listed events are hurricanes or tropical storms that included devastating floods as part of their destructive force. In recent history alone, Hurricanes Irene (2011) and Matthew (2016) brought devastating flooding and heavy winds inland to many communities and counties in Eastern North Carolina. These events are more thoroughly discussed in the Hurricanes and Coastal

Hazards section found later in this risk assessment, but a brief overview of the flooding impacts is warranted here.

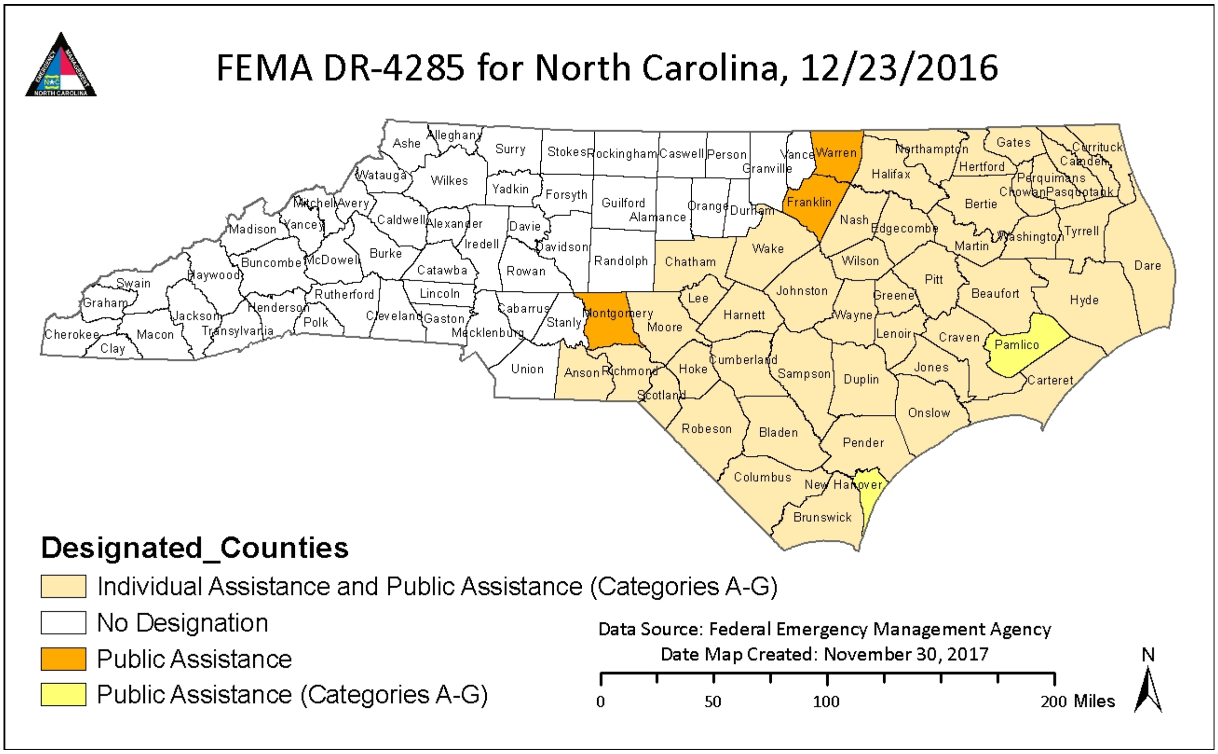
In August of 2011, Hurricane Irene caused the worst flooding the state had experienced in nearly a decade. Although the storm was only a category 1 storm when it made landfall and its course did not continue inland, several coastal counties in Eastern North Carolina were hit hard. Counties located on the Pamlico Sound were particularly affected as storm surge and torrential rain caused flooding in many areas located along the sound. In Figure 3-3 below, a map displays all of the counties that were a part of the presidentially declared disaster area.

Figure 3-3 Counties Declared in FEMA DR-4019



The most recent flooding disaster occurred during Hurricane Matthew in October 2016. Most of the damage was in central and eastern North Carolina from torrential rainfall of 8 to 15 inches. Flooding from this storm directly caused 11 fatalities and caused record-setting river flooding along the Neuse, Cape Fear, and Tar River basins. A presidential disaster was declared on October 10, and a map of the affected counties is pictured in Figure 3-4 below. North Carolina is still in the process of recovering from the Hurricane Matthew disaster.

Figure 3-4 Counties Declared in FEMA DR-4285



According to NCEI data, between 1996 and 2017, North Carolina has experienced flooding in every county, resulting in 72 deaths and $ 1,663,464,754 in property and crop damages. A detailed summary of NCEI flooding event data by county is listed in Table 3-1 below. A graphic representation follows the table in Figure 3-5.

Table 3-2 North Carolina Flood Event Summary by County

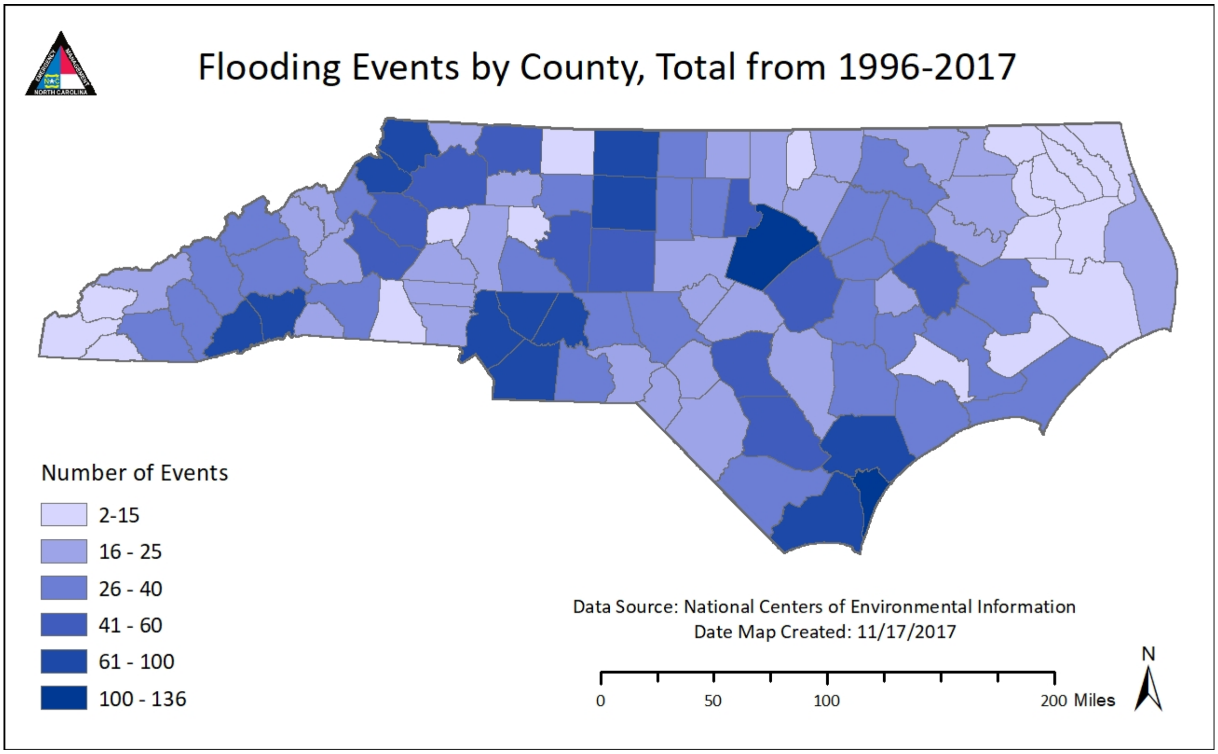
County	**Number of events** (1996-2017)	**Fatalities**	**Injuries**	**Property Damage** (Inflated to 2017 Dollars)	**Crop Damage** (Inflated to 2017 Dollars)
Alamance	32	0	0	$2,502,578	$0
Alexander	9	0	0	$130,661	$0
Alleghany	20	0	0	$658,993	$241,723
Anson	36	0	0	$0	$0
Ashe	63	0	0	$1,059,241	$0
Avery	28	0	0	$26,890,133	$9,152,034
Beaufort	27	0	0	$802,580	$62,254,856
Bertie	24	1	0	$10,289,555	$1,028,382
Bladen	41	2	0	$19,927,883	$0
Brunswick	75	0	0	$4,950,971	$0
Buncombe	35	2	0	$110,535,960	$1,306,611
Burke	52	0	0	$11,986,644	$0
Cabarrus	64	0	4	$14,948,945	$3,075,626
Caldwell	59	0	1	$2,355,460	$1,959,917
Camden	13	0	0	$519,922	$0
Carteret	39	0	0	$18,416	$0
Caswell	26	0	0	$430,735	$1,148,360

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Catawba	25	0	0	$1,050,442	$0
Chatham	24	0	0	$51,419	$0
Cherokee	15	0	0	$2,306,764	$0
Chowan	7	0	0	$514,191	$0
Clay	6	0	0	$1,279,792	$0
Cleveland	13	0	0	$84,921	$0
Columbus	30	1	0	$47,105,275	$15,129,685
Craven	27	1	0	$688,961	$565,953
Cumberland	50	2	0	$67,867,213	$20,567,650
Currituck	14	0	0	$7,113,258	$0
Dare	24	0	0	$9,374,362	$0
Davidson	45	1	0	$873,045	$0
Davie	9	0	0	$1,318,326	$156,793
Duplin	26	0	0	$208,953	$1,131,906
Durham	53	0	0	$403,687	$0
Edgecombe	35	8	0	$71,092,276	$20,567,650
Forsyth	37	0	0	$384,295	$0
Franklin	23	1	0	$0	$0
Gaston	22	0	0	$2,810,482	$0
Gates	14	1	0	$721,601	$8,740,888
Graham	11	0	0	$495,623	$0
Granville	17	0	0	$0	$0
Greene	18	1	0	$0	$0
Guilford	82	1	0	$3,262,483	$0
Halifax	36	2	0	$76,146,263	$20,567,650
Harnett	19	1	0	$9,383,989	$0
Haywood	29	3	0	$31,168,930	$2,613,223
Henderson	78	0	1	$7,817,825	$13,359,226
Hertford	16	0	0	$10,627,641	$18,518,832
Hoke	22	0	0	$4,605,291	$0
Hyde	7	0	0	$0	$0
Iredell	21	0	0	$3,070,931	$0
Jackson	38	0	0	$934,686	$9,146
Johnston	45	7	0	$25,416,683	$20,567,650
Jones	15	0	0	$565,953	$3,791,438
Lee	18	0	0	$550,184	$0
Lenoir	34	5	0	$14,360,204	$37,754,340
Lincoln	25	0	0	$2,277,544	$0
Macon	31	0	0	$5,414,897	$1,371,941
Madison	38	1	2	$23,023,809	$17,111,088
Martin	17	0	0	$290,210	$0
McDowell	24	0	0	$9,868,447	$1,306,611
Mecklenburg	99	6	4	$30,319,223	$11,319
Mitchell	23	0	0	$9,788,018	$0
Montgomery	34	0	0	$0	$0
Moore	32	0	0	$4,347,804	$0
Nash	29	4	0	$219,485,123	$20,567,650
New Hanover	136	0	2	$5,475,278	$0
Northampton	18	0	0	$2,294,611	$30,074,584
Onslow	35	0	0	$2,895,627	$6,791,438

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Orange	30	0	0	$13,970,031	$0
Pamlico	12	0	0	$11,319	$0
Pasquotank	15	0	0	$262,826	$0
Pender	74	0	0	$1,311,278	$0
Perquimans	9	0	0	$205,676	$0
Person	17	0	0	$297,913	$0
Pitt	47	1	0	$427,808	$113,190
Polk	22	0	0	$1,683,650	$0
Randolph	46	0	0	$10,000	$0
Richmond	19	0	0	$74,936	$0
Robeson	19	0	0	$4,892,669	$0
Rockingham	62	0	0	$1,238,525	$582,045
Rowan	32	0	0	$686,772	$0
Rutherford	27	0	2	$10,540,731	$0
Sampson	24	0	0	$4,216,368	$25,709,562
Scotland	17	0	0	$3,085,147	$0
Stanly	63	5	0	$293,172	$0
Stokes	14	0	0	$47,538	$0
Surry	52	0	0	$1,414,327	$5,486
Swain	25	0	0	$4,706,937	$15,679
Transylvania	67	0	10	$5,766,327	$8,362,315
Tyrrell	2	0	0	$0	$0
Union	70	1	0	$455,928	$5,212
Vance	9	1	0	$51,419	$0
Wake	130	0	0	$70,862,270	
Warren	17	2	2	$257,095	$0
Washington	8	5	0	$11,319	$1,131,906
Watauga	93	0	0	$21,679,689	$0
Wayne	32	4	0	$124,239,925	$25,709,562
Wilkes	52	0	0	$4,422,237	$0
Wilson	27	2	0	$33,216,754	$20,567,650
Yadkin	19	0	0	$19,635	$0
Yancey	22	0	0	$2,311,364	$1,175
North Carolina	3,363	72	28	$1,239,816,802	$423,647,952

Source: NCEI

Figure 3-5 North Carolina Flood Events by County



3.2.1.5 Changing Future Conditions

Changing climate and weather patterns, environmental conditions, and urban and rural development may affect the frequency and intensity of flooding in North Carolina. Although flooding events have been recorded in all parts of the state, North Carolina is highly susceptible to severe coastal flooding, and the Environmental Protection Agency reports that it has the third highest land area vulnerable to changing sea levels. A 2017 report by the US Government Accountability Office also projects tidal flooding to increase in "depth, frequency, and extent this century." The same report also mentions that over the last decade, $90 billion in losses has been incurred by the US government in combined flood and crop insurance payments due to extreme weather. Intensified flooding and increased periods of extreme precipitation would have severe impacts on the North Carolina's economy, public health, and environment.

Additionally, according to the National Climate Assessment, the increased likelihood of extreme participation events due to climate change will result in greater risks of flash flooding and impacts from stormwater runoff in the state. Indeed, even though there may be less precipitation overall in the long term (leading to more frequent drought events), the rainfall that does occur will be likely be during more intense, l events that may lead to flash flooding. While overall precipitation may decline, flooding impacts may actually intensify as a result of changing future conditions. This is especially true in the southeastern United States which is located in a middle ground between the southwestern states (which will likely be experiencing significant declines in precipitation) and northeastern states (which will likely be experiencing significant increases in precipitation). The result will be that there are likely to be periods of both drought and substantial precipitation in the southeast going forward.

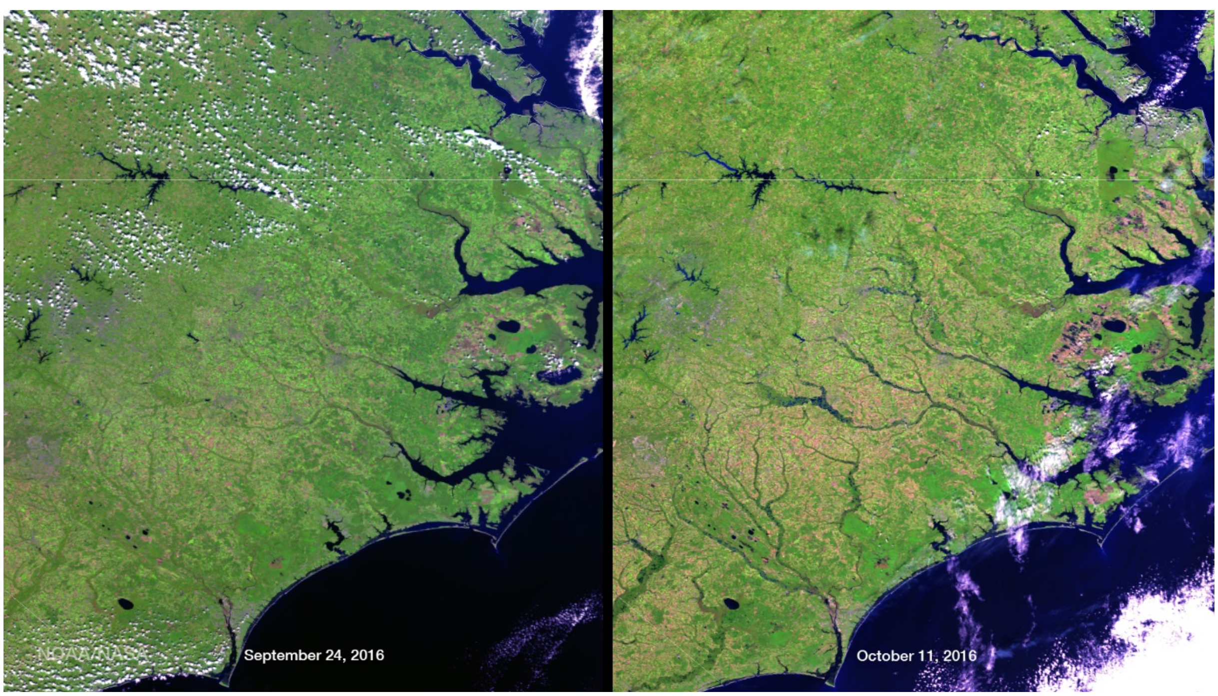
3.2.1.6 Impact

Flooding has the potential to cause critical impacts to the State of North Carolina. During the worst flooding events, such as those experienced during and immediately following major hurricanes that occur in the state, there is the potential for multiple deaths and injuries. It is possible that more than 25% of property in the State could be damaged or destroyed and complete shutdown of critical facilities can sometimes be expected for more than one week.

3.2.1.7 Future Probability

Floods will continue to impact North Carolina in the future. All counties remain vulnerable to flooding as each has identified and mapped Special Flood Hazard Areas (SFHAs)—floodplains with at least a 1-percent annual chance of floods that could potentially cause damage to development lying within those floodplains.

Flooding is the most common environmental hazard to affect North Carolina. The state's varying physiography makes it very vulnerable to this type of hazard. Not only does it have many flat and low-lying areas, but it also has lots of coastline in the east and valleys in the western region that are all prone to flooding after heavy rainfall accumulation. Based on historical evidence, it is highly likely (between 66.7 and 100 percent annual probability) that North Carolina will continue to experience flooding events in the future.



3.2.1.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

There is not a separate flood operations or response plan Appendix in the existing NCEOP as there is for other hazards. Rather, flooding EOP procedures are integrated into Annex B, Appendix 1.

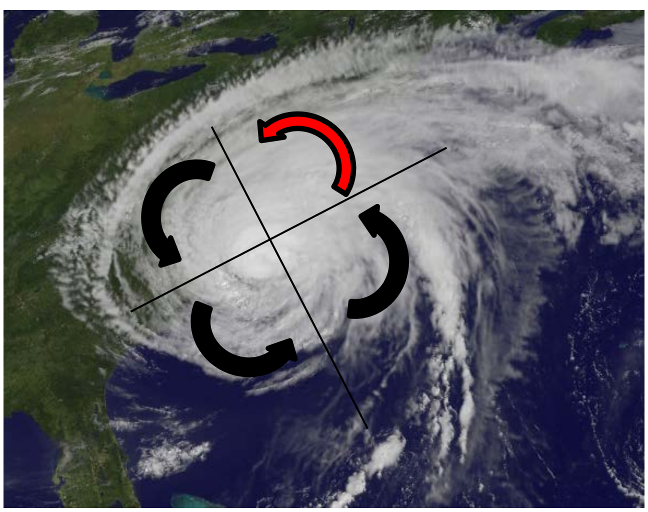
3.2.2 Hurricanes and Coastal Hazards

3.2.2.1 Description

Hurricanes are cyclonic storms that originate in tropical ocean waters poleward of about 5 degrees latitude. Hurricanes are heat engines, fueled by the release of latent heat that results from the condensation of warm water. Their formation requires several elements, including: a low-pressure disturbance; sufficiently warm sea surface temperature; rotational force caused by the spinning of the earth; and the absence of wind shear in the lowest 50,000 feet of the atmosphere. Hurricanes can produce an array of hazardous weather conditions, including storm surge, high winds, torrential rain, and tornadoes.

Hurricanes have the greatest potential to inflict damage as they move from the ocean and cross the coastline. The crossing of the center of the storm's eye is called landfall. Because hurricanes derive their strength from warm ocean waters, hurricanes are generally subject to deterioration once they make landfall. The forward momentum of a hurricane can vary from just a few miles per hour to up to 40 mph. This forward motion (combined with a counterclockwise surface flow) makes the hurricane's right-front quadrant the location of its most potentially damaging winds.

Figure 3-6 Quadrant Image of Hurricane Irene August 27, 2011



Source: NASA/NOAA GOES Project

3.2.2.2 Extent

Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from 1 (minimal) to 5 (catastrophic), as shown in Table 3-3 and Table 3-4. The scale categorizes hurricane intensity linearly, based upon maximum sustained winds and minimum barometric pressure.

These factors combine to create an estimate of the potential flooding and damage to property, given a hurricane's estimated intensity.

Table 3-3 Saffir-Simpson Hurricane Scale (Simpson and Reihl, 1981)

Saffir-Simpson Scale				
Saffir-Simpson Category	Maximum sustained Wind Speed			Minimum Surface Pressure
	MPH	Meter/Sec	Knots	Millibars
1	74–96	33–42	64–83	Greater than 980
2	97–111	43–49	84–96	979–965
3	112–131	50–58	97–113	964–945
4	132–155	59–69	114–135	944–920
5	156+	70+	136+	Less than 920

Hurricanes with a Saffir-Simpson classification of 3, 4, or 5 are considered major hurricanes (which are the most potentially dangerous).1 These intense hurricanes cause much of the hurricane-related damage in the United States, even though they account for only a small portion of tropical cyclone landfalls.

Table 3-4 Examples of Hurricane Damage by Saffir-Simpson Category

Hurricane Category Damage Examples			
Category	Level	Description	Example
1	Minimal	Damage primarily to shrubbery, trees, foliage, and unanchored homes. No real damage to other structures. Some damage to poorly constructed signs. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.	Hurricane Jerry (1989)
2	Moderate	Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. Coast roads and low-lying escape routes inland cut by rising water two to four hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying areas required.	Hurricane Bob (1991)
3	Extensive	Foliage torn from trees; large trees blown down. Almost all poorly constructed signs blown down. Some damage to roofing materials of buildings; some wind and door damage. Some structural damage to small buildings. Mobile homes destroyed. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves	Hurricane Gloria (1985)

[1] *Saffir-Simpson Hurricane Wind Scale. National Oceanic and Atmospheric Administration: National Hurricane Center. Retrieved on December 14, 2017 from: http://www.nhc.noaa.gov/aboutsshws.php*

		and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Flat terrain five feet or less above sea level flooded inland eight miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.	
4	Extreme	Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failures of roofs on many small residences. Complete destruction of mobile homes. Flat terrain 10 feet or less above sea level flooded inland as far as six miles. Major damage to lower floors of structures near shore, due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, as well as the evacuation of single-story residences within two miles of shore.	Hurricane Harvey (2017)
5	Catastrophic	Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. Major damage to lower floors of all structures less than 15 feet above sea level and within 500 yards of shore. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.	Hurricane Camille (1969)

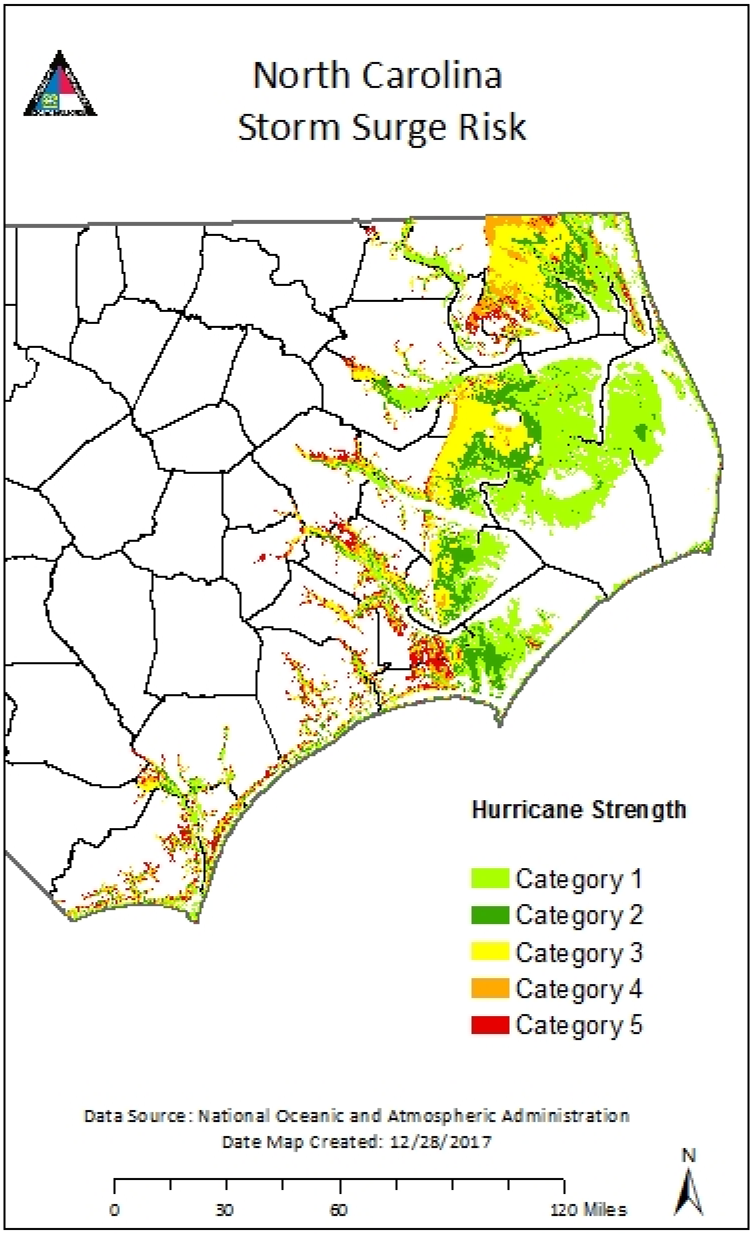
Historically, the state has been impacted by a number of major storms that were categorized as major hurricanes (Category 3, 4, or 5) when they made landfall in the state. Therefore, North Carolina could be impacted by a storm up to a Category 5 based on the Saffir-Simpson Hurricane Scale.

3.2.2.3 Location/Spatial Extent

All of the state's 100 counties are at risk of hurricanes, although the effects are likely to vary. For example, the eastern part of the state is much more likely to be severely impacted by high winds and storm surge than the mountainous western part of the state. But all areas of the state are susceptible to winds and flooding from heavy rains that a hurricane may bring.

Storm surge is limited to the coastal counties of North Carolina. Figure 3-7 provides a graphical representation of storm surge risk zones as determined by NOAA.

Figure 3-7 Storm Surge Inundation Areas



3.2.2.4 Hazard History

North Carolina has an extensive hurricane history dating back to colonial times, with notable 19th century storms occurring in 1837, 1846, 1856, 1879, 1883, and 1899. Within the 20th century, the mid-1950s proved to be an exceptionally busy time for hurricanes in North Carolina, including major storms such as Hazel (1954), Connie (1955), Diane (1955), and Ione (1955).

Between 1960 and 1990, a relative lull occurred in the number of major hurricanes that made landfall, with only a few major storms coming ashore including Hurricanes Donna (1960) and Hugo (1989). Hurricane Donna was a strong Category 2 hurricane when it made landfall on Topsail Island and Hurricane Hugo made landfall in South Carolina as a Category 4 storm and significantly impacted the Charlotte area and the North Carolina mountains. Recent years, however, have witnessed a dramatic change as substantially more storms have impacted the state since 1990 than in the period between 1960 and 1990. The following storms had major impacts on the state since 1990: Emily (1993), Opal (1995), Bertha (1996), Fran (1996), Bonnie (1998), Dennis (1999), Floyd (1999), Irene (1999), Isabel (2003), Ivan (2004), Ophelia (2005), Earl (2010), Irene (2011) and Matthew (2016).

Table 3-5 lists significant hurricanes from 1879 to 2016 that impacted North Carolina. Each event listing contains detailed information of each hurricane.

Table 3-5 Significant Hurricanes in North Carolina, 1879-2016

Hurricane Category Damage Examples Significant Hurricanes in North Carolina 1879-2016					
Name/Date	Category (in NC)	Maximum Wind	Pressure (in NC) inches Hg	NC Deaths	NC Damage (in millions $)
Aug. 1879	4	168	N/A	40+	N/A
Sept. 1883	3	100+	N/A	53	N/A
Aug. 1899	4	140	N/A	25	N/A
Sept. 1933	3	125	28.26	21	3
Sept. 1944	3	110	27.97	1	1.5
Hazel, 1954	4	150	27.70	19	136
Ione, 1955	3	107	28.00	7	88
Donna, 1960	3	120	28.45	8	25
Diana, 1984	3	115	28.02	3	85
Gloria, 1985	3	100+	27.82	1	8
Hugo, 1989	3	100	28.88	7	1,000
Emily, 1993	3	111	29.00	0	13
Floyd, 1999	2	155	27.2	13	4,500
Ivan, 2004	N/A	<39	26.9	8	13.4
Irene, 2011	1	96	27.82	6	275.2
Arthur, 2014	2	101	27.73	0	2.34
Matthew, 2016	1	97	28.06	26	1,500

Table 3-6 lists the hurricanes that impacted North Carolina between Sept. 31, 1993, and October 8, 2016 according to NCEI data. Each event is described in expanded detail following the table.

Table 3-6 North Carolina Detailed Hurricane History

North Carolina Detailed Hurricane History				
Event	**Duration**	**Location**	**Severity**	**Extent of Damages (2017 dollars)**
Hurricane Emily	08/31/1993	Hyde, Carteret	Injuries: 1	Property: $85.4 million
Hurricane Gordon	11/17/1994	Carteret, Currituck, Dare, Hyde		Property: $832,722
Hurricane Felix	08/15/1995	Carteret, Currituck, Dare, Hyde, Onslow, Pamlico	Fatalities: 1	Property: $809,773 Crops: $809,700
Hurricane Bertha	07/12/1996	Alamance, Anson, Bertie, Beaufort, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Forsyth, Franklin, Gates, Granville, Greene, Guilford, Halifax, Harnett, Hertford, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Northampton, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 1 Injuries: 10	Property: $263.4 million Crops: $227.3 million
Hurricane Eduoard	08/29/1996	Carteret, Dare		
Hurricane Fran	09/04/1996–09/05/1996	Alamance, Anson, Beaufort, Bertie, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Forsyth, Franklin, Gates, Granville, Greene, Guilford, Halifax, Harnett, Hertford, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Northampton, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 13 Injuries: 6	Property: $1.85 billion Crops: $77 million

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Bonnie	08/26/1998–08/28/1998	Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Cumberland, Currituck, Dare, Duplin, Edgecombe, Franklin, Greene, Harnett, Hoke, Hyde, Johnston, Jones, Lenoir, Martin, Nash, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Sampson, Tyrrell, Wake, Washington, Wayne, Wilson	Fatalities: 1	Property: $139 million Crops: $359 million
Hurricane Dennis	08/30/1999–09/04/1999	Alamance, Anson, Beaufort, Bertie, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Forsyth, Franklin, Granville, Greene, Guilford, Halifax, Harnett, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson		Property: $162,900 Crops: $4.4 million
Hurricane Floyd	09/14/1999–09/15/1999	Alamance, Anson, Beaufort, Bertie, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Franklin, Granville, Greene, Guilford, Halifax, Harnett, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 13	Property: $5.2 billion Crops: $1.4 billion
Hurricane Irene	10/16/1999–10/17/1999	Beaufort, Bertie, Camden, Carteret, Chowan, Craven, Currituck, Hyde, Onslow, Pamlico, Pasquotank, Perquimans	Fatalities: 1	Property: $45,923

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Isabel	09/17/2003–09/18/2003	Beaufort, Bertie, Camden, Carteret, Chowan, Craven, Cumberland, Currituck, Dare, Duplin, Durham, Edgecombe, Franklin, Gates, Granville, Greene, Halifax, Hertford, Hyde, Jones, Lenoir, Martin, Nash, Northampton, Onslow, Pamlico, Pasquotank, Perquimans, Person, Pitt, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 2	Property: $621.9 million Crops: $19.1 million
Hurricane Alex	08/03/2004	Beaufort, Carteret, Craven, Dare, Hyde, Onslow, Pamlico, Tyrrell, Washington		Property: $9.8 million
Hurricane Charley	08/14/2004	Beaufort, Bladen, Brunswick, Carteret, Columbus, Craven, Dare, Duplin, Greene, Hyde, Jones, Lenoir, Martin, New Hanover, Onslow, Pamlico, Pender, Pitt, Tyrrell, Washington	Injuries: 3	Property: $22.2 million Crops: $6.99 million
Hurricane Ophelia	09/13/2005–09/14/2005	Beaufort, Brunswick, Carteret, Craven, Dare, Duplin, Greene, Hyde, Jones, Lenoir, Martin, New Hanover, Onslow, Pamlico, Pender, Pitt, Tyrrell, Washington	Injuries: 5	Property: $63.9 million Crops: $14.5 million
Hurricane Ivan	9/18/2004	Alamance, Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Caswell, Davidson, Forsyth, Graham, Guilford, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Randolph, Rockingham, Rutherford, Stokes, Swain, Transylvania, Watauga, Wilkes, and Yancey .	Fatalities: 8	Property: $17.5 million
Hurricane Earl	9/01/2010	Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Duplin, Edgecombe, Gates, Greene, Halifax, Hertford, Hyde, Jones, Lenoir, Martin, New Hanover, Northampton, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Tyrrell, and Washington .	Fatalities: 0 Injuries: 0	Property: $430,000 Crops: $2.92 million
Hurricane Irene	8/27/2011 – 8/28/2011	Beaufort , Bertie , Bladen , Brunswick , Camden , Carteret , Chowan , Columbus , Craven , Currituck , Dare , Duplin , Edgecombe , Gates , Greene , Halifax , Hertford , Hyde , Johnston , Jones , Lenoir , Martin , Nash , New Hanover , Northampton , Onslow , Pamlico , Pasquotank , Pender , Perquimans , Pitt , Sampson , Tyrrell , Vance , Warren , Washington , Wayne , and Wilson.	Fatalities: 6 Injuries: 0	Property: $106.4 million Crops: $95.00 million

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Arthur	7/3/2014	Hyde, Carteret, Dare	Fatalities: 0 Injuries: 0	Property: $698,500
Hurricane Matthew	10/8/2016	Brunswick, New Hanover, Pender, Dare	Fatalities: Injuries:	Property: Crops:

Source: NCEI

Significant North Carolina Hurricane Event Overviews

Hurricane Fran (09/04/1996–09/05/1996)

Hurricane Fran moved onshore near Cape Fear on the evening of Sept. 6, 1996, and raced north toward Raleigh, cutting a swath of destruction as it traveled. The Category 3 hurricane destroyed or damaged 90 percent of the homes located in North Topsail Beach. The town hall and police station were destroyed. A 15-foot storm surge cut a 100-foot-wide inlet through the middle of the island. A Camp Lejeune-based Marine lost his life when he and two others mistakenly drove onto the island at the height of the storm. State Route 1568 was washed out and NC 210 was covered with sand. Damages in North Topsail Beach and Onslow County alone exceeded $500 million, as 6,688 structures were either destroyed or damaged. In Carteret County, Emerald Isle reported 67 homes destroyed and 409 that had experienced major damage. Thirty-three mobile homes were destroyed. The Emerald Isle fishing pier was destroyed, and Bogue Sound Pier lost 150 feet. Dune elevation was reduced by 5 to 20 feet due to erosion. Winds gusted up to 100 mph at Atlantic Beach. Storm surge in Swansboro was measured at 10 feet. Several businesses along the waterfront were destroyed and water covered Main Street. Storm surges approaching 9 feet flooded portions of Washington and Belhaven. The storm surge in Washington was the highest recorded since the unnamed hurricane that occurred on Sept. 3, 1912. New Bern experienced a storm surge of 10 feet on the Neuse River. One bridge was closed when an approach road collapsed. Other bridges were washed out near Stella and Swansboro. One motorist was killed near Greenville when his car struck a tree. In Duplin County (near Rose Hill), a resident perished when the chimney in her home collapsed. Another resident died when a tree fell through her trailer, located in Catherine Lake in Onslow County. Measured wind gusts approached speeds of 94 mph at the New River Marine Corps Air Station in Jacksonville, and 92 mph at Duke Marine Labs in Beaufort.

Hurricane Fran was the worst natural disaster in terms of economics in North Carolina history. In the RAH county warning area alone, the damage exceeded $2 billion. Damage to crops, livestock, and farm equipment/buildings was more than $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. Almost every neighborhood in the path of the storm's center was affected. The copious rainfall produced many severe flash floods and river floods. The flooding experienced by the Haw River (at the town of Haw River), the Neuse River (at Smithfield and Goldsboro), and the Tar River (at Louisburg and Rocky Mount) approached or exceeded the highest floods on record. Many homes located in the floodplain had to be evacuated. The most massive evacuation occurred in Goldsboro, where residents of 550 homes had to be relocated to public shelters. Hundreds of cars in Goldsboro were damaged by water; many of these vehicles were so deeply submerged beneath floodwater that only the tops of their radio antenna were visible from the surface. Many homes and businesses incurred heavy losses. Along the Crabtree Creek in Raleigh, which crested at its highest peak since 1973, hundreds of new cars from local auto dealerships floated in 6 feet of water. Scores of businesses reported heavy damage at the area's largest shopping center. Basic living necessities were unavailable for several days, including milk, bread, drinking water, power, and telephone service. It took more than 10 days for power to be restored to many areas. Schools were closed for a week in the hardest-hit counties. Automobile travel was hazardous for days after the storm, due to fallen and falling trees. A full 12 days after the event, 150 secondary roads remained closed.

Spiral bands associated with Hurricane Fran affected northeast North Carolina from the evening of Sept. 5 through the morning of Sept. 6. The highest sustained wind speed recorded at the Elizabeth City Coast Guard Station (ECG) was 43 mph, with the highest gust recorded at 55 mph. There were no confirmed tornadoes, but numerous trees and power lines were blown down across northeast North Carolina, resulting in assorted structural damage and power outages. Coastal Pasquotank and Camden counties experienced approximately a 6-foot storm surge in the Albemarle Sound, flooding coastal sections of these counties, including the business district of downtown Elizabeth City. Chowan County experienced a 4-foot surge from the Albemarle Sound, causing some flooding in Edenton. Currituck County received only minor flooding from the Currituck Sound. The heaviest rain fell across the inland counties of northeast North Carolina, where amounts generally ranged from 1.5 to 3.5 inches. Some roads were flooded due to the rainfall.

The eye of Hurricane Fran passed over eastern Brunswick County with winds measured as high as 109 mph at Long Beach. The storm surge was approximately 6 feet, with beach erosion around 15 feet on the eastern islands. Seven beach houses on the east end of Holden Beach were damaged or destroyed. Emergency shelters housed 1,750 residents and vacationers.

The center of Fran's eye (which measured approximately 25 miles across), passed up the Cape Fear River during the evening, with winds gusting around 110 mph, storm surge recorded at 12 feet MSL, and 40-foot beach erosion, which destroyed most docks and piers. County infrastructure suffered $5 million in damage. Schools experienced $2 million in damage. Power outages lasted for more than a week in some areas. Pleasure Island was hit hard, as 25 homes were carried off their foundations and many others were badly damaged. Wrightsville Beach was not hit as hard, but 15 homes suffered at least 75 percent damage. In Wilmington, 14 homes were destroyed and 385 homes suffered major damage. The 197-foot tall steeple of the 130-year-old First Baptist Church fell. Shelters housed 880 evacuees.

Fran's eye then moved across Pender County. On Topsail Island, a 12-foot storm surge caused 40 feet of beach erosion and wiped out dunes as overwash destroyed most of the first row of beach houses and heavily damaged the rest. Damage to Surfside Beach and Topsail Beach was $112 million. The rest of the county experienced more than $50 million in structural damage, with 161 buildings destroyed and 585 more sustaining major damage (including the roof being blown off the county courthouse). Marketable timber loss was $37 million. Two people died: a woman found on a mattress in the marsh and a man floating in the Scotts Hill Marina Boat Basin. Shelters housed more than 600 evacuees.

Hurricane Floyd (09/14/1999–09/15/1999)

Hurricane Floyd caused the largest peacetime evacuation in the history of the United States up to that point in time. The storm also caused massive record flooding across inland sections of eastern North Carolina. At one time, Floyd was classified as a Category 4 hurricane on the Saffir-Simpson scale, and will likely be categorized as one of the most costly hurricanes to strike the United States during the 20th century.

Tropical Depression 8 (Hurricane Floyd's initial designation) was detected by the National Hurricane Center at 4 p.m. EST on Sept. 7. The broad center was located nearly 1,000 miles west of the Lesser Antilles. At that time, the depression was moving toward the west at 14 mph, with maximum sustained winds of 30 mph. Within 12 hours, the depression gained strength, became a tropical storm, and was named Floyd. As it neared the Virgin Islands on the afternoon of Sept. 10 (just 415 miles west of San Juan), Floyd was officially designated as a hurricane. Hurricane Floyd rapidly intensified and by the evening of Sept. 12 was classified as a Category 4 hurricane. The hurricane continued to intensify. At its peak on the morning of Sept. 13, the winds increased to 155 mph and the central pressure bottomed-out at 921 mb. The position was 525 miles east-southeast of Miami and moving west at 14 mph. Fortunately for Floridians, Hurricane Floyd soon made an expected turn to the north. By 5 p.m. EST on Sept. 14, the entire North Carolina coast was under a hurricane watch, which at midnight was upgraded to a hurricane warning.

That same night, the first outer rain bands began affecting eastern North Carolina and, in turn, reports of flooding began filtering into the National Weather Service office in Morehead City/Newport (MHX). At least 40 official shelters were opened across the county warning area. Severe weather and rainfall preceded landfall. By the night of Sept. 16, 20 tornado warnings had been issued, with over half of the possible tornado occurrences being verified. The greatest rainfall estimates from the MHX Doppler radar were over Duplin, Jones, Lenoir, Greene, Pitt, Martin, Craven, and Onslow counties. Estimates were near 6 to 10 inches of rain, with isolated areas receiving 12 to 15 inches. The greatest amount of rainfall (15.48 inches) was reported by a Cooperative observer in Washington. Tyrrell, eastern Carteret, eastern Pamlico, Hyde, and Dare counties all reported estimates of less than 3 inches.

Hurricane Floyd made landfall on the morning of Sept. 16 near North Topsail Beach, as a Category 2 hurricane. The eye moved northeast over Jacksonville, New Bern, Washington, Plymouth and continued over the eastern shores of Virginia. As the hurricane moved over the eastern coast of North Carolina, it accelerated and weakened. It lost its tropical characteristics early on Sept. 17. The University of Oklahoma Doppler-On-Wheels (DOW) team was positioned at Topsail Beach. Around 2 a.m. EST, the DOW recorded a sustained wind of 81 mph with gusts of up to 105 mph. The peak inland report in the MHX 15-county warning area was 82 mph at Cherry Point Marine Corp Air Station (NKT). The peak offshore report was 96 mph at Duck Pier. Similar to rainfall, the strongest ocean storm surges occurred west and northwest of the eye. Ocean storm surges were about 4 to 6 feet above normal, generally affecting Onslow, Carteret, and Hyde counties. This caused extensive beach erosion on the south facing beaches. Ocracoke Island officials reported at least 10 new dune breaks along Highway 12. In Carteret County, Pine Knoll Shores lost some 50 feet of beach. Emerald Isle lost an average of 14 feet and 52 public beach access walkways. The Oceana Pier on Atlantic Beach lost a 200-foot section and the remaining 200-foot section of Iron Steamer Pier that Hurricane Bonnie spared was also wiped out. Along the Albemarle Sound, storm tides were about 5 to 6 feet above normal. The Pamlico River storm tides ranged between 6 to 8 feet above normal. Water levels were especially high in Hyde County, Sladesville, and Scranton. Along the Neuse River, storm tides were also near 6 to 8 feet above normal, especially in the Core Creek area. Extreme flooding was experienced across most counties. Inland flooding exceeded that generated by hurricanes Bertha, Fran, Bonnie, and Dennis combined. Most counties reported their worst flooding ever. The Tar River in Greenville and the Neuse River in Kinston were nearly 15 feet above their flood stages of 13 and 14 feet, respectively. The Tar River remained above flood stage for nearly two weeks, while the Neuse River remained above flood stage for more than a month. The Northeast Cape Fear River in Chinquapin was 8 to 10 feet above the flood stage of 13 feet. The Roanoke River in Williamston rose to nearly 3 feet above its flood stage. Unbelievable numbers of homes were covered with water and over half a million customers throughout the county warning area were left without power. In Greenville alone, a 100-acre parcel of land would be needed to store all the mobile homes that were destroyed due to flooding.

Unofficially, the flooding from Hurricane Floyd has been compared to that of a 500-year flood. At least 13 fatalities have been reported during the event in the 15-county warning area. Unfortunately, a majority of the deaths could have been avoided had the victims not tried to drive on flooded roadways. As with most hurricanes, inland flooding is now responsible for the largest percentage of fatalities.

Floyd also produced more human misery and environmental impact on North Carolina than any disaster in memory. The 15 to 20 inches of rain that fell across the eastern half of the state caused every river and stream to flood. Many rivers set new flooding records. Whole communities were submerged for days, and some areas remained underwater for weeks. Thousands of homes were lost. Crop damage was extensive. The infrastructure of the eastern counties (composed mainly of roads, bridges, water plants, etc.) was heavily damaged. By the end of 1999, $1.5 billion of emergency funding had already been spent, with estimates that the cost would ultimately reach $3 to $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, which occurred mainly due to flooding. Many North Carolinians did not heed the call to evacuate and many more attempted to drive through flooded areas. In the central part of the state, 21 people lost their lives. Also, a significant loss of livestock occurred, mainly involving swine and poultry.

Floyd, with wind gusts around 90 mph caused the widespread occurrences of downed trees and power outages. In Brunswick County, power was lost by 95 percent of the county. The wind did major damage to the roof of Brunswick Community Hospital. Storm surge was 7 to 9 feet on the east side of the county and 3 to 6 feet further west. Ocean Crest Pier, Long Beach Pier, and Sunset Beach Pier were hit hard. Ocean over wash was worst at Oak Island, where 4 miles of beach containing 100 oceanfront homes sustained $23 million in damage. Holden Beach sustained $8.8 million in damage, and 46 homes were condemned—many due to exposed septic tanks. Ocean Isle Beach suffered $6 million in damage: two houses were knocked off their foundations; 500 feet of roadway was lost; and 28 homes were declared unsafe. Sunset Beach experienced $1.25 million in damage and lost half its dune and a road, thus isolating 75 homes. However, it was the heavy rains that accumulated around 20 inches which caused the worst flooding in history. High water closed most roads (including US 17), isolating many areas. A dam broke at Boiling Springs Lakes, inundating the area. In New Hanover County, housing losses approached $25 million: eight homes were destroyed and more than 200 sustained major damage. Ocean storm surge was 9 to 10 feet, inundating barrier islands and causing extensive dune erosion.

Record rainfall distinguished Floyd—the most rain ever in 24 hours at ILM Airport (14.84 inches) and a storm total 19.06 inches, causing widespread flooding. In Pender County, a 7- to 9-foot storm surge at the beach damaged the barrier islands, eroding half the dune. However, it was record rainfall with ensuing ponding and flooding of rivers that caused the most serious damage. The Northeast Cape Fear had the worst flood of the 20th Century, while the Black River flood was the worst experienced since 1945. Largely due to flooding, more than 1,000 homes suffered major damage and 200 more were condemned. More than 3,000 hogs, 90,000 turkeys, and 200 cows were lost due to drowning. Animal waste and septic tanks added pollution to the flooding. Two human fatalities occurred as motorists drove into flooded parts of highways. In Columbus and Bladen counties, wind gusts approached 75 mph in the eastern parts of the counties, downing trees and power lines. More than 15 inches of rain caused widespread flooding. In Robeson County, Hurricane Floyd caused wind gusts near 70 mph in eastern portions of the county, downing trees and power lines. Rainfall around 10 inches caused widespread flooding.

Floyd was a Category 1 hurricane as it crossed the Wakefield WFO county warning area. Sustained tropical-storm-force winds with gusts up to near hurricane force occurred over the northwest quadrant of the storm, over interior portions of northeast North Carolina and along the coastal waters of the Wakefield marina area. The center of the storm crossed the county warning area along Elizabeth City to Currituck County, to Sandbridge Virginia Beach axis. The highest sustained wind speed recorded at the Elizabeth City Coast Guard Station (ECG) was 39 mph, with gusts to 64 mph. Two confirmed tornadoes occurred in association with Floyd, both in northeast North Carolina. Several thousand persons were evacuated and housed in several shelters from coastal jurisdictions. Hundreds of trees and power lines were blown down across northeast North Carolina, resulting in widespread power outages. Coastal Pasquotank and Camden counties experienced approximately a 5- to 6-foot surge in the Albemarle Sound, flooding coastal sections of those counties, including the business district of downtown Elizabeth City. Chowan County experienced a 5- to 6-foot surge from the Albemarle Sound, causing some flooding in Edenton. The lowest sea level pressure recorded at the ECG was 968.5 mb.

Hurricane Irene (08/27/2011–08/28/2011)

Hurricane Irene moving northward over the outer banks of North Carolina and just off the Virginia coast produced hurricane force wind gusts across portions of coastal northeast North Carolina from early Saturday morning, August 27th into Sunday morning, August 28th. Announcing itself with howling winds and hammering rains, Hurricane Irene made landfall at Cape Lookout, on the Outer Banks of North Carolina, at about 7:30 a.m. on Saturday, August 27, 2011. However, tropical-storm-force winds began to affect the Outer Banks hours before landfall, producing waves of 6–9 ft (1.8–2.7 m). During Irene, some of the state’s worst flooding happened along the Pamlico and Albemarle sounds, in the state’s Inner Banks. Rescue crews fanned out late Saturday, August 27th and Sunday, August 28th in search of people trapped by the rising waters. Boats that were once docked in the Albemarle Sound were washed up on the side of N.C. 158 in Nags Head about a half mile down from the causeway bridge.

The large hurricane left extensive damage in its wake and there were reports that tornadoes may have leveled homes and overturned vehicles. Following the touch down of a potent tornado, at least four homes were demolished in Columbia, while up to three others sustained significant damage. Preliminary assessment indicated multiple flooded areas and uprooted trees along coastlines; in Nash County, a snatched tree limb struck and killed one person. Prior to the storm, a resident in Onslow County suffered a fatal heart attack while applying plywood to his house. Two people in Pitt and Sampson Counties were additionally killed by falling trees, as were two others in Goldsboro and Pitt County in traffic accidents. A man also drowned in the flooded Cape Fear River. In all, over 1,100 homes were destroyed. The estimated $71 million in damage did not include agricultural losses.

Hurricane Irene left downed and denuded trees, impassable roadways, damaged municipal buildings, and widespread flooding on its way. In Bay Drive in Kill Devil Hills, debris from the Albemarle Sound covered the street after overflowing with overnight rainfall. Storm surge from Hurricane Irene spilled over Kitty Hawk Bay in Albemarle Sound and Roanoke Island, Hatteras Island, Collington, Duck, and other parts of the islands were simply inundated by the Albemarle and Pamlico Sounds. In addition, heavy rains contributed to minor crop damage. Storm total rainfall generally ranged from ten to fourteen inches.

Hurricane Matthew (10/8/2016-10/9/2016)

Hurricane Matthew was an extraordinarily severe and sustained event that brought record-level flooding to many areas in eastern North Carolina’s coastal plain, sound, and coastal communities. Hurricane Matthew hit North Carolina on October 8, 2016, as a Category 1 storm. Communities were devastated by this slow-moving storm primarily by widespread rainfall. During a 36-hour period, up to 18 inches of heavy rainfall inundated areas in central and eastern North Carolina.

Riverine flooding began several days after Hurricane Matthew passed and lasted for more than two weeks. New rainfall records were set in 17 counties in the Tar, Cape Fear, Cashie, Lumber, and Neuse River watersheds. Entire towns were flooded as water levels throughout eastern North Carolina crested well above previously seen stages.

During the peak of the hurricane, 800,000 households lost power and 635 roads were closed, including a section of I-40 West in Johnston County that was closed for seven days, and sections of I-95 North and South in Robeson and Cumberland Counties that were closed for 10 days.

Approximately 88,000 homes were damaged and 4,424 residences were completely destroyed. Losses totaled more than $967 million, representing an economic loss as high as 68 percent of the damages, or $659 million, not expected to be covered by insurance or FEMA assistance.

North Carolina Governor McCrory requested FEMA assistance on October 9, 2016, and FEMA subsequently declared a major disaster (DR-4285) for North Carolina on October 10, 2016, for 48 counties encompassing approximately 325 cities, towns, townships, and villages. Preliminary estimates indicate that more than 30,000 businesses suffered physical or economic damage, and 400,000 employees were affected as a result. Hurricane Matthew also had a significant impact on the agriculture and agribusiness economy in eastern North Carolina. The nearly 33,000 agricultural workers and 5,000 agriculture-support workers hit by the storm account for more than half of the state's agricultural and agriculture-support workforce.

Initial economic analysis of the impacts of crop and livestock losses caused by Hurricane Matthew estimated that there was a loss of more than 1,200 jobs and roughly $10 million in state and local income and sales tax revenue.2

North Carolina's response to Hurricane Matthew included 2,300 swift-water rescues using 79 boats, and more than 90 air rescues. North Carolina also deployed more than 1,000 National Guard and State Highway Patrol to assist with rescue and sheltering missions. There were 3,744 individuals transported to 109 shelters across central and eastern North Carolina during the storm's peak.

FEMA's disaster declaration made 50 counties eligible for FEMA assistance, 45 of which are eligible for Individual Assistance and Public Assistance and five of which are eligible for Public Assistance only. There were 81,832 individuals registered for FEMA/state assistance. Federal/state financial assistance in the amount of $92.5 million was approved to help flood survivors recover. Small Business Administration (SBA) loans approved for individuals after Hurricane Matthew totaled $65.6 million. SBA loans approved for businesses after Hurricane Matthew totaled $23.2 million.

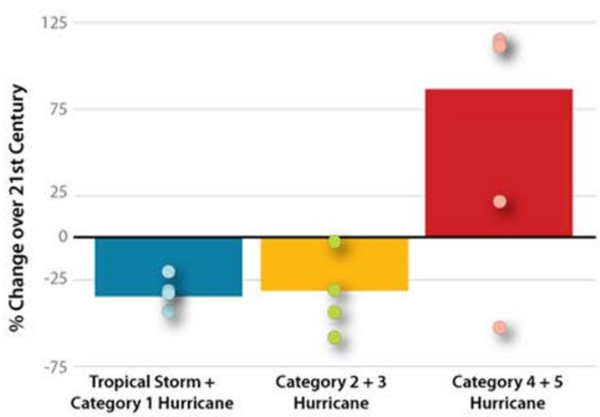
[2] *Governor McCrory's Request for Federal Assistance for Hurricane Matthew Recovery, November 14, 2016*

3.2.2.5 Changing Future Conditions

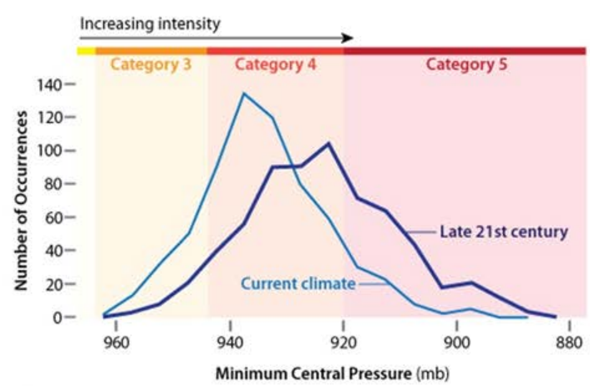
North Carolina’s coastal location makes it a prime target for hurricane landfalls, and changing climate and weather conditions may increase the number and frequency of future hurricane events. Hurricanes and other coastal storms may result in increased flooding, injuries, deaths, and extreme property loss. According to the US Government Accountability Office, national storm losses from changing frequency and intensity of storms is projected to increase anywhere from $4-6 billion in the near future.

Additionally, as NOAA reports in Figure 3-8, weather extremes will likely cause more frequent, stronger storms in the future due to rising surface temperatures. That is to say, NOAA models predict that while there may be less frequent, low-category storm events (Tropical Storms, Category 1 Hurricanes), there will be more, high-category storm events (Category 4 and 5 Hurricanes) in the future. This means that there may be fewer hurricanes overall in any given year, but when hurricanes do form, it is more likely that they will become large storms that can create massive damage.

Figure 3-8: National Oceanic and Atmospheric Administration Climate Models Projection for Future Hurricanes



Climate models project there will be fewer weak to moderate-strength Atlantic hurricanes as surface temperatures rise this century. However, the models predict that a greater number of the hurricanes that do form will tend to strengthen to category 4 and 5 hurricanes. The bars in this graph show the average results from 18 different models. The dots on each bar show a range of results from 4 of the 18 different models. Graph courtesy of Gabriel Vecchi, NOAA GFDL.



Models project there will be an increase in hurricane intensities as the climate warms over the course of this century. Though there will likely be fewer Atlantic hurricanes overall, wind speeds for the ones that do form will be about 4 percent stronger for every 1°C increase in sea surface temperature. Graph courtesy of Tom Knutson, NOAA GFDL.

Source: National Oceanic and Atmospheric Administration GFDL

3.2.2.6 Impact

North Carolina is susceptible to potentially catastrophic impacts from hurricane. While not highly likely, a Category 5 hurricane could strike North Carolina causing a high number of deaths/injuries possible and damaging or destroying more than 50% of the property in the State. It is not out of the realm of possibility that a major could hurricane could cause complete shutdown of some critical facilities for 30 days or more.

3.2.2.7 Future Probability

North Carolina has an extensive hurricane history, partially due to its coastal location. Because hurricanes are able to impact large areas at one time, all parts of the state are vulnerable to being affected. Historical occurrences of hurricanes and coastal hazards show that North Carolina is likely (between 33.4 and 66.6 percent annual probability) to experience these types of events in the future.

3.2.2.8 NCEOP Reference

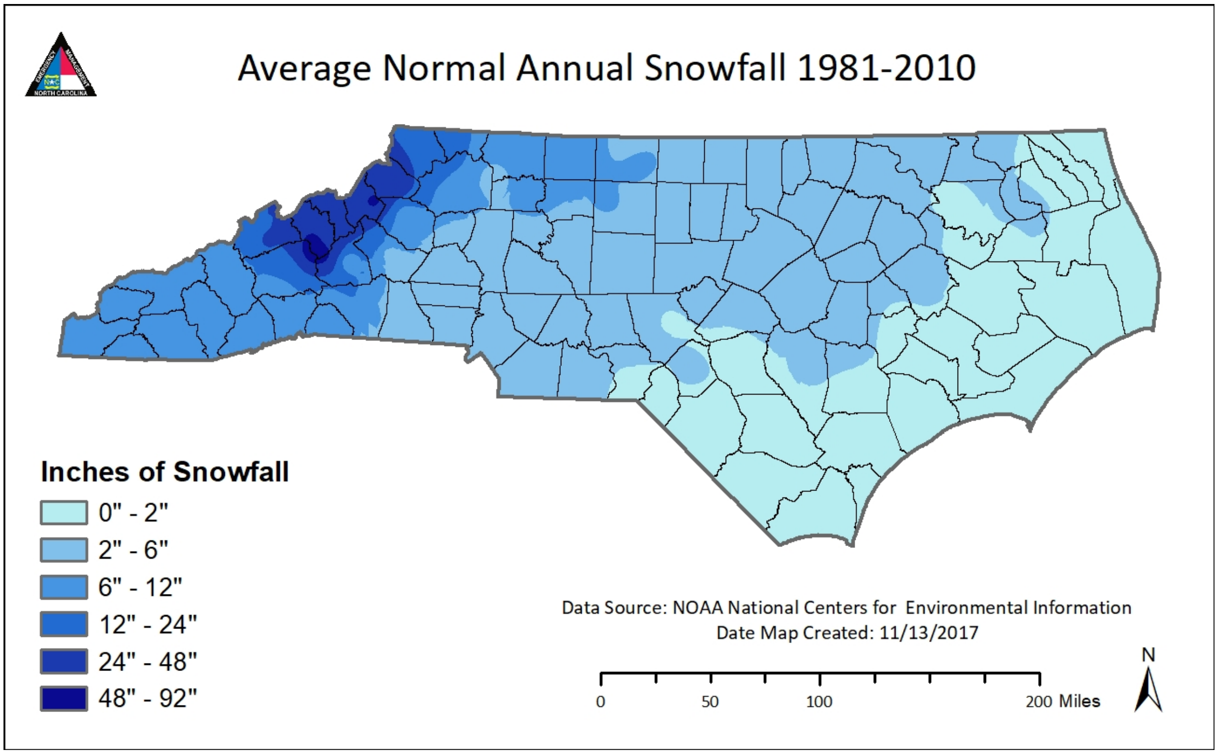
Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 1, Hurricane Operations Plan

3.2.3 Severe Winter Weather

3.2.3.1 Description

The winter storms that typically impact North Carolina generally form in the Gulf of Mexico or off the southeast Atlantic Coast. The entire state has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal areas typically face their greatest weather threat from nor'easters and other severe winter coastal storms. These storms can contain strong waves and result in extensive beach erosion and flooding. Freezing rain and ice storms typically occur once every several years at coastal locations and severe snowstorms have been recorded occasionally in coastal areas.

Figure 3-9 Average Normal Annual Snowfall 1981-2010



3.2.3.2 **Extent**

The extent of winter storms can be measured by the amount of snowfall received (in inches). The greatest 24-hour snowfall (36 inches) and single storm snowfall (50 inches) in North Carolina was recorded on March 1993 at Mount Mitchell.[3]

When reviewing historical snowfall information provided by NOAA and NCEI information, the mountains of North Carolina are more prone to snowfall events and the piedmont, and event coastal counties can experience ice storms that often cause major disruption.

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[3] *Weather Extremes. North Carolina State Climate Office. Retrieved on December 14, 2017 from: https://climate.ncsu.edu/nc_extremes*

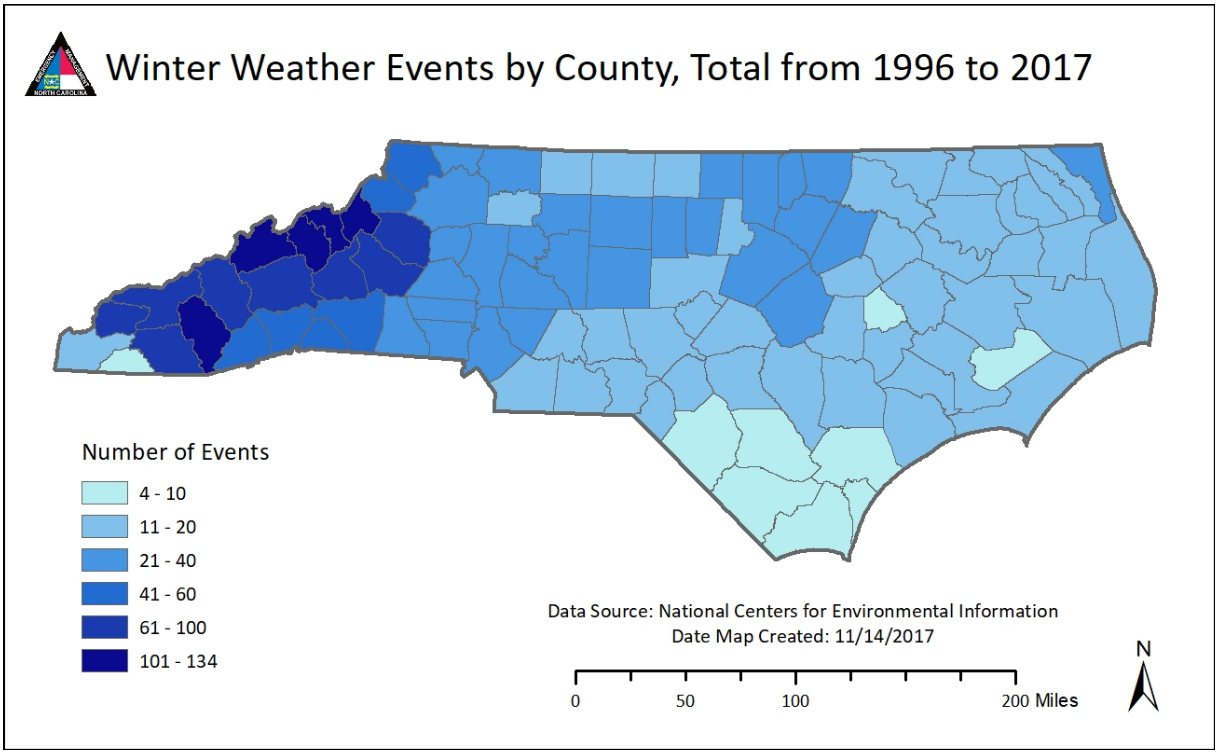
3.2.3.3 Location/Spatial Extent

Nearly the entire continental United States 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. The State of North Carolina is accustomed to severe winter weather conditions, and frequently receives winter weather during the winter months. This is especially true in the western part of the state which receives severe winter weather much more frequently and in higher precipitation amounts than the eastern part of the state.

3.2.3.4 Hazard History

In recent years, presidential disasters have been declared in North Carolina for severe winter weather in January/February 1996, January 2000, December 2002, March 2003, and March 2014. Since January 1996, 34 deaths and 191 injuries have been attributed to snow and ice events that have occurred in the state. Total property damage for those events is estimated at $471.9 million. Table 3-7 lists severe winter storms and the impacted counties. FEMA Public Assistance data is listed when available. Detailed information about two of these severe winter weather events follows the table.

Figure 3-10 Severe Winter Weather Events for North Carolina



All counties in North Carolina have been affected by winter weather events at least once between 1996 and 2017. Western counties, such as Avery and Mitchell, reported having 384 and 362 occurrences, respectively. Over these years, there have also been 34 fatalities and 177 injuries due to severe winter weather. Table 3-7 summarizes the winter weather events by county, as listed in the NCEI's Storm Events Database.

Table 3-7 Detailed Severe Winter Weather History of North Carolina

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Alamance	62	0	0	$544,484	$0
Alexander	116	0	0	$11,007,425	$1,190,395
Alleghany	66	0	1	$182,559	$4,719
Anson	33	0	0	$0	$0
Ashe	99	0	0	$353,966	$4,719
Avery	384	1	0	$78,688,101	$1,190,395
Beaufort	27	4	13	$70,879	$0
Bertie	41	0	0	$35,833	$0
Bladen	26	0	0	$4,604,380	$0
Brunswick	9	0	0	$201,211	$0
Buncombe	254	0	0	$95,110	$11,903,955
Burke	219	0	0	$12,417,530	$2,380,791
Cabarrus	71	0	0	$16,529,076	$1,190,395
Caldwell	213	0	0	$12,414,917	$2,380,791
Camden	36	0	0	$0	$0
Carteret	21	4	4	$334,011	$0
Caswell	37	0	0	$112,359	$229,322
Catawba	114	0	0	$12,414,952	$1,190,395
Chatham	44	0	0	$544,484	$0
Cherokee	31	0	0	$1,573	$0
Chowan	36	0	0	$0	$0
Clay	22	0	0	$0	$0
Cleveland	88	0	0	$12,478,142	$2,380,791
Columbus	18	0	0	$7,845,330	$0
Craven	27	0	0	$0	$0
Cumberland	33	1	0	$10,283	$0
Currituck	34	0	0	$0	$0
Dare	18	0	0	$0	$0
Davidson	62	0	0	$ 6,464,068	$0
Davie	107	0	0	$12,379,403	$0
Duplin	30	1	5	$0	$0
Durham	49	0	0	$1,494,102	$0
Edgecombe	41	0	0	$23,807	$0
Forsyth	66	0	0	$497,438	$0
Franklin	49	0	0	$538,532	$0
Gaston	79	0	0	$24,887,328	$1,190,395
Gates	40	0	0	$0	$0
Graham	217	0	0	$0	$1,190,395
Granville	53	1	3	$827,329	$0
Greene	26	1	4	$31,461	$0
Guilford	63	0	0	$9,046,072	$0
Halifax	45	0	0	$657,674	$0
Harnett	47	0	0	$28,138	$0
Haywood	277	0	0	$0	$2,380,791
Henderson	157	2	0	$1,735,324	$11,903,955

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Hertford	41	0	0	$0	$0
Hoke	30	0	0	$0	$0
Hyde	22	0	0	$0	$538,234
Iredell	113	0	0	$13,759,256	$1,190,395
Jackson	360	0	0	$4,115,936	$595,197
Johnston	49	0	0	$600,763	$0
Jones	25	0	0	$0	$0
Lee	44	0	0	$0	$0
Lenoir	31	1	10	$62,923	$0
Lincoln	86	0	0	$12,413,611	$1,190,395
Macon	172	0	0	$0	$2,380,791
Madison	298	0	0	$0	$3,751,186
Martin	31	1	14	$62,923	$0
McDowell	169	0	0	$12,417,530	$0
Mecklenburg	77	2	0	$58,272,063	$0
Mitchell	36	0	0	$32,956	$1,190,395
Montgomery	40	0	0	$0	$0
Moore	39	0	0	$0	$0
Nash	49	0	0	$554,767	$0
New Hanover	6	0	0	$0	$0
Northampton	43	0	0	$2,222,259	$0
Onslow	26	1	35	$222,211	$0
Orange	59	0	0	$3,892,063	$0
Pamlico	21	0	2	$23,596	$0
Pasquotank	33	0	0	$0	$0
Pender	23	2	0	$2,001,571	$0
Perquimans	37	0	0	$0	$0
Person	61	0	0	$1,095,275	$0
Pitt	31	0	92	$117,982	$0
Polk	109	0	0	$28,143,279	$0
Randolph	57	0	0	$3,770,566	$0
Richmond	34	0	0	$0	$0
Robeson	27	0	0	$5,947,616	$0
Rockingham	43	0	0	$346,605	$225,751
Rowan	100	5	0	$13,757,936	$1,190,395
Rutherford	142	0	0	$12,475,224	$2,380,791
Sampson	32	0	0	$0	$0
Scotland	31	0	0	$	$0
Stanly	39	0	0	$0	$0
Stokes	42	2	0	$307,279	$47,192
Surry	52	4	5	$1,149,945	$300,790
Swain	244	0	0	$0	$1,190,395
Transylvania	154	1	0	$9,832,875	$3,571,186
Tyrrell	34	0	0	$0	$0
Union	53	0	0	$15,745,072	$595,197
Vance	51	0	0	$817,035	$0
Wake	51	0	0	$1,087,349	$0
Warren	46	0	0	$793,227	$0
Washington	29	0	2	$23,596	$0

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Watauga	100	0	0	$611,391	$4,719
Wayne	31	0	0	$10,283	$0
Wilkes	55	0	0	$914,712	$2,132,270
Wilson	42	0	0	$554,767	$0
Yadkin	37	0	0	$222,477	$661,903
Yancey	361	0	0	$33,226	$1,190,395
North Carolina	7500	34	177	$330,416,008	$65,039,781

Source: NCEI

Significant North Carolina Severe Winter Weather Events

The following overview provides a synopsis of two notable severe winter weather events that have impacted North Carolina during this decade:

Ice Storm (02/27/2003)

Another round of frozen precipitation moved into the area on the heels of a previous storm, bringing more freezing rain and sleet to areas that already had more than a quarter inch of ice frozen on trees. The total ice accumulations ranged from a trace near the coast to as much as three quarters of an inch of ice over interior sections. The weight of the ice caused major power outages from falling tree limbs, as well as significant structural damage to many residential structures. Some ice accumulations occurred on the roads, especially on bridges and overpasses, with numerous traffic accidents reported. Many residences were left without power for more than a week. Monetary damages totaled more than a million dollars per county in some parts of the state, due to the costs of debris cleanup, utility expenses, and home repair.

Ice Storm (02/03/2005)

Ice accretion began to cause damage across the southern mountains and foothills of North Carolina just prior to sunrise. By late morning, the ice storm had become severe, as thousands of trees fell across the area, and power outages became widespread. Numerous trees and large limbs fell on and damaged homes and vehicles. It was estimated that three-quarters of Henderson County's residents lost power. Most who lost power went without it for at least 24 hours. In some areas, it took as much as five days to restore electricity. Despite the devastation, road problems occurred only rarely, as temperatures hovered right around the freezing mark for most of the event. Duke Power estimated costs for labor overtime and line repair at $72 million for the event, thought these costs are not reflected in the property damage values for the event. In Henderson County, two deaths occurred as an indirect result of the ice storm. One resident died of carbon monoxide poisoning after running an unventilated generator inside a garage. Another resident died of carbon monoxide poisoning due to a malfunctioning gas stove. Ice accumulation ranged from more than a half-inch along the Blue Ridge to one-eighth-of-an-inch or less along the Tennessee border. Several trees and large limbs fell on and damaged homes and vehicles. Numerous slick spots also developed on roadways, primarily in the North Carolina mountains, where a number of accidents occurred.

In addition to these profiled events, Figure 3-11 displays a map of declared disaster counties impacted by a blizzard that occurred in Jan. 2000. Likewise, Figure 3-12 shows a map of declared disaster counties impacted by an ice storm that occurred in Dec. 2002.

Figure 3-11 Severe Winter Weather Event #2: Map of Declared Disaster Counties

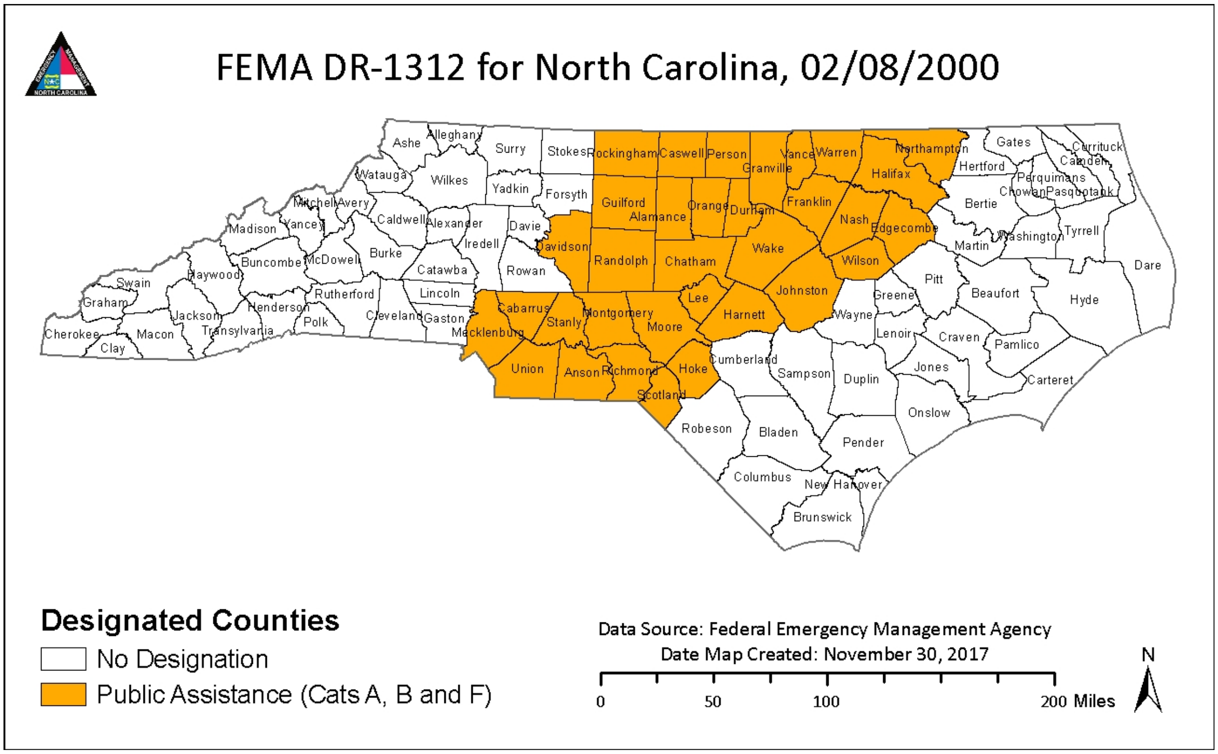
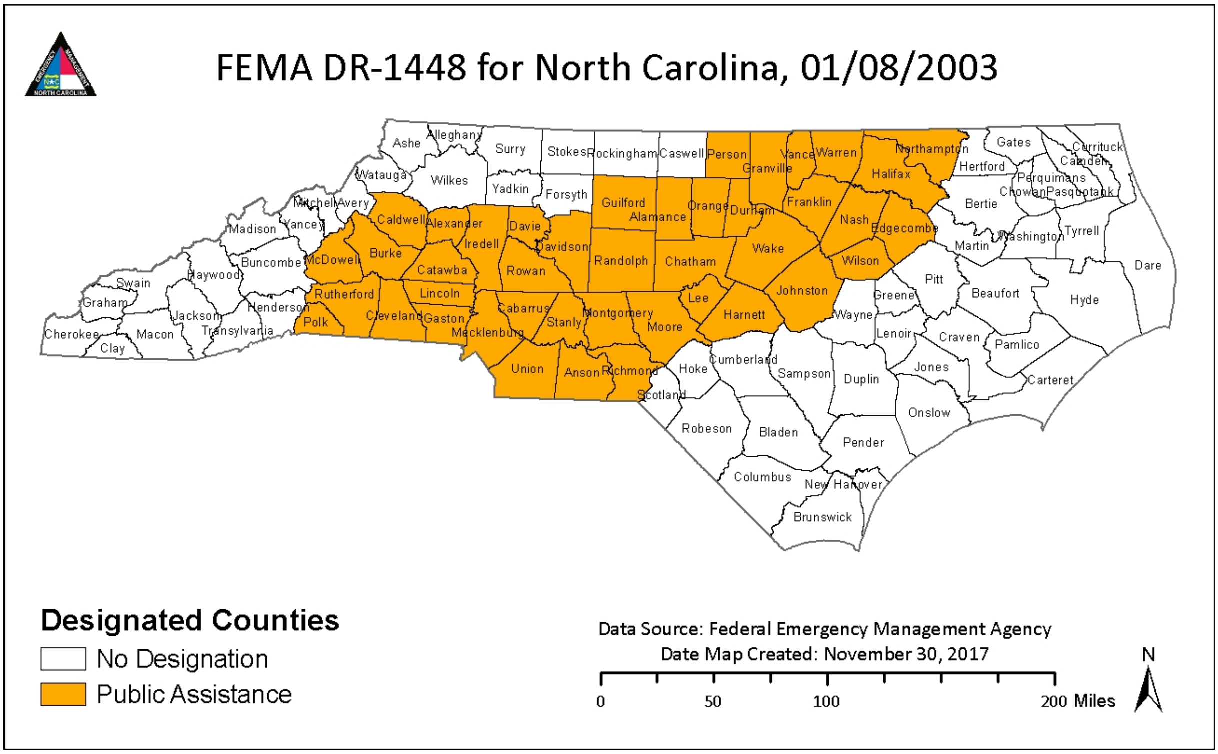


Figure 3-12 Severe Winter Weather Event #3: Map of Declared Disaster Counties



3.2.3.5 Changing Future Conditions

The uncertainty associated with potentially changing climate conditions creates uncertainty for predicting future severe winter storms. If it is determined that global temperatures are indeed rising, this 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.

3.2.3.6 Impact

North Carolina has received and will continue to receive dangerous winter storms. However, because the state is not prone to winter weather events like more northern states, rare winter storms have more of an impact. Roads easily become covered by snow and ice, making driving more dangerous. According to the North Carolina State University Climate Office, 70% of winter weather related injuries are from vehicle accidents. Winter weather can also cause power outages when ice accrues on power lines, and widespread outages may occur.

3.2.3.7 Future Probability

Although North Carolina typically experiences a warmer climate, it still has been affected by severe winter weather. According to historical evidence, the state experiences on average 21 winter storm events per year. All parts of the state are vulnerable to winter storms, but they are more likely to occur in the western counties. Winter storm events will remain a likely (between 33.4 and 66.6 percent annual probability) occurrence, and the probability of future occurrences is certain. Fortunately, large-scale property damages and/or threats to human life and safety are rare with these events.

3.2.3.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 2, Winter Storm Operations Plan

3.2.4 Excessive Heat

3.2.4.1 Description

Excessive heat is a dangerous and deadly occurrence in North Carolina. According to the National Weather Service, heat is one of the leading weather-related causes of loss of life in the United States.[4] The Centers for Disease Control and Prevention indicates that 618

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[4] *Heat Safety Tips and Resources. National Oceanic and Atmospheric Administration: National Weather Service. Retrieved on December 14, 2017 from: http://www.nws.noaa.gov/os/heat/*

people in the United States are killed by extreme heat every year.[5] Also, according to the CDC, that number represents more deaths than hurricanes, lightning, tornadoes, earthquakes and floods combined.[6] The CDC defines extreme heat as "summertime temperatures that are much hotter and/or humid than average." The National Weather Service defines a heat wave as "a period of abnormally and uncomfortably hot and unusually humid weather, typically lasting two or more days."[7]

3.2.4.2 Extent

The National Weather Service devised the Heat Index as a mechanism to better inform the public of heat dangers. The Heat Index Chart, shown in Figure 3-13, uses air temperature and humidity to determine the heat index or apparent temperature.

Figure 3-13 NOAA Heat Index

NWS Heat Index — Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: NOAA, National Weather Service

It should also be noted that the highest temperature ever recorded in the state by the State Climate Office was 110 degrees Fahrenheit in Fayetteville in August of 1983.[8]

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[5] *Natural Disasters and Severe Weather. Centers for Disease Control and Prevention. Retrieved on December 14, 2017 from: https://www.cdc.gov/disasters/extremeheat/heat_guide.html*
[6] *Extreme Heat. Centers for Disease Control and Prevention. Retrieved on December 14, 2017 from: https://www.weather.gov/images/rah/heat/CDCInfographic.jpg*
[7] *Historic Heat Waves in the Carolinas. National Oceanic and Atmospheric Administration: National Weather Service. Retrieved on December 14, 2017 from: http://www.weather.gov/ilm/heatwaves*
[8] *Weather Extremes. North Carolina State Climate Office. Retrieved on December 14, 2017 from: https://climate.ncsu.edu/nc_extremes*

3.2.4.3 Location/Spatial Extent

Excessive heat can have an impact in any location throughout the state as temperatures in all parts of the state have been high enough historically to cause heat disorders in the population. It is especially notable that high humidity rates across the state often exacerbate already high temperatures and lead to greater incidences of heat-related illness. In general, the mountainous western part of the state is somewhat less susceptible to excessive heat as higher elevations tend to lead to cooler temperatures. The central and eastern parts of the state much more frequently experience high temperatures that can lead to human health problems.

3.2.4.4 Hazard History

NCEI data indicates 125 unique heat/excessive heat events that have occurred in North Carolina since 1996 through 2017. Impacts have been recorded in 60 counties and have resulted in 16 fatalities. These events are listed in Table 3-8 below, and a graphic representation of the data follows the table in Figure 3-14. These heat events are only inclusive of those reported by the National Centers for Environmental Information.

Table 3-8 North Carolina Excessive Heat Event Summary by County

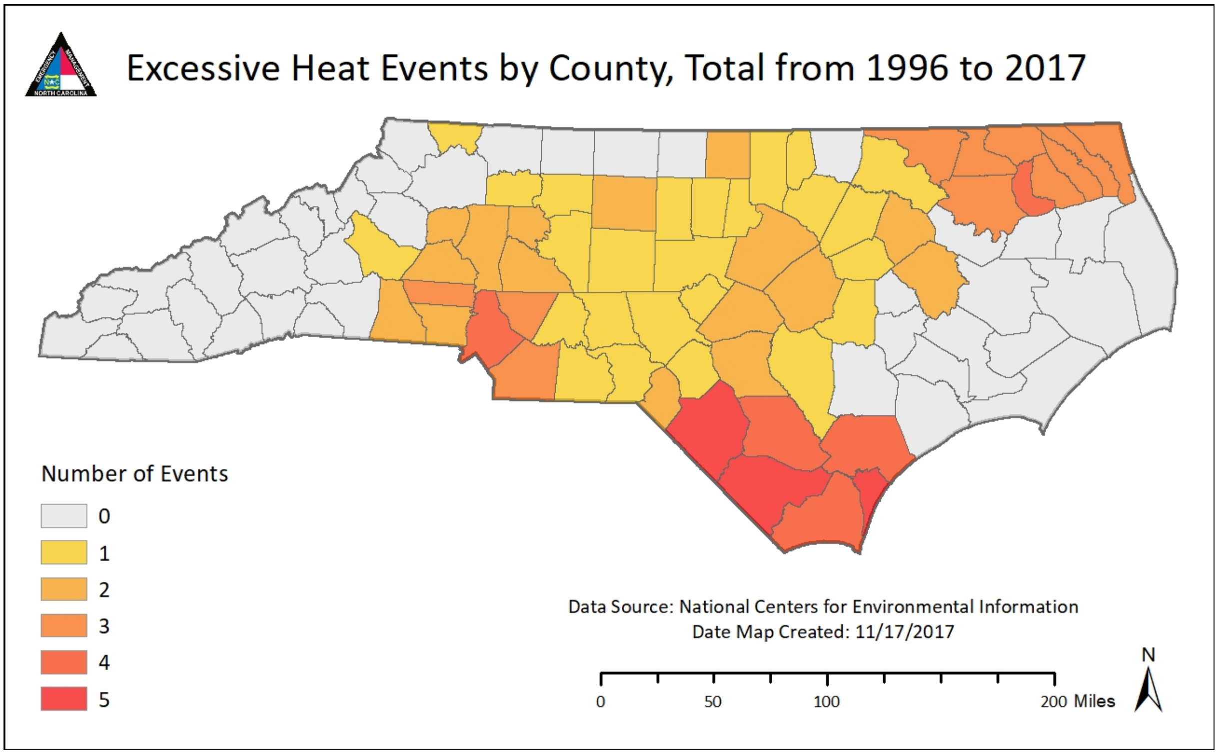
North Carolina Excessive Heat Events					
County	Number of Events (1996-2017)	Injuries	Fatalities	Property Damage (Inflated to 2017 Dollars)	Crops Damage (Inflated to 2017 Dollars)
Alamance	1	0	0	$0	$0
Alexander	2	0	0	$0	$0
Alleghany	1	0	0	$0	$0
Anson	1	0	0	$0	$0
Ashe	0	0	0	$0	$0
Avery	0	0	0	$0	$0
Beaufort	0	0	0	$0	$0
Bertie	3	0	0	$0	$0
Bladen	4	0	0	$0	$0
Brunswick	4	0	0	$0	$0
Buncombe	0	0	0	$0	$0
Burke	1	0	1	$0	$0
Cabarrus	3	0	0	$0	$0
Caldwell	0	0	0	$0	$0
Camden	3	0	0	$0	$0
Carteret	0	0	0	$0	$0
Caswell	0	0	0	$0	$0
Catawba	2	0	0	$0	$0
Chatham	1	0	0	$0	$0
Cherokee	0	0	0	$0	$0
Chowan	4	0	1	$0	$0
Clay	0	0	0	$0	$0
Cleveland	2	0	0	$0	$0
Columbus	5	15	1	$0	$0
Craven	0	0	0	$0	$0
Cumberland	2	0	1	$0	$0
Currituck	3	0	0	$0	$0
Dare	0	0	0	$0	$0

North Carolina Excessive Heat Events					
County	Number of Events (1996-2017)	Injuries	Fatalities	Property Damage (Inflated to 2017 Dollars)	Crops Damage (Inflated to 2017 Dollars)
Davidson	1	0	0	$0	$0
Davie	2	0	0	$0	$0
Duplin	0	0	0	$0	$0
Durham	1	0	0	$0	$0
Edgecombe	2	0	1	$0	$0
Forsyth	1	0	0	$0	$0
Franklin	1	0	0	$0	$0
Gaston	2	0	0	$0	$0
Gates	3	0	0	$0	$0
Graham	0	0	0	$0	$0
Granville	1	0	0	$0	$0
Greene	0	0	0	$0	$0
Guilford	2	0	1	$0	$0
Halifax	1	0	0	$0	$0
Harnett	2	0	1	$0	$0
Haywood	0	0	0	$0	$0
Henderson	0	0	0	$0	$0
Hertford	3	0	0	$0	$0
Hoke	1	0	0	$0	$0
Hyde	0	0	0	$0	$0
Iredell	2	0	0	$0	$0
Jackson	0	0	0	$0	$0
Johnston	2	0	1	$0	$0
Jones	0	0	0	$0	$0
Lee	1	0	0	$0	$0
Lenoir	0	0	0	$0	$0
Lincoln	3	1	0	$0	$0
Macon	0	0	0	$0	$0
Madison	0	0	0	$0	$0
Martin	0	0	0	$0	$0
McDowell	0	0	0	$0	$0
Mecklenburg	4	0	2	$0	$0
Mitchell	0	0	0	$0	$0
Montgomery	1	0	0	$0	$0
Moore	1	0	0	$0	$0
Nash	1	0	0	$0	$0
New Hanover	5	0	0	$0	$0
Northampton	3	0	0	$0	$0
Onslow	0	0	0	$0	$0
Orange	1	0	0	$0	$0
Pamlico	0	0	0	$0	$0
Pasquotank	3	0	0	$0	$0
Pender	4	0	0	$0	$0
Perquimans	3	0	0	$0	$0
Person	2	0	1	$0	$0
Pitt	2	0	3	$0	$0
Polk	0	0	0	$0	$0
Randolph	1	0	0	$0	$0
Richmond	1	0	0	$0	$0

North Carolina Excessive Heat Events					
County	Number of Events (1996-2017)	Injuries	Fatalities	Property Damage (Inflated to 2017 Dollars)	Crops Damage (Inflated to 2017 Dollars)
Robeson	5	0	1	$0	$0
Rockingham	0	0	0	$0	$0
Rowan	2	0	0	$0	$0
Rutherford	0	0	0	$0	$0
Sampson	1	0	0	$0	$0
Scotland	2	0	1	$0	$0
Stanly	1	0	0	$0	$0
Stokes	0	0	0	$0	$0
Surry	0	0	0	$0	$0
Swain	0	0	0	$0	$0
Transylvania	0	0	0	$0	$0
Tyrrell	0	0	0	$0	$0
Union	3	0	0	$0	$0
Vance	1	0	0	$0	$0
Wake	2	1	0	$0	$0
Warren	0	0	0	$0	$0
Washington	0	0	0	$0	$0
Watauga	0	0	0	$0	$0
Wayne	1	0	0	$0	$0
Wilkes	0	0	0	$0	$0
Wilson	1	0	0	$0	$0
Yadkin	1	0	0	$0	$0
Yancey	0	0	0	$0	$0
North Carolina	125	17	16	$0	$0

Source: NCEI

Figure 3-14 NC Excessive Heat Events by County, 1996-2017



Details for Selected Excessive Heat Events

July 22, 1998–July 23, 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°F at several locations and those that did achieved that feat for only an hour or two. Strong thunderstorms ended the two-day excessive heat ordeal when rain cooled the environment enough to send temperatures into the lower 70s at most locations.

July 20, 1999–July 31, 1999

A heat wave caused many to require hospital treatment in Columbus County and in neighboring counties in southeast NC. A farm worker died of heat stroke after hospitalization.

July 23, 1999–July 25, 1999

A farm worker was overcome by heat exhaustion. He was taken to the local hospital where his body temperature was measured at 108 degrees. A three-year-old boy died after he apparently entered his parents' car and could not get out.

Aug. 7, 2001–Aug. 9, 2001

High humidity and temperatures in the mid-90s caused afternoon heat indices between 105 and 110 degrees (measured by ASOS) in New Hanover County. A heat index of 108 was also reported at Lumberton.

July 21, 2011

Excessive heat advisories and warnings were issued for a large portion of eastern North Carolina for several days toward the end of July. The heat and humidity combined to push heat indices near 110 degrees at times during the afternoon.

June 29, 2012 – Jul1 1, 2012

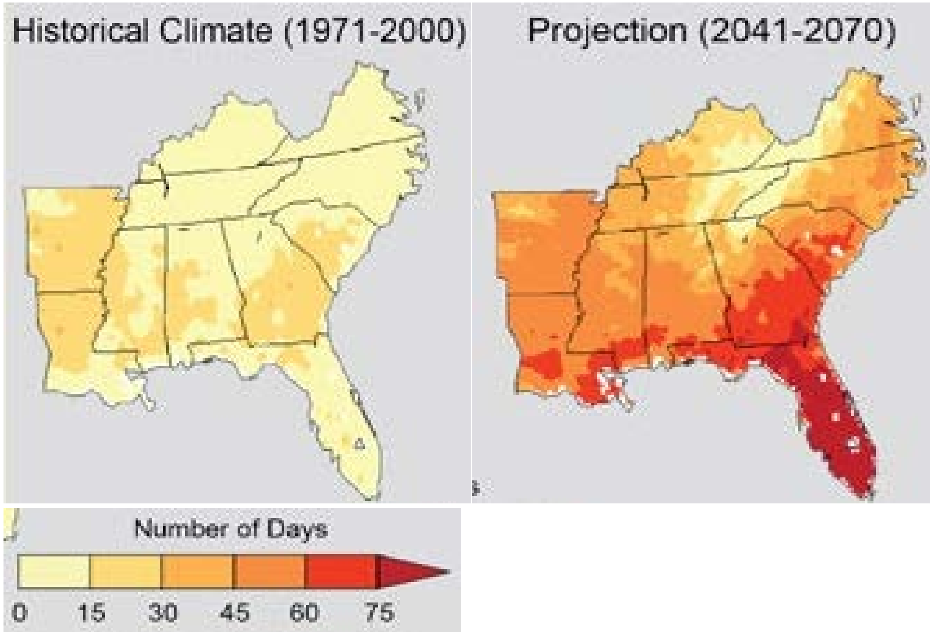
A very hot and humid airmass that spent several days building west of the Appalachians finally made it east of the mountains, bringing very hot conditions to foothills and Piedmont of North Carolina. The high temperature at Charlotte-Douglas International Airport hit 104 degrees on both the 29th and 30th, tying the all-time high. The heat index hit 105 degrees. Excessive heat affected areas east of Charlotte. The ASOS at Monroe, NC reported a heat index value of 110 degrees on 30th. Lower dewpoints over the foothills resulted in sub-advisory and warning level heat index values. The heat lasted through July 1st, before thunderstorms brought somewhat cooler conditions.

3.2.4.5 Changing Future Conditions

Changing climate patterns may affect North Carolina's likelihood of experiencing days with extreme heat. As global surface temperatures rise, so does the probability of excessive heat. In the US Global Change Research Program's 2017 Climate Science Special Report, researchers predict the frequency and intensity of extreme high temperature events are virtually certain to surge. More intense heat waves may further affect agricultural production and species diversity. Occasionally, destructive wildfires may also spread in dry conditions during heat waves.

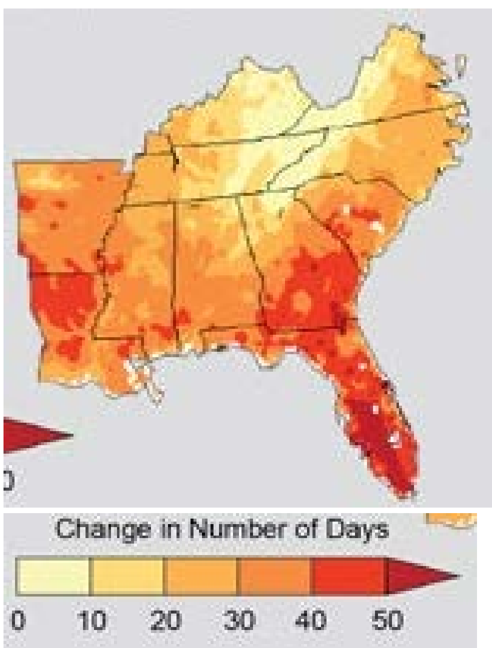
Additionally, according to the National Climate Assessment, the increase in the number of days over 95°F is likely to increase over the next 30 to 50 years when compared to a baseline over the last 30 years of the 20th century. Figure 3-15 shows both the baseline, historical number of days over 95°F from 1971 to 2000 and the projection for the 2041 to 2070 period. Figure 3-16 shows the projected change in number of days between the historic data and the projected data. This increase in days of extreme heat due to weather extremes will likely result in a higher number of rolling brown/blackouts and decreased air quality in the state.

Figure 3-15: Number of Days Over 95 Degrees Fahrenheit



Source: National Climate Assessment

Figure 3-16: Projected Change in Number of Days Over 95 Degrees Fahrenheit



Source: National Climate Assessment

3.2.4.6 Impact

Extreme heat poses little risk to property. However, extreme heat can have devastating effects on public health. The primary impacts are heat-related illnesses such as dehydration and heat-stroke and even death. Some populations, such as the elderly and young, are more susceptible to heat danger than other segments of the population. Other impacts can be felt on utility companies that may experience strains on power supplies and people increase power usage through increased use of air conditioning in times of excessive heat.

3.2.4.7 Future Probability

Changing future conditions create concern regarding extreme heat occurrences. Due to the fact that weather extremes may cause more extreme temperatures and based on historical evidence, it is unlikely (between 1 and 33.3 percent annual probability) that North Carolina will continue to experience excessive heat events in the near future.

3.2.4.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 9, Heat Emergency Response Plan

3.2.5 Earthquakes

3.2.5.1 Description

An earthquake is a vibration or shaking of Earth's surface due to an underground release of energy. They can be caused by various conditions, such as sudden movements along geological faults or volcanic activity. Earthquake magnitudes, or severity, are recorded on the Richter scale with seismographs. Some may be so small that they are virtually unnoticed, while others can destroy entire cities. Seismology, the study of earthquakes, helps scientists understand what areas are more prone to experiencing earthquakes, such as along the Ring of Fire; however, earthquakes are generally unpredictable. According to the USGS, there around 500,000 earthquakes reported each year, but only around 100,000 are strong enough to be felt.

Sometimes earthquakes have foreshocks, which are smaller earthquakes that occur in the same location where a larger earthquake follows. The largest quake, or the mainshock, may also be followed by smaller tremors called aftershocks. The exact location where the earthquake begins is referred to as the hypocenter, and the epicenter is the location directly above the hypocenter on earth's surface. Major destruction generally occurs near the epicenter because it is the area of maximum intensity.

Historical seismicity is an indicator of where earthquakes have happened. Paleoseismicity (the study of earthquake-induced ground failures during prehistoric times) provides further evidence as to the size and frequency of earthquakes. Since 1735, North Carolina has experienced 23 earthquakes, each of which caused at least architectural damage. From historical data, scientists from the U.S. Geological Survey (USGS) and several university research centers have produced maps that project the expected ground motion for various return periods. The last recorded damaging earthquake in which the epicenter was located in North Carolina occurred in the vicinity of the Town of Hendersonville in 1985. The epicenter for the last recorded damaging event that affected the state was in Mineral Springs, Virginia in 2011.

Figure 3-17 NC Earthquake Events Since 1973

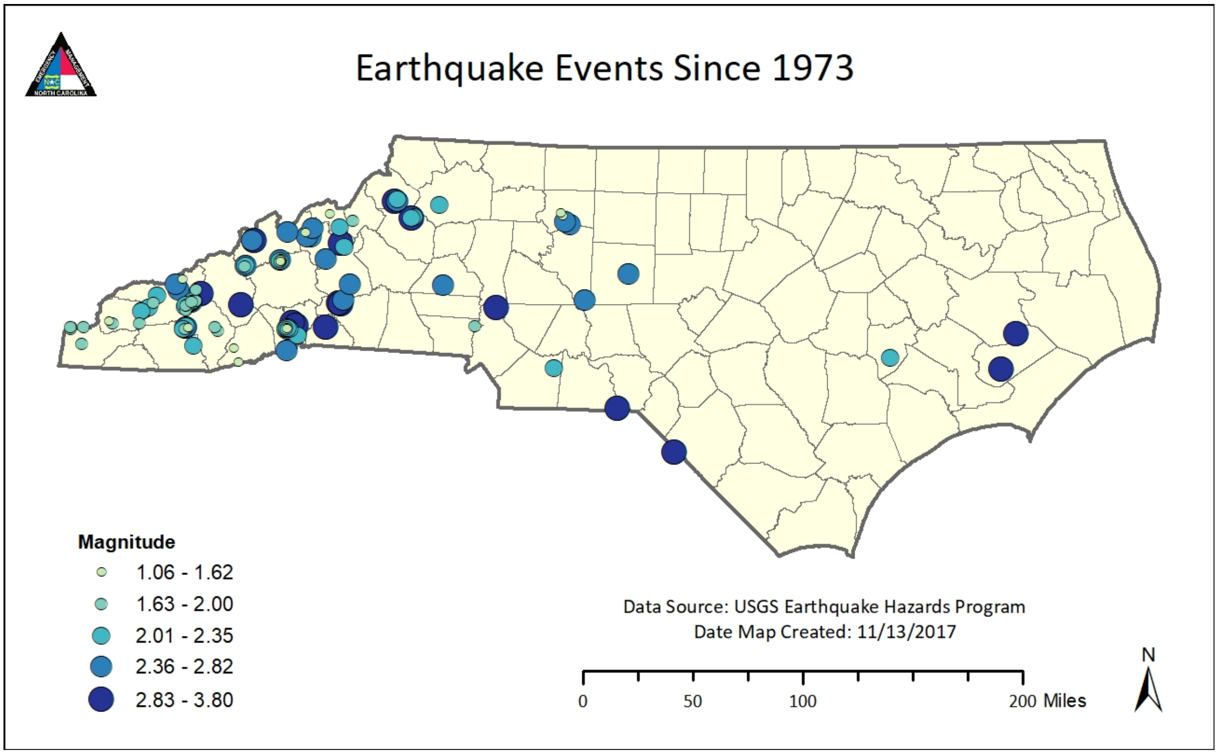


Figure 3-18 Western North Carolina Earthquake Events Since 1973

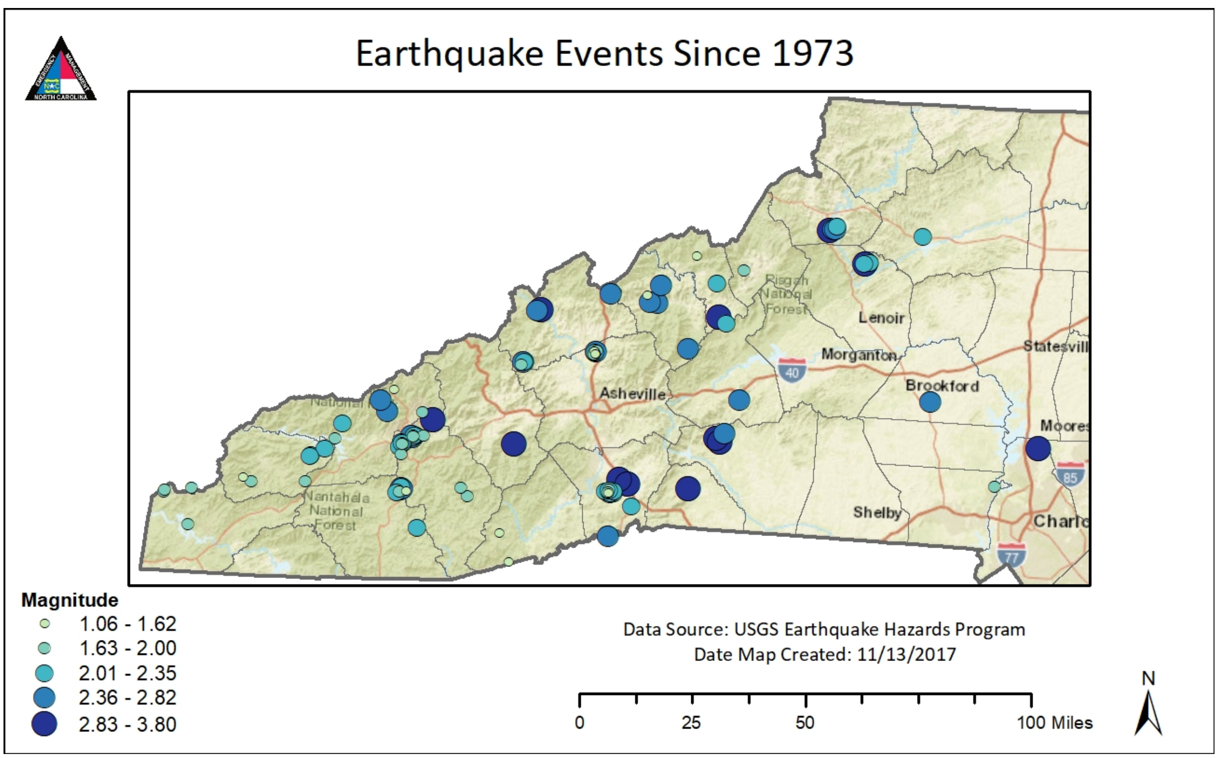
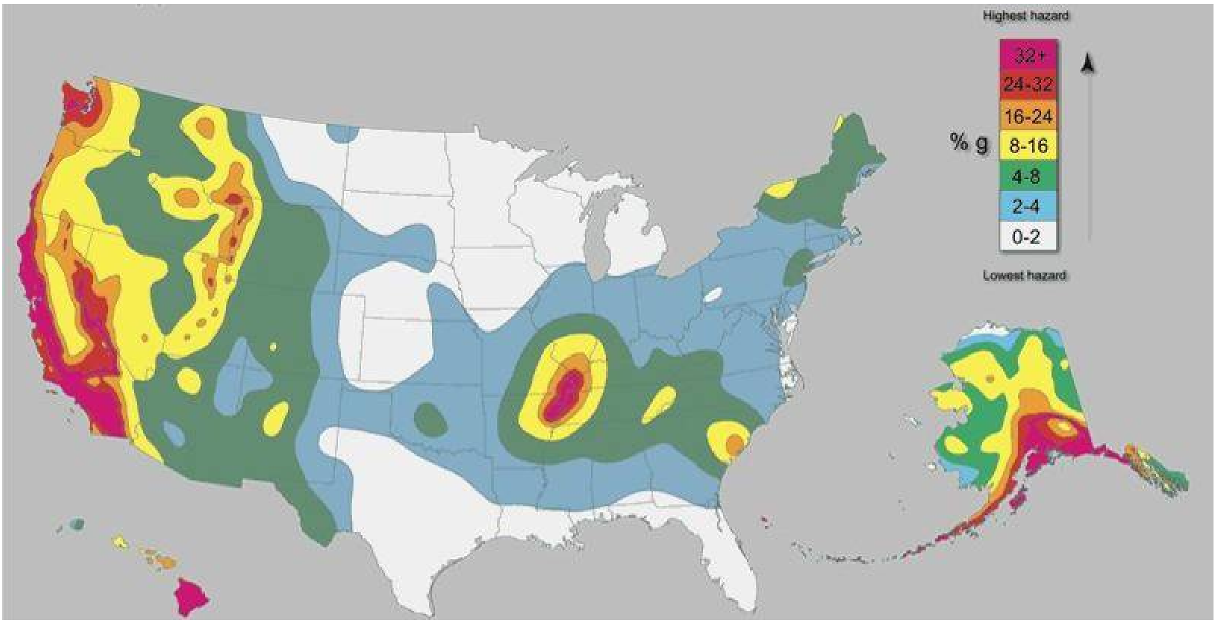


Figure 3-19 United States Earthquake Hazard Map



Source: United States Geological Survey

3.2.5.2 Extent

Earthquakes capable of producing structural damage or structural collapse are typically events with magnitudes greater than 5.5 on the Richter Scale. Seismologists use two terms to describe earthquakes and their effects. The oldest term is intensity and this describes the extent of shaking and the damages caused by it (i.e., the effects of the event on human populations and the built environment). The Modified Mercalli Intensity Scale (Table 3-9) lists the effects of earthquakes, ranging from slightly felt (I), to waking people (V), to complete devastation (XII). Roman numerals are used to indicate the rated intensity. For most widely felt events, intensity maps are prepared to document the extent of various intensities. From these maps, seismologists can relate the maximum shaking (highest intensity), as well as the felt area (spatial area in which the earthquake was observed).

Table 3-9 Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	INSTRUMENTAL	Detected only on seismographs.	
II	FEEBLE	Some people feel it.	< 4.2
III	SLIGHT	Felt by people resting; like a truck rumbling by.	
IV	MODERATE	Felt by people walking.	

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
V	SLIGHTLY STRONG	Sleepers awake; church bells ring.	< 4.8
VI	STRONG	Trees sway; suspended objects swing, objects fall off shelves.	< 5.4
VII	VERY STRONG	Mild alarm; walls crack; plaster falls.	< 6.1
VIII	DESTRUCTIVE	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged.	
IX	RUINOUS	Some houses collapse; ground cracks; pipes break open.	< 6.9
X	DISASTROUS	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread.	< 7.3
XI	VERY DISASTROUS	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards.	< 8.1
XII	CATASTROPHIC	Total destruction; trees fall; ground rises and falls in waves.	> 8.1

Source: Federal Emergency Management Agency

A second indicator was invented in 1935 to describe earthquakes in which no felt data was available. At that time, Charles Richter (working at the California Institute of Technology) demonstrated that the amplitude of ground motion—as recorded on a seismograph for earthquakes at the same distance from the seismograph—could be characterized. Richter proposed that each time the ground motion increased tenfold, the magnitude or size of the event increased by 1 unit of magnitude. The magnitude scale, therefore, relates the amplitude of ground motion. As the scale (Table 3-10) was improved to correct for wave attenuation (decreases in the height of a wave over distance), seismographs could be used to estimate an earthquake's magnitude and arrive at the same value. A magnitude 6 earthquake, therefore, will possess 10 times (10x) greater ground motion than a magnitude 5 earthquake and 100 times (or 100x) greater ground motion than a magnitude 4 earthquake.

Table 3-10 Richter Scale for Earthquakes

Richter Magnitudes	Earthquake Effects
< 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 about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

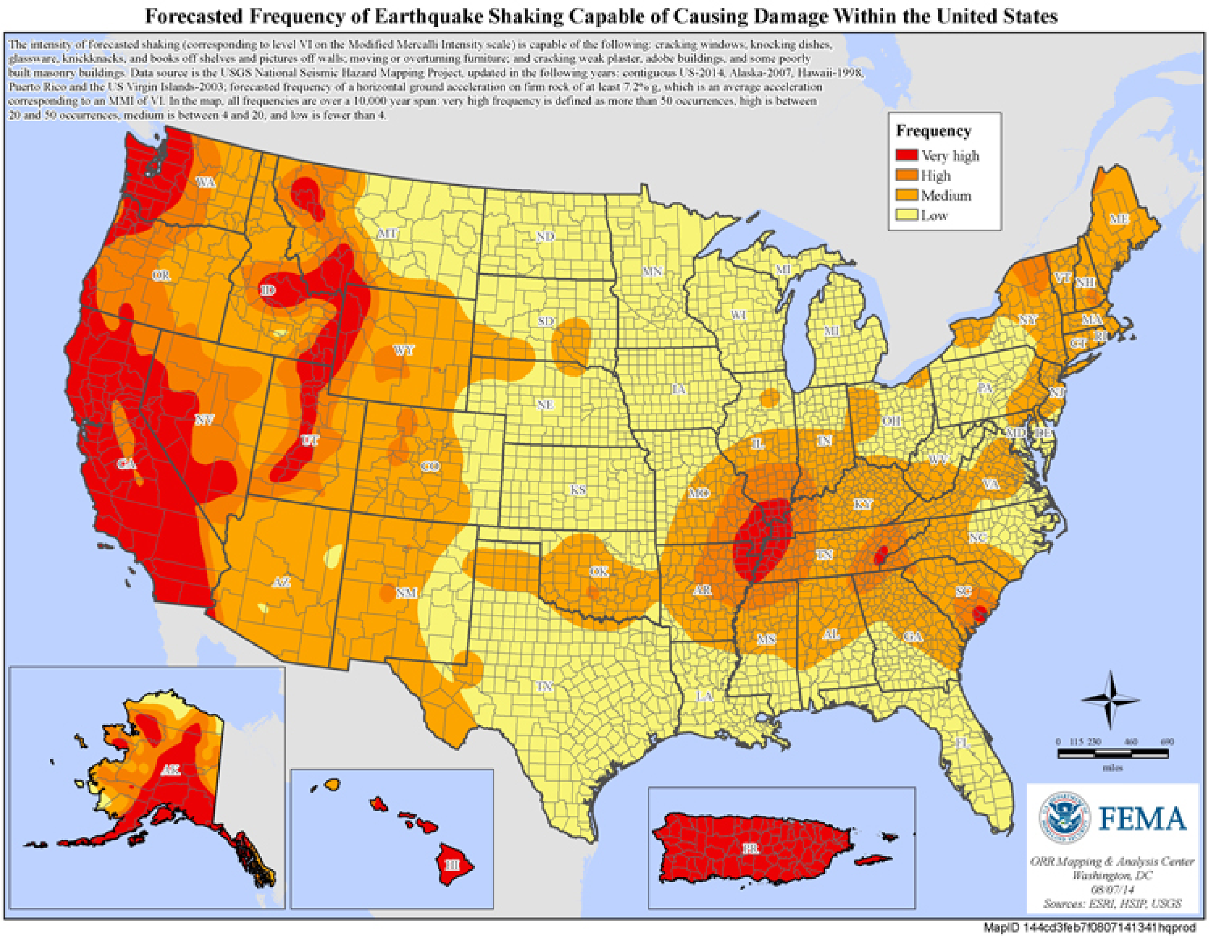
Decades later, seismologists found that an earthquake's magnitude could be related directly to the energy released in ground motion. For each tenfold increase in ground motion, there is a 30-fold increase in energy. Therefore, a magnitude 5 earthquake releases 30 times more energy than a magnitude 4 event. A magnitude 7 earthquake is 900 times larger (30 multiplied by itself) than a magnitude 5 earthquake, and 27,000 times (30 multiplied by 30 multiplied by 30) larger than a magnitude 4 earthquake.

By using observations related to magnitude, ground motion amplitude and duration (as well as wave attenuation), seismologists have been able to estimate earthquake magnitudes for historical earthquakes. In addition, by using the relationships developed through the study of large recent events, prehistoric earthquakes have also been characterized. Although it is possible that the state could experience an earthquake rated as high as a 10 on the Richter scale, the most likely high-level event is a 6 or 7. Likewise, Modified Mercalli intensity for a high-level event is likely to be around 8 or 9.

3.2.5.3 Location/Spatial Extent

Earthquakes could potentially affect any geographic location in North Carolina, however they are far more likely in the western and southern parts of the state. The northeastern part of the state very infrequently experiences significant earthquakes. This is apparent in Figure 3-20, which shows that the probability of significant, damaging earthquake events affecting North Carolina is generally medium. The forecasted frequency of an earthquake that would result in shaking capable of causing damage is fairly low in the northeast and gets higher moving west and south from there. It is possible that future earthquakes resulting in moderate to strong perceived shaking and damages that are substantial will affect the state, especially in the western and southern parts of the state.

Figure 3-20: Forecasted Frequency of Earthquake Shaking Capable of Causing Damage within the United States



Source: National Geophysical Data Center

3.2.5.4 Hazard History

North Carolina is located in “earthquake country.” Since 1735, when the state’s first reported earthquake was felt in Bath, seismologists have compiled catalogs of felt events. Later, when seismographs became available, earthquake magnitude and hypocenter (earthquake location within the earth) parameters were compiled on a regional basis. The Southeastern United States Earthquake Catalog (SEUSEC) is one such compilation and represents the combination of the U.S. Geological Survey “United States Earthquake Data File,” compiled by C.W. Stover, B.G. Reager, and S.T. Algermissen in 1984 (USGS Open File report 84-225) with more than 25 years of instrument-measured activity. Since 1977, earthquake magnitudes and hypocenters have been compiled by seismic network operators based in the southeastern United States and documented in a series of publications titled, “Southeastern United States Seismic Network Bulletin”—July 1977 to December 2002 (SEUSEC). The combination of these two datasets provides the best and most complete catalog of seismicity for the region.

A SEUSEC list of earthquakes that have caused damage in North Carolina is shown on Table 3-11. The table charts the date, magnitude, location, and felt intensity for the 23 earthquakes that have caused at least architectural damage in North Carolina. Of the 23 events, seven were located in North Carolina, primarily in the western region One can determine from the data in the table that six of these events were centered in North Carolina. The average time span between damaging events is 22 years, with the longest "quiet" interval lasting 40 years.

Table 3-11 Historic Earthquakes Registered in North Carolina

Date	Location	Magnitude	Max MMI*	MMI in NC**
12/16/1811	Northeast AK	8.5	XI	VI
12/16/1811	Northeast AK	8.0	XI	VI
12/16/1811	Northeast AK	8.0	XI	VI
1/23/1812	New Madrid, MO	8.4	XI	VI
2/7/1812	New Madrid, MO	8.7	XII	VI
4/29/1852	Wytheville, VA	5.0	VI	VI
8/31/1861	Wilkesboro, NC	5.1	VII	VII
12/23/1875	Central VA	5.0	VII	VI
8/31/1886	Charleston, SC	7.3	X	VII
5/31/1897	Giles County, VA	5.8	VIII	VI
1/1/1913	Union County, SC	4.8	VII	VI
2/21/1916	Asheville, NC	5.5	VII	VII
7/8/1926	Mitchell County, NC	5.2	VII	VII
11/3/1928	Newport, TN	4.5	VI	VI
5/13/1957	McDowell County, NC	4.1	VI	VI
7/2/1957	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
7/13/1971	Newry, SC	3.8	VI	VI
11/30/1973	Alcoa, TN	4.6	VI	VI
9/13/1976	Southwest VA	4.1	VI	VI
5/5/1981	Henderson County, NC	3.5	VI	VI
8/23/2011	Mineral Springs, VA	5.8	VIII	V

*Maximum Modified Mercalli Intensity experienced in the event
**Modified Mercalli Intensity experienced in North Carolina

Table 3-12 North Carolina Earthquakes in 2016

Date	Region	Magnitude
2/7/2016	Western North Carolina	2.1
2/10/2016	Tennessee/North Carolina border region	2.0
2/10/2016	Tennessee/North Carolina border region	2.1
3/1/2016	Southwestern North Carolina	2.4
3/22/2016	Southwestern North Carolina	1.6
4/24/2016	Southwestern North Carolina	1.6
4/22/2016	Southwestern North Carolina	2.5
4/25/2016	Southwestern North Carolina	1.4
4/25/2016	Southwestern North Carolina	1.5
4/25/2016	Southwestern North Carolina	2.0
4/25/2016	Southwestern North Carolina	1.5
4/25/2016	Southwestern North Carolina	1.9
4/26/2016	Southwestern North Carolina	2.0
4/26/2016	Southwestern North Carolina	1.1
4/26/2016	Southwestern North Carolina	1.9
4/26/2016	Southwestern North Carolina	1.9
4/26/2016	Southwestern North Carolina	1.4
4/26/2016	Southwestern North Carolina	1.7
4/29/2016	Southwestern North Carolina	1.5
4/29/2016	Southwestern North Carolina	1.8
6/29/2016	Southwestern North Carolina	2.1
7/21/2016	Virginia/North Carolina border region	1.9
7/24/2016	Virginia/North Carolina border region	2.4
9/6/2016	Tennessee/North Carolina border region	1.9
10/29/2016	Tennessee/North Carolina border region	1.8
10/29/2016	Tennessee/North Carolina border region	2.0
10/30/2016	Tennessee/North Carolina border region	1.8
10/30/2016	Tennessee/North Carolina border region	2.2
10/30/2016	Tennessee/North Carolina border region	2.1
10/30/2016	Tennessee/North Carolina border region	2.0
10/30/2016	Tennessee/North Carolina border region	1.8
10/31/2016	Tennessee/North Carolina border region	1.9
12/6/2016	Virginia/North Carolina border region	2.1
12/16/2016	Southwestern North Carolina	2.9

Source: Southeast US Seismic Network, USGS

3.2.5.5 Changing Future Conditions

Although North Carolina does not fall on any major fault lines, it is still susceptible to earthquakes, particularly in the western region.

3.2.5.6 Impact

Earthquakes capable of causing structural damage or failure (Mercalli Intensity VII or greater) are usually magnitude 5.5 or greater. This means that most of the historical catalog (large events) has great importance, since much of the accurate characterization of the earthquake hazard depends upon those events. By studying the relationship that exists between the number of earthquakes of various magnitudes, it has been shown that the number of small events (magnitude 3 or less) is directly related to the number of large events. This relationship is called the Gutenberg/Richter law. Put simply, a location in which numerous earthquakes occur is called a seismic source zone. Inside these zones, there are 100 magnitude 3 events for every 10 magnitude 4 events and for every one magnitude 5 event during a particular length of time. This allows seismologists to use current observations to predict or estimate the largest possible earthquake in a seismic source zone. High-activity source zones, such as those found in California, experience many more earthquakes over a given period of time, so it stands to reason that damaging earthquakes occur more often, as well. Other seismic source zones experience fewer earthquakes and will experience damaging earthquakes less often. The size of the source zone gives a direct indication of the largest possible earthquake that could occur within that zone.

For example, the great earthquakes that struck California in 1857 and 1906 broke the entire San Andreas fault from Mexico to the offshore areas around San Francisco. These events were estimated to register more than 8.3 on the Richter Scale. The seismic source zone for the San Andreas fault system runs for hundreds of miles and experiences approximately 3,000 earthquakes per quarter (12,000 per year). Based on the maximum possible earthquake that could occur inside a source zone and observed activity (based on a combination of historical data and current observations), seismologists have produced ground motion maps, which relate the expected level of ground shaking to occur during a given period of time. In 1977, the National Earthquake Hazards Reduction Program (NEHRP) was established in order to coordinate the production of ground motion maps and to provide guidance on the interpretation and use of these maps to the emergency management, risk assessment, design, and governmental communities.

The NEHRP maps show an expected level of ground shaking in terms of acceleration (as a percent of “g” or gravity, which exerts a downward force of 9.8 meters/second/second or 32 feet/second/second), which would not be exceeded at the 90-percent and 98-percent confidence levels. Mathematically, the 90-percent and 98-percent levels of non-exceedance relate to the 425-year and 2,500-year return period earthquake. For a given location, the level of ground shaking in “g” (3 percent, 5 percent, or 10 percent), which has a 90-percent chance of not being exceeded in 50 years, is plotted on the map. A higher level of ground shaking (which has a 98-percent probability of not being exceeded in 50 years) is also plotted to demonstrate the upper bounds of potential impact. Taken together, these two maps provide two measures of the expected ground motion. For example, seismologists estimate that within the next 50 years in North Carolina, there is a 98 percent chance that ground shaking could equal a level of shaking in which structural failure would occur. By knowing the level of shaking, engineers can design structures and infrastructure to withstand that level of shaking, or at least reduce significantly the level of resulting damage.

HAZUS Applications in North Carolina

The North Carolina Division of Emergency Management, including its Hazard Mitigation Section, has been using HAZUS (FEMA's loss estimation software) since 1997. During the last several years, many analyses have been conducted with this software in order to estimate losses. An example of this application is documented in the report "Earthquake Planning Scenarios for Henderson County, North Carolina—Using HAZUS, the FEMA Software Tool for Estimating Earthquake Losses," which was prepared for the Henderson County Local Emergency Planning Committee (LEPC) and dated July 10, 1997. This early analysis used HAZUS97 and was the first study undertaken by any state outside of California. Later applications included three regional analyses: one for the 35 jurisdictions that compose the Western NCEM Branch (34 counties and the Eastern Band of the Cherokee); a second analysis for the 33 counties in the Central NCEM Branch; and a third analysis of the 33 counties in the Eastern NCEM Branch. Those analyses were completed in Aug. 1998 and are the first statewide HAZUS analyses performed outside the state of California.

The earthquake analysis completed by State Hazard Mitigation Officer Kenneth B. Taylor (now State Geologist, NC Department of Environment and Natural Resources) was applicable to the more academic planning side of the house as an upper bound estimate of expected damages for earthquake in North Carolina, and on the practical, project development and management side of the mitigation house. The study aggregated anticipated damages from an earthquake event rating approximately VI on the Mercalli Intensity Scale (or <5.4 on the Richter Scale) for three geographic regions of NC. The analysis was run on a regional basis as the vagaries of strength and associated damages across the scale of earthquake intensities NC is likely to experience, coupled with the random nature of any particular assigned earth quake epicenter could result in vastly differing estimated damages. Placing the epicenter a few miles closer to or farther from, say the international banking center of Charlotte, NC, could result in millions of dollars of difference in estimated damages. Therefore, a broader brush stroke was employed to give a reasonable, if softly focused, idea of loss potential. This study was aggregated by building type (residential, commercial, government) and represented the first known attempt in NC to complete an aggregate look at all buildings in the state. Because earth quake activity seems to be fairly stable over geologic timeframes, and thus certainly over the periodic life of a hazard mitigation plan, the risk is deemed to be fairly stable in NC and no further updates to the analysis have been completed.

The analysis suggested that non-structural earth quake retrofits for critical public facilities including schools, emergency operations centers, hospitals and other critical, high value targets would be selected for mitigation projects. As of the 2013 update of the 322 plan, a dozen or more individual Earth Quake mitigation projects have been completed in western NC including: application of ballistic window films to plate glass windows in schools; anchoring of tall/heavy shelving and light fixtures; provision of segregated chemical storage in science labs; anchoring of expensive/delicate equipment in hospitals; and delivery of earth quake education, outreach and training of local emergency managers in assessment of non-structural earthquake mitigation opportunities. These projects have been funded through the HMGP and the NEHRP Earth Quake Consortia Grant program.

HAZUS and updates of previous HAZUS runs have not been given much attention since 1998 for a variety of reasons, including staffing, occupation with implementation of massive HMGP and non-disaster appropriations, and due to the limited utility of HAZUS given its gross scale. The tool is well-suited for county level general assessments but doesn't provide the level of detail necessary to address specific issues or individual projects. The benefit and advantage of HAZUS is that it replaced guesswork with modeling based on aggregate data, the downside, as referenced above, is a lack of focus. NCEM is currently directing it hazard assessment efforts toward collection of building-specific data through the IHRM so that county-level and local level assessments can be done at the individual building level. As these assessments will be done on the same basis across the state, we anticipate being able to collect and utilize a much finer risk analysis than we have been able to use in the past.

3.2.5.7 Future Probability

Using the SEUSEC, two seismologists from the Virginia Tech Seismological Observatory proposed a map of the 10 seismic source zones which have affected the southeastern United States. These are:

1. Giles County, Virginia;
2. Central Virginia;
3. Eastern Tennessee;
4. Southern Appalachians;
5. Northern Virginia and Maryland;
6. Central Appalachians;
7. Piedmont-Coastal Plain;
8. Charleston, South Carolina;
9. Appalachian Foreland; and,
10. The New Madrid Seismic Zone.

Using SEUSEC data, a formula was developed to express the relationship that exists between the expected earthquake magnitude in each seismic source zone and the return period (i.e., how long a time interval exists between events) for that magnitude. Only one earthquake with a magnitude greater than 6 has been located in the southeast: the 7.3 magnitude earthquake that struck Charleston, S.C., on Aug. 31, 1886. That quake caused damage that can still be seen at the Old Cotton Exchange in Wilmington, N.C. Earthquake bolts were placed across the front side of the building to shore up the un-reinforced masonry building.

The two other most active zones that affect North Carolina are the Eastern Tennessee Seismic Zone (ETSZ) and the Southern Appalachian Seismic Zone (SASZ). Recurrence rates for the two zones are very similar. For the ETSZ, a magnitude 2 earthquake occurs about every 1.4 months with a similar size event occurring within the SASZ about every two months. Larger events (such as magnitude 5 quakes) typically occur in the ETSZ once every 60 years and once every 59 years in the SASZ. For magnitude 6 events, the return period is 476 years (for ETSZ) and 417 years (SASZ).

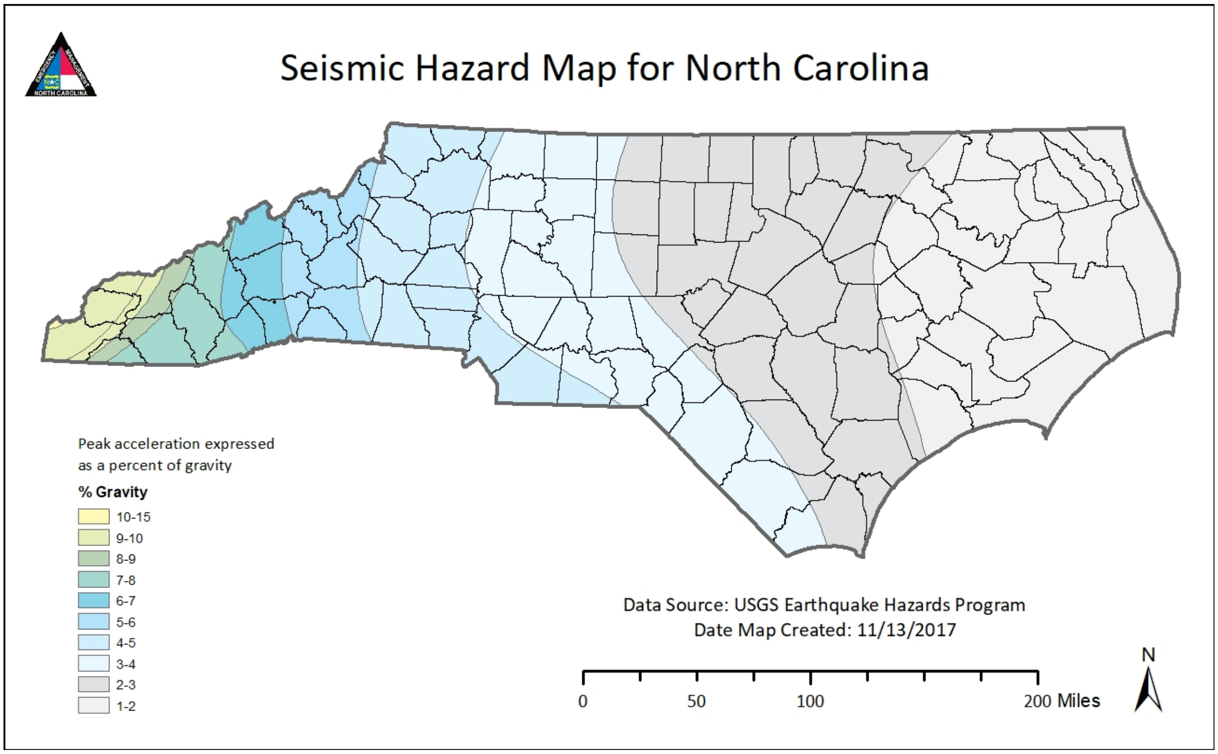
The ETSZ is the second most-active seismic zone east of the Rocky Mountains. One troubling finding presented by seismologists in 1994 argues that the ETSZ's seismicity clusters along a 185-mile line that exists in the middle of the zone. Should that entire line break at once, the estimated magnitude of such an event would register at least 7 on the Richter Scale.

The largest earthquake to be centered in North Carolina occurred in 1916 in western North Carolina. That event was felt in seven states. Based on historical events, the state could experience an earthquake as large as a magnitude 8 or 9; however, the likelihood of such an event is relatively low. That being said, an earthquake of magnitude 6 is a highly likely event over the next 50 years and would cause significant damage in the state. An earthquake could affect any part of the state, though it is much more likely in the west and in the southeast.

Using historical catalogs such as SEUSEC, the USGS has compiled two NEHRP maps that display 90 percent probability of non-exceedance and 98 percent probability of non-exceedance, as recorded during a 50-year time interval. There is a 90-percent chance that ground accelerations would equal or exceed 6 percent to 9 percent g. This level of shaking is above the threshold of architectural damage that would occur in the western third of the state. Considering the greatest possible level of shaking (98 percent non-exceedance), ground accelerations could equal or exceed 12 percent to nearly 30 percent g. Those levels of shaking would lead to structural damage or structural failure in western North Carolina. Figure 3-21 shows the earthquake acceleration percentages for the state.

In interpreting the NEHRP maps, ground accelerations of 3 percent to 6 percent g can cause architectural damage (non-load-bearing building ornaments). Ground accelerations of 6 percent to 12 percent g can cause architectural failure. Even greater accelerations (12 percent to 24 percent g) can result in structural damage (cracks in load-bearing walls), and accelerations of 25 percent to 48 percent g can result in structural collapse. The expected level of damage for these levels of shaking is based on a comparison of observed ground motion and the performance of un-reinforced masonry buildings, which are the structurally weakest and most damage-prone type of building.

Figure 3-21 Seismic Hazard Map for North Carolina



Although the western side of the state is more prone to experience earthquakes on a regular basis, most earthquakes are not of high magnitudes, and many are virtually unnoticeable. However, based on historical evidence, in the entire state of North Carolina, it is unlikely (between 1 and 33.3 percent annual probability) that there will be more earthquakes in the near future.

3.2.5.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 8, Earthquake Operations Plan

3.2.6 Wildfire

3.2.6.1 Description

A wildfire is an uncontrolled burning of grasslands, brush or woodlands. The potential for wildfire depends upon surface fuel characteristics, recent climate conditions, current meteorological conditions, and fire behavior. Hot, dry summers and dry vegetation increase susceptibility to fire in the fall—a particularly dangerous time of year for wildfire.

Southern forest landscapes have had a long history of wildfire. Wildfires have taken place as a natural process for many thousands of years, playing an important role in the ecological integrity of our natural environment. Human settlement has significantly influenced changes in the spatial and temporal pattern of wildfire occurrence, as well as the risks associated with them for human life and property. The fire regimes of the Southeast can be categorized into five time periods, as described in Table 3-13.[9]

Table 3-13 Southeast Fire Regime Time Periods

Time Period	Fire Description
14,000 to 500 years ago	American Indians used fire for swidden agriculture, better hunting visibility, reduction of wildfire fuel, and maintenance of trails.
500 to 100 years ago	European settlers used fire to maintain large amounts of permanent agricultural fields at a much greater scale than previously done.
Late 1800s to early 1900s	Forests were extensively logged, creating conditions that exacerbate the common occurrence of wildfires.
1900 to 1950s	Response to wildfires was widespread fire suppression.
1950 to Present	Active management; the natural role of fire is incorporated through prescribed burning.
14,000 to 500 years ago	American Indians used fire for swidden agriculture, better hunting visibility, reduction of wildfire fuel, and maintenance of trails.

Natural wildfires still take place on a regular basis in the Southeast. They can be caused by human carelessness, arson, or from lightning strikes that occur on the ridge tops of the Appalachian Mountains. Other natural disturbances (such as tornadoes and hurricanes) can influence the structure and fuel distribution of forests, leading to a change in wildfire intensity and risk. The occurrence and frequency of wildfires also depends greatly upon the type of forests, of which there are several in North Carolina, ranging from longleaf pine forest along the coast to oak-hickory forests in the mountains.[10]

The current scale of wildfire risk conditions is measured with the Keetch-Byram Drought Index (KBDI). The KBDI estimates the potential risk for wildfire conditions based on daily temperatures, daily precipitation, and annual precipitation levels on an index of 0 (no drought) to 800 (extreme drought).[11] The daily KBDI for the state of North Carolina can be found on the North Carolina Forest Service Division of Forest Resource Web site.[12]

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[9] *Stanturf, John A., Wade, Dale D., Waltrop, Thomas A., Kennard, Deborah K., and Achtemeier, Gary L. 2002. Southern Forest Resource Assessment: Background Paper Chapter 25: Fire in Southern Forest Landscapes. Southern Research Station, United States Department of Agriculture Forest Service, pp 607-630. Retrieved on December 14, 2017 from: http://www.srs.fs.usda.gov/sustain/report/pdf/chapter_25e.pdf*

[10] *Stanturf, John A., Wade, Dale D., Waltrop, Thomas A., Kennard, Deborah K., and Achtemeier, Gary L. 2002. Southern Forest Resource Assessment: Background Paper Chapter 25: Fire in Southern Forest Landscapes. Southern Research Station, United States Department of Agriculture Forest Service, pp 607-630. Retrieved on December 14, 2017 from: http://www.srs.fs.usda.gov/sustain/report/pdf/chapter_25e.pdf*

[11] *Keetch-Byram Drought Index. United States Forest Services: Wildland Fire Assessment System. Retrieved on December 14, 2017 from: https://www.wfas.net/index.php/keetch-byram-index-moisture--drought-49*

[12] *Fire Weather Intelligence Portal. State Climate Office of North Carolina. Retrieved on December 14, 2017 from: http://climate.ncsu.edu/fwip/?tab=curr&state=NC&map_bg=ter&point_curr=kbdi*

3.2.6.2 Extent

Although North Carolina has not experienced wildfires as large as some areas in the western United States, it has still been impacted by several large fires historically that have had a significant impact on the state.

Wildfire data was provided by the North Carolina Forest Service and is reported annually by county from 1970 to 2017. The greatest number of acres to burn in a single year occurred in 2000 in Mitchell County when 2,794 acres were burned in 24 fires. The greatest crop damage from wildfires occurred in 2016 in Brunswick County that resulted in $2.33 million in losses.

3.2.6.3 Location/Spatial Extent

The entire state is at risk to a wildfire occurrence. However, several factors such as drought conditions or high levels of fuel on the forest floor may make a wildfire more likely in certain areas. Furthermore, areas in the urban-wildland interface are particularly susceptible to fire hazard where populations and development abut formerly undeveloped areas. That is to say that more rural areas where some development is just starting to take place tend to be at highest risk to a wildfire.

3.2.6.4 Hazard History

The Wildfire Ignition Density data shown in Figure 3-22 below gives an indication of historic location of wildfires in North Carolina based on data from the Southern Wildfire Risk Assessment. This data is based on historical fire ignitions and the likelihood of a wildfire igniting in an area. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. This is measured in the number of fires per year per 1,000 acres.[13]

[13] *Southern Wildfire Risk Assessment, 2016.*

Figure 3-22 North Carolina Wildfire Ignition Density

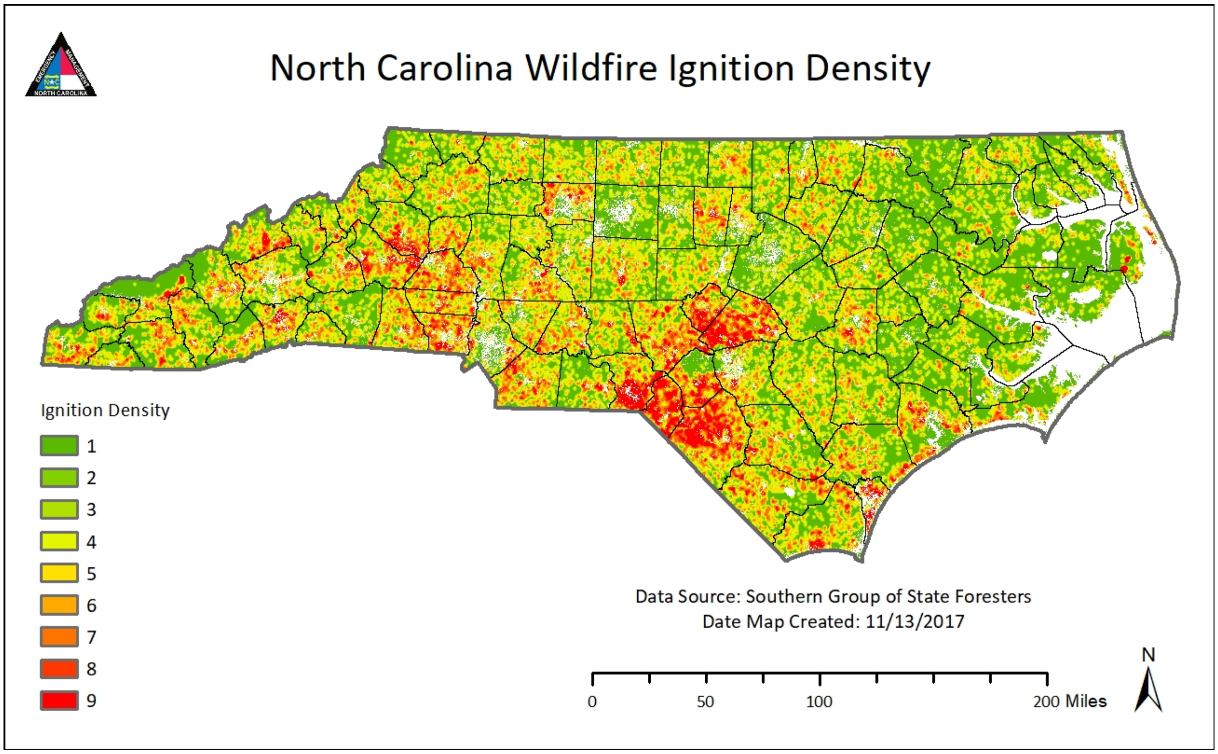


Figure 3-23 Number of Wildfires Per Year

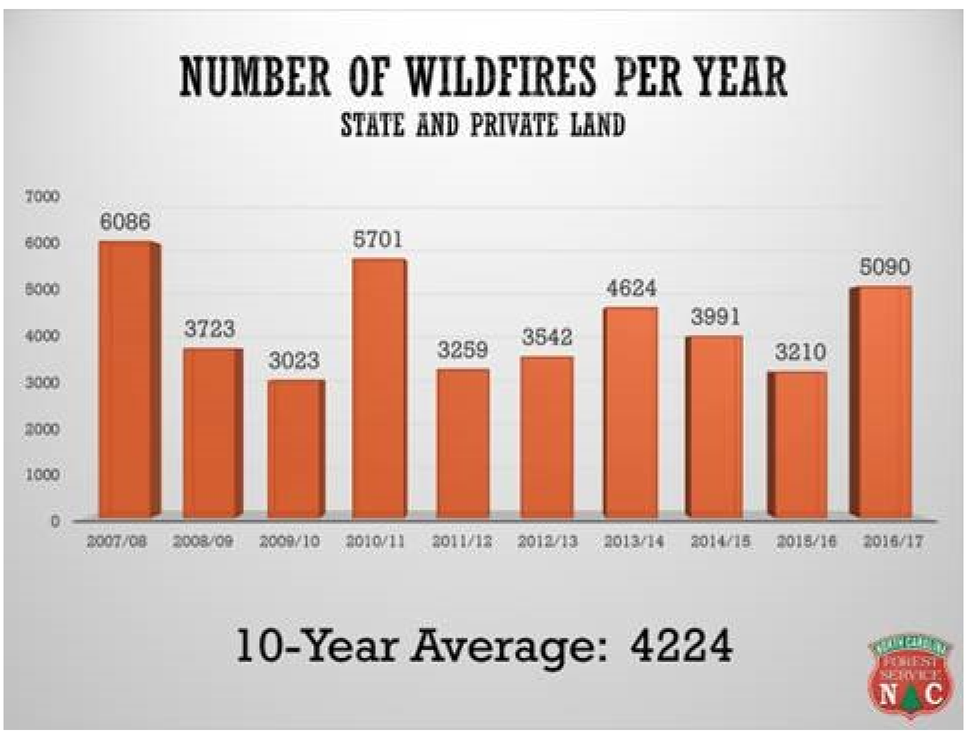


Table 3-14 describes wildfire events that occurred in North Carolina between 1998 and 2017, as listed in the NCEI's Storm Events Database. Detailed information for selected events follows the table. Figure 3-24 provides a visual representation of these events.

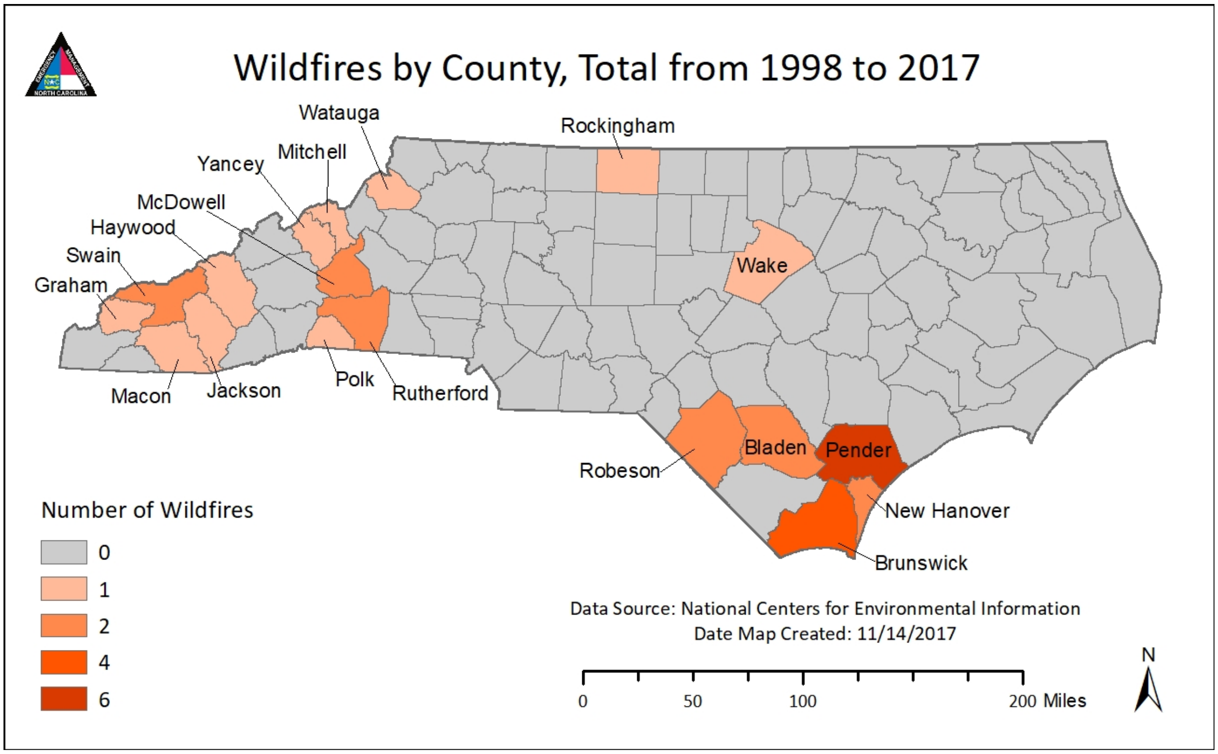
Table 3-14 Detailed Wildfire History

North Carolina Wildfire Events					
#	Event	Duration	Location (County)	Severity	Extent of Damages
1	Wild/Forest Fire	06/03/1998–06/05/1998	Pender (12 miles NE of Rocky Point)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
2	Wild/Forest Fire	10/28/2000–10/31/2000	McDowell (4 miles N of Ashford)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
3	Wild/Forest Fire	11/01/2000–11/02/2000	McDowell (4 miles N of Ashford)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
4	Wild/Forest Fire	11/01/2000–11/02/2000	Yancey (8 Miles SW of Burnsville, Celo)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
5	Wild/Forest Fire	11/01/2000-11/02/2000	Mitchell (5 miles SE of Spruce Pine)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
6	Wild/Forest Fire	11/01/2000–11/02/2000	Haywood (Waterville)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
7	Wild/Forest Fire	03/11– 12/2007	Swain County --Grassy Ridge community	Fatalities: 0 Injuries: 0	Property: $1,190,395 Crops: $0
8	Wild/Forest Fire	9/25– 28/2007	Brunswick County - Hale Swamp Road	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
9	Wild/Forest Fire	11/05/2007	Robeson County -- Jackson Swamp area	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
10	Wild/Forest Fire	12/01/2007	Robeson County	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
11	Wild/Forest Fire	3/26-27/2008	New Hanover east of I-40 between Sidbury and Holly Shelter Road	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
12	Wild/Forest Fire	3/28-28/2008	Brunswick County -- Highway 133 and Funston Road	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
13	Wild/Forest Fire	4/19-21/2008	Pender Shiloh Road west of Highway 421 near Atkinson	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
14	Evans Road Fire	3/23/2010	Wake County – Highland Creek Community	Fatalities 0 Injuries 4	Property: $1,131,906 Crops: $0
15	Wild/Forest Fire	04/7/2010	Northern Jackson County --Bradley Branch Rd	Fatalities: 0 Injuries: 0	Property: $113,190 Crops: $0
16	Wild/Forest Fire	2/12– 20/2011	Rutherford County - Chimney Rock State	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0

North Carolina Wildfire Events					
#	Event	Duration	Location (County)	Severity	Extent of Damages
			Park		
17	Wild/Forest Fire	2/12– 20/2011	Polk County -- Chimney Rock State Park	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
18	Wild/Forest Fire	2/14/2011	Rockingham County – Near Ruffin	Fatalities: 0 Injuries: 0	Property: $5,486 Crops: $0
19	Wild/Forest Fire	2/14/2011	Watauga County – Green Briar/Rocky Knob area	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
20	Simmons Road Wildfire	6/18-7/30/2011	Bladen County --NC Hwy 53 and Simmons Road	Fatalities: 0 Injuries: 0	Property: $548,635 Crops: $0
21	Juniper Road Wildfire	6/18-7/30/2011	Pender County – Holly Shelter Game Land	Fatalities 0 Injuries 0	Property: $0 Crops: $0
22	Wild/Forest Fire	7/1/2011	Inland Pender County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
23	Wild/Forest Fire	7/1/2011	Bladen County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
24	Wild/Forest Fire	4/14/2012	Inland Pender County - Hampstead	Fatalities 0 Injuries 0	Property: $2,150 Crops: $0
25	Wild/Forest Fire	4/16/2012	Inland New Hanover County - Cameron Art Museum Property, Wilmington	Fatalities 0 Injuries 0	Property: $2,687 Crops: $0
26	Wild/Forest Fire	4/4-4/5/2014	Inland Pender County - Holly Shelter Game Land	Fatalities 0 Injuries 0	Property: $47,437 Crops: $0
27	Wild/Forest Fire	4/6-4/16/2015	Inland Brunswick County – Compass Point Subdivision	Fatalities 0 Injuries 0	Property: $208,871 Crops: $0
28	Wild/Forest Fire	4/19/2016	Inland Brunswick County - Clemmons Rd	Fatalities 0 Injuries 0	Property: $2,570 Crops: $2.39M
29	Tellico Fire	11/3-11/30/2016	Macon County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
30	Tellico Fire	11/3-11/30/2016	Swain County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
31	Maple Springs Fire	11/4-11/30/2016	Graham County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
32	Party Rock Fire	11/5-11/30/2016	Rutherford County Mountains	Fatalities 0 Injuries 0	Property: $0 Crops: $0

Source: NCEI

Figure 3-24 Wildfire Events in North Carolina



Significant North Carolina Wildfire Events

June 3, 1998–June 5, 1998

Lightning sparked a forest fire just east of Shaw Highway (north of Highway 210) that burned 695 acres on the western edge of Holly Shelter Game Land.

Oct. 28, 2000–Nov. 2, 2000

A wildfire was started in the Linville Gorge area and eventually burned hundreds of acres. Extremely dry conditions had persisted across the area; rainfall had not been measured for 50 days. Wildfires that started in late October continued to burn out of control into early November. Several thousand acres were burned with the largest burn area occurring in the Linville Gorge.

June 1, 2008- January 5, 2009

A wildfire sparked by lightning in Hyde County NC burned 40,704 acres of private, state owned and federally managed land in three counties. 60% of the damage was contained on the federal Pocosin Lakes Wildlife Refuge. Due to ongoing drought in the region, the peat soil caught fire and the fire spread underground over a large area. At the height of the response, over 400 local, county, state and federal agents participated. Over 2 billion gallons of water was pumped over 35 miles from Lake Phelps, New Lake and the Alligator River and used to flood the local canal system in an effort to raise the water table and extinguish the underground fires. Heavy smoke led to air quality warnings as far as 150 miles away in piedmont NC. Three mobile homes used as hunt camps were the only structures destroyed by the blaze. The last hot spots from the fire were identified and extinguished on January 5, 2009. Suppression of the blaze cost just under $20 million.

March 23, 2010

Dry conditions in Wake county along with above normal temperatures during the week preceding the fire likely contributed to a decrease in fuel moisture and an increased potential for fires. Strong gusty westerly winds developed during the afternoon and in advance of a surface|trough. these gusty winds and the close proximity of the homes were factors in the rapid spread of the fire. Three homes were destroyed and 4 homes were damaged in the Highland Creek Home Community in north Raleigh when a fire spread from a grass, pine straw area directly behind one of the homes

June 18, 2011-July 30, 2011

Lightning sparked a wildfire near the intersection of NC Hwy 53 and Simmons Road, in the Live Oak community in Bladen County. Against the backdrop of an ongoing severe drought and 100-degree heat, strong and erratic winds caused the fire to cross containment lines on June 20-21. The fire destroyed three homes and eleven outbuildings. The fire spread to all or parts of several bays containing dense vegetation and organic soil. Evacuations were ordered on two occasions, but all residents were able to return home. The fire grew to 5600 acres and continued to burn into July.

Party Rock Fire, Rutherford County, November 5 – November 30, 2016

An extended period of abnormally dry weather and drought conditions that began in late winter of 2016, and continued through the year resulted in very dry vegetation across western North Carolina by mid-autumn. This was exacerbated by an unusually warm late summer and fall, when temperatures averaged as much as 5 degrees above normal. In these conditions, multiple wildfires ignited and spread during the first week of November, culminating in one of the worst wildfire episodes in recent western North Carolina history. Multiple large fires burned, mainly across the southern mountains, and most of these fires were not completely contained until a cold front brought much-needed rain to the area at the end of the month.

The Party Rock fire burned more than 7,000 acres in the Lake Lure/Chimney Rock/Bat Cave area. Chimney Rock State Park was closed throughout much of the month, while Chimney Rock village was evacuated multiple times during adverse fire weather conditions. The Maple Springs Fire burned around 8000 acres in an area just north and northwest of Lake Santeetlah. The Tellico fire burned more than 13,000 acres in the Nantahala area along the Macon/Swain County line.

A historical record of the number of wildfires and acreage burned in North Carolina from 1928 to 2015 can be found at the North Carolina Forest Service Web site. Also available on the Web site is a listing of the causes of wildfire in North Carolina from 1970 to 2015, as shown in Table 3-15.[14]

Table 3-15 Causes of Wildfire in North Carolina (1970–2015)

Year	Fires	Acres	Lightning	Camping	Smoking	Debris Burning	Incendiary	Mach. Use	Rail-Road	Children	Misc.
1970	5,291	72,747	64	45	722	1,752	1,084	191	454	265	714
1971	4,015	79,864	26	40	528	1,208	784	105	410	241	673
1972	2,524	37,715	16	22	261	886	601	81	193	189	275
1973	3,649	29,658	17	55	540	1,218	743	156	154	227	539
1974	3,407	33,836	8	35	433	1,198	749	111	220	244	409
1975	2,710	16,321	24	38	332	852	591	88	139	253	393
1976	6,355	69,805	26	60	736	2,007	1,705	233	342	447	799
1977	5,836	38,295	129	48	627	2,141	1,177	208	409	385	712
1978	4,865	36,137	29	50	604	1,735	1,093	175	326	329	524
1979	3,563	30,767	12	41	403	1,433	809	127	244	237	257
1980	4,420	62,785	107	52	492	1,513	1,072	225	301	281	377
1981	8,746	108,253	58	122	996	3,023	2,231	352	444	572	948
1982	3,734	74,269	23	40	349	1,557	817	163	179	228	378
1983	2,900	12,579	99	24	276	1,001	648	270	128	195	259
1984	3,569	19,771	30	53	317	1,453	829	216	95	236	340
1985	7,318	99,473	92	80	832	2,861	1,674	345	172	487	775
1986	5,580	113,479	188	66	652	1,794	1,366	318	92	458	646
1987	3,908	17,834	89	55	374	1,517	880	239	62	266	426
1988	4,581	23,795	151	48	496	1,636	1159	216	74	313	488
1989	2,660	14,440	32	32	260	1,008	664	134	47	188	295
1990	4,037	26,193	129	41	354	1,352	1,199	251	36	291	384
1991	5,051	24,336	49	60	483	1,945	1,178	282	51	394	609
1992	5,721	23,952	54	52	622	2,322	1,237	340	57	444	593
1993	4,793	25,334	204	59	397	1,690	1,086	303	56	430	568
1994	5,809	19,359	99	73	474	2,472	1,188	302	61	525	615
1995	5,296	21,253	48	58	457	2,165	1,134	277	49	559	549

[14] *Wildfire Statistics. North Carolina Forest Service. Retrieved on December 14, 2017 from: http://www.ncforestservice.gov/fire_control/wildfire_statistics.htm*

Year	Fires	Acres	Lightning	Camping	Smoking	Debris Burning	Incendiary	Mach. Use	Rail-Road	Children	Misc.
1996	4,272	15,963	49	35	300	1,838	807	222	81	428	512
1997	4,539	16,274	127	50	273	1,890	929	226	86	477	481
1998	4,317	15,699	80	40	297	1,755	944	258	63	387	493
1999	6,244	28,298	110	75	439	2,629	1,195	325	107	598	776
2000	4,949	25,146	57	60	358	2,049	955	282	119	443	626
2001	8,129	28,733	82	110	708	3,226	1593	524	121	749	1,015
2002	5,618	28,216	261	73	370	2,250	975	360	65	501	764
2003	1,994	5,841.4	10	21	121	864	355	140	15	154	314
2004	4,364	14,722.8	29	49	255	2,046	693	295	36	335	626
2005	4,057	15,235.8	49	47	278	1,697	764	325	45	311	541
2006	5,096	21,924.0	97	52	333	2,111	943	430	49	393	690
2007	7,260	38,065	215	105	503	2,461	1,476	614	98	614	1,174
2008	4,381	50,646	197	36	246	1,567	758	384	58	332	802
2009	3,291	12,322	56	38	186	1,309	618	283	26	246	469
2010	4,053	14,703	71	36	166	1,642	801	435	24	268	602
2011	5,265	63,547	200	28	216	2102	1012	522	40	298	803
2012	3,550	11,992	129	46	91	1,221	715	384	36	228	668
2013	3,374	9,451	20	37	102	1,492	580	344	14	200	583
2014	4,593	13,327	53	41	90	2,237	706	460	30	210	766
2015	3,886	10,558	77	32	82	1,671	444	416	0	223	941

Source: North Carolina Forest Service

3.2.6.5 Changing Future Conditions

A United States Government Accountability Office report dated September 2017 states that the Presidential budget proposal for 2017 references that the United States government has incurred direct costs of more than $350 billion because of extreme weather and fire events including:

- $205 billion for domestic disaster response and relief
- $90 billion for crop and flood insurance
- $34 billion for wildland fire management and
- $28 billion for maintenance and repairs to federal facilities and federally managed lands, infrastructure and waterways.

These costs are only expected to increase according to the U.S. Global Change Research Program that finds “impacts and costs of extreme events – such as floods, drought, and other events – will increase in significance as what are considered rare events become more common and intense because of weather extremes.

3.2.6.6 Impact

Wildfires are a key part of nature's cycle that renews many ecosystems; however, they can also be dangerous and deadly when uncontrolled. Smoke from wildfires can cause health risks, and carbon dioxide is also released into the atmosphere during burns.

There have been several notable incidents that caused significant damage in North Carolina's recorded history of wildfires that can be used as a basis for the impacts that a wildfire might have in the stat. For example, Fayetteville experienced a devastating fire on May 29, 1831. The fire was considered to be more destructive than the Great Fire of Chicago in 1871. Fayetteville lost 600 homes, 100 businesses, and several churches, among other structures.[15] In recent years, North Carolina has also experienced significant wildfires, including on June 3, 1998, when lightning sparked a forest fire just east of Shaw Highway (north of Highway 210 in Pender County) that burned 695 acres on the western edge of Holly Shelter Game Land. The event lasted 45 hours. On October 28, 200, a wildfire was started in the Linville Gorge area and eventually burned hundreds of acres in McDowell County. Extremely dry conditions had persisted across the area and rain had not been measured for 50 days, so the event lasted around 60 hours. The last major wildfire in the state occurred in Brunswick County in April 2016 when burning debris caught fire. The wildfire covered 1,578 acres and destroyed a travel trailer and mobile home. Over $2 million was lost in property and crop damages.

3.2.6.7 Future Probability

There is a high probability of future wildfire events in the State of North Carolina. The likelihood of wildfires increases during drought cycles and abnormally dry conditions. In addition, increased development throughout the State leads to increased vulnerability.

Figure 3-25 shows areas of the state that have a high probability of experiencing a wildfire according to the Southern Wildfire Risk Assessment's Burn Probability Index.

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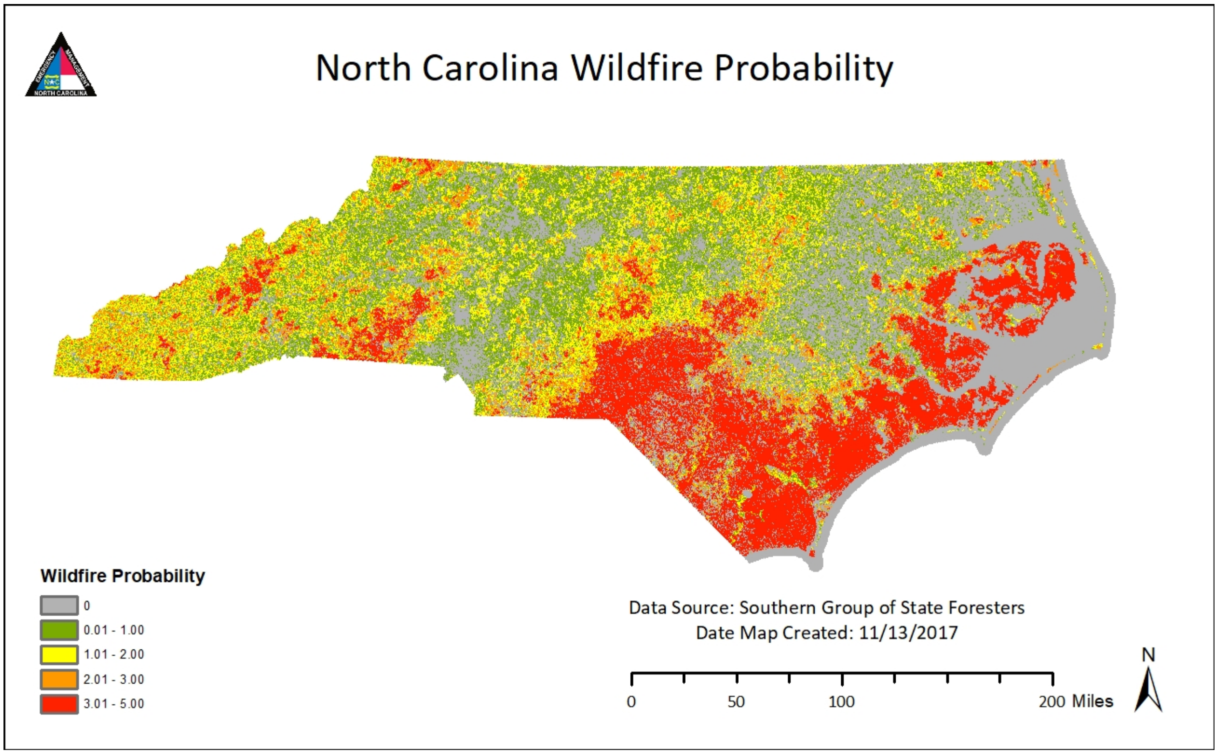
[15] *Citywide Fire in Fayetteville, 1831. North Carolina Department of Natural and Cultural Resources. Retrieved on December 14, 2017 from: https://www.ncdcr.gov/blog/2015/05/29/citywide-fire-in-fayetteville-1831*

Figure 3-25 Wildfire Probability



North Carolina has an extensive history of wildfires in recent years, many of which were sparked by burning debris in hotter and dryer months. Extreme heat, drought, and wind may make the probability of experiencing wildfires even higher. Therefore, according to historical evidence and changing future conditions, it is likely (between 33.4 and 66.6 percent annual probability) that North Carolina will continue to experience wildfires in the future.

3.2.6.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.2.7 Dam Failures

3.2.7.1 Description

Dams store water in reservoirs during times of excess flow, so that water can be released from the reservoir during other times, when natural flows are inadequate to meet the needs of water users.[16] Dams can pose risks to communities if not designed, operated, and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing the loss of life and considerable property damage if

[16] *Storing and Moving Water. National Drought Mitigation Center: University of Nebraska. Retrieved on December 14, 2017 from: http://drought.unl.edu/DroughtforKids/HowCanWeProtectOurselves/StoringandMovingWater.aspx*

there are people located downstream from the dam.[17] Many dam failures have resulted because of an inability to safely pass flood flows. Failures caused by hydrologic conditions can range from sudden (with complete breaching or collapse), to gradual (with progressive erosion and partial breaching). The most common modes of failure associated with hydrologic conditions include overtopping, the erosion of earth spillways, and overstressing the dam or its structural components.[18]

Like all built structures, dams deteriorate. Lack of maintenance causes dams to be more susceptible to failure. Often, the corrugated piping used in dam construction has a shorter life span than the dam itself, involving expensive replacement to avoid potential dam weakening. In the United States since 2000, more than 600 dam incidents, (including 70 dam failures) were reported to the National Performance of Dams Program, which collects and archives information on dam performance as reported by state and federal regulatory agencies and dam owners. Dam incidents are events (such as large floods, earthquakes or inspections) that alert dam safety engineers to deficiencies that threaten the safety of a dam. Due to limited state staff, many incidents are not reported, and therefore the actual number of incidents is likely to be much higher.

Communities continue to develop along the state's rivers, many in potential dam-failure inundation zones. Further exacerbating the potential risk to citizens is the disrepair of many dams and the lack of sound plans to help guide necessary repairs and warning systems to alert the public in the event of a dam failure.

3.2.7.2 Extent

The hazard potential is the possible adverse incremental consequences that result from the release of water or stored contents, due to the failure of the dam or disoperation of the dam or appurtenances. Dam failures can be grouped into three categories: low-, significant-, and high-hazard potential situations. Hazard potential does not indicate the structural integrity of the dam itself, but rather the effects if a failure should occur. The hazard potential assigned to a dam is based on consideration of the effects of a failure during both normal and flood-flow conditions.19 Table 3-16 (below) provides a description and guidelines of the three classes of dam hazards defined using the North Carolina Division of Land Resources criteria.

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[17] *Dams Sector: Crisis Management Overview Course. Federal Emergency Management Agency. Retrieved on December 14, 2017 from: https://emilms.fema.gov/IS0870a/DCM01summary.htm*

[18] *Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams. April 2004. Retrieved on December 14, 2017 from: https://www.ferc.gov/industries/hydropower/safety/guidelines/fema-94.pdf*

[19] *Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams. April 2004. Retrieved on December 14, 2017 from: https://www.ferc.gov/industries/hydropower/safety/guidelines/fema-94.pdf*

Table 3-16 Dam Hazard Classifications

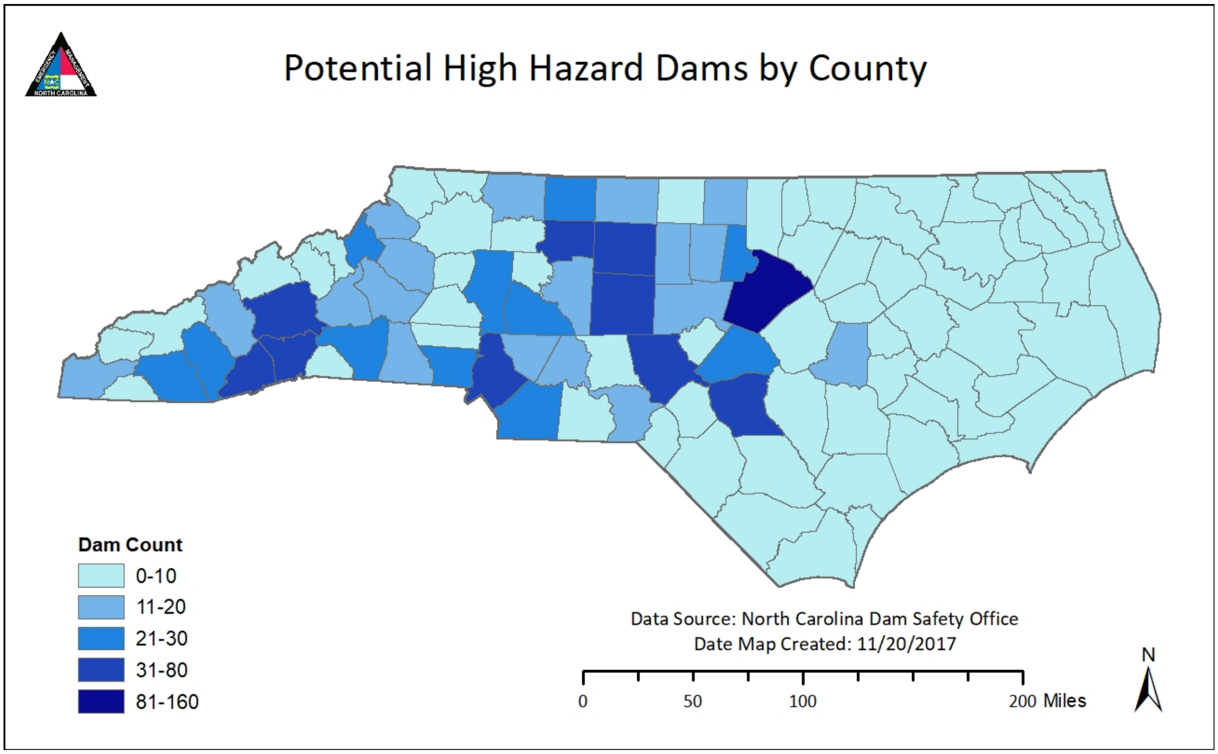
Dam Hazard Classification[20]		
Hazard Classification	Description	Quantitative Guidelines
Low	Interruption of road service, low volume roads; economic damage	Less than 25 vehicles per day; less than $30,000
Intermediate (Significant)	Damage to highways, interruption of service; economic damage	25 to less than 250 vehicles per day; $30,000 to less than $200,000
High	Loss of human life; economic damage *Probable loss of human life due to breached roadway or bridge on or below the dam	Probable loss of one or more human lives; more than $200,000 * 250 Vehicles per day at 1000-ft. visibility;100 Vehicles per day at 500-ft. visibility; 25 Vehicles per day at 200-ft. visibility

3.2.7.3 Location/Spatial Extent

In North Carolina, dams exist throughout the state and have played an important role in its economic development. Dams are relied upon to generate power, provide communities with drinking water, and protect individuals from floods. There are more than 5,600 dams in North Carolina. According to the State's Dam Safety Office, there are 1,429 high hazard dams that would pose a risk to public safety and property if a dam failure were to occur. And that number is increasing. In 1998, North Carolina had 874 high hazard dams. In 2015 that number had increased to 1,235. The number of North Carolina dams that were identified as potentially being eligible for National Rehabilitation Funds in 2017 was reported to be 44.[21]

[20] *What is a High-Hazard Potential Dam? North Carolina Emergency Action Planning. Retrieved on December 14, 2017 from: http://www.damsafetyaction.org/NC/about-eaps/what.php*
[21] *2017 Infrastructure Report Card. American Society of Civil Engineers. Retrieved on December 14, 2017 from: https://www.infrastructurereportcard.org/dams/funding-future-need/#dams-infographic*

Figure 3-26 NC Potential High Hazard Dams by County



3.2.7.4 Hazard History

Table 3-17 lists the historical occurrences of dam failure that have impacted North Carolina.

Table 3-17 Detailed Dam Failure History

North Carolina Dam Break Events					
#	Event	Year	Location	Severity	Extent of Damages
1	Bearwallow Lake Dam Break	1976	Bearwallow Lake, N.C.	Sliding	Unknown
2	Potato Hill Lake Dam Break	1977	Potato Hill Lake, N.C.	Overtopping	Unknown
3	Winston Dam Break	1912	Winston, N.C.	Overtopping	Unknown
5	Hurricane Fran	1996	Eastern N.C.	3 major and 12 minor breaks	Private facilities
6	Hurricane Floyd	1999	44 Counties of N.C.	36 failures	100 dams damaged; hog lagoon overflow
7	Hope Mills	2003	Hoke and Cumberland Counties, N.C.	5 failures and 11 damaged dams	No injuries
8	Hurricane Matthew	2016	Cumberland, Duplin, Harnett, Hoke, Lenoir, Sampson, Wayne and Wilson Counties	12 state-regulated dams breached, 8 other, non-regulated dams breached	400 inspections conducted after the event

3.2.7.5 Changing Future Conditions

Climate and weather pattern changes may not affect dams as much as other hazards. However, there are growing concerns on whether or not dams positively or negatively contribute to weather extremes. Supporters believe dams may keep stored water cooler than undammed rivers, while critics argue dams only add to increasing global temperatures. Dam failures, however, present dangers of flooding, which could be problematic in the flat, low lying areas of North Carolina.

3.2.7.6 Impact

Dam failures have to potential to cause critical impacts in some parts of the state. This means that multiple deaths/injuries are possible and that more than 25% of property in affected area damaged or destroyed. In some parts of the state, a major dam failure has the potential to cause complete shutdown of critical facilities for more than one week.

3.2.7.7 Future Probability

Although construction of dams in North Carolina is increasing, historical occurrences of dam failures have been infrequent historically. It is relatively unlikely (between 1 and 33.3 percent annual probability) that dam failures will occur in North Carolina without a precipitating event such as a hurricane or flood; however, since dam failures often create widespread impacts beyond their surrounding location, they should still be properly monitored and maintained to prevent this hazard from happening.

3.2.7.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.2.8 Drought

3.2.8.1 Description

Drought refers to an extended period of deficient rainfall relative to the statistical mean established for a region. Drought can be defined according to meteorological, hydrological, and agricultural criteria. Meteorological drought uses long-term precipitation data to measure present precipitation levels against departures from normal precipitation levels. Hydrological drought is defined by surface and subsurface water supply deficiencies based on stream flow, lake, reservoir, and ground water levels. Agricultural drought occurs when there is insufficient soil moisture to satisfy the water budget of a specific crop, leading to destroyed or underdeveloped crops with greatly depleted yields.

Table 3-18 Drought Classification Definitions

Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
Agricultural Drought	Soil moisture deficiencies relative to water demands of plant life, usually crops.
Socioeconomic Drought	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.

Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

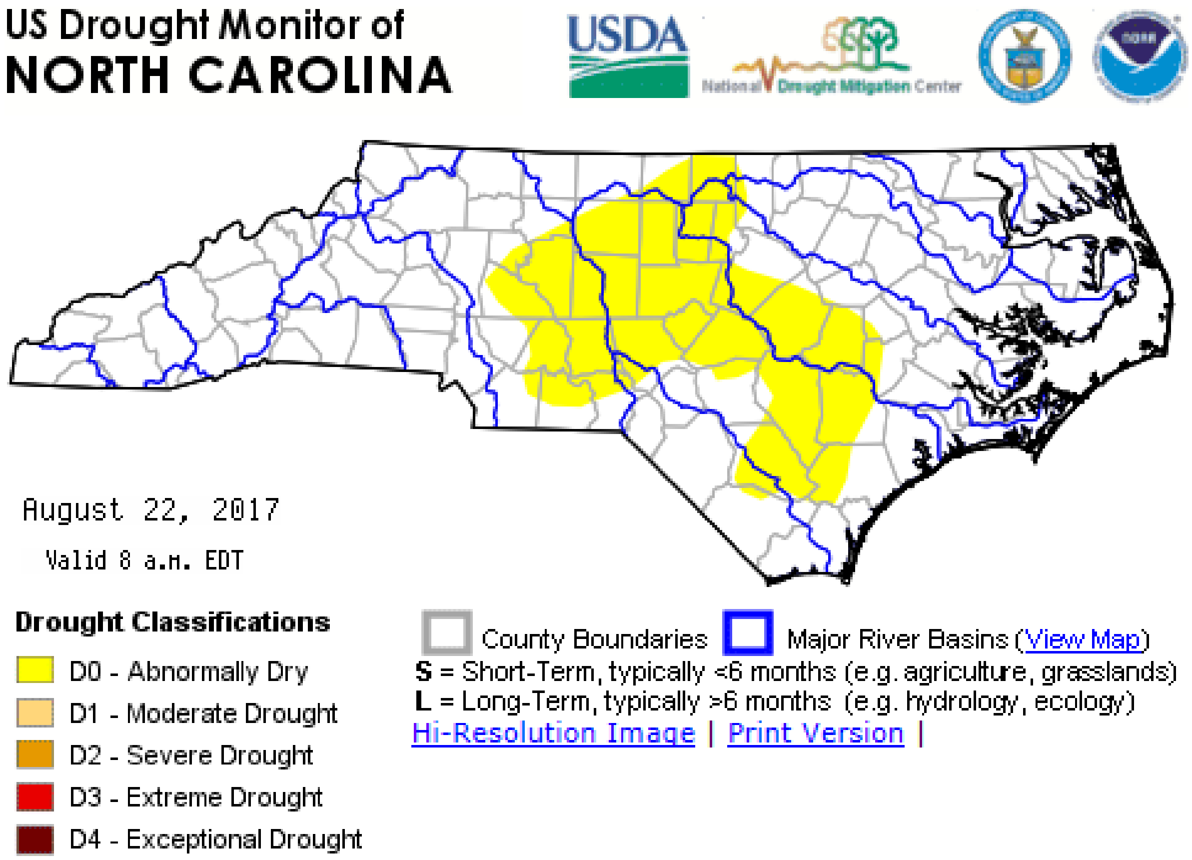
A drought is a prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. Human demands and actions have the ability to hasten or mitigate drought-related impacts on local communities.

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. Because drought is progressive in nature and develops slowly, it is often not recognized until it reaches a severe level.

The underlying cause of most droughts can be related to variations in large-scale atmospheric circulation patterns and the locations of anticyclones, or high-pressure systems. Sometimes, whirling masses of air separate from the main westerly airflow (analogous to whirlpools that form in rapidly flowing rivers) and effectively prevent the usual west-to-east progression of weather systems. When these “blocking systems” persist for extended periods of time, weather extremes (such as drought, floods, heat waves, and cold snaps) can occur.
Extent

One way of measuring drought extent is defined by the drought classifications provided by the U.S. Drought Monitor, an example of which can be found in Figure 3-27.

Figure 3-27 US Drought Monitor of North Carolina

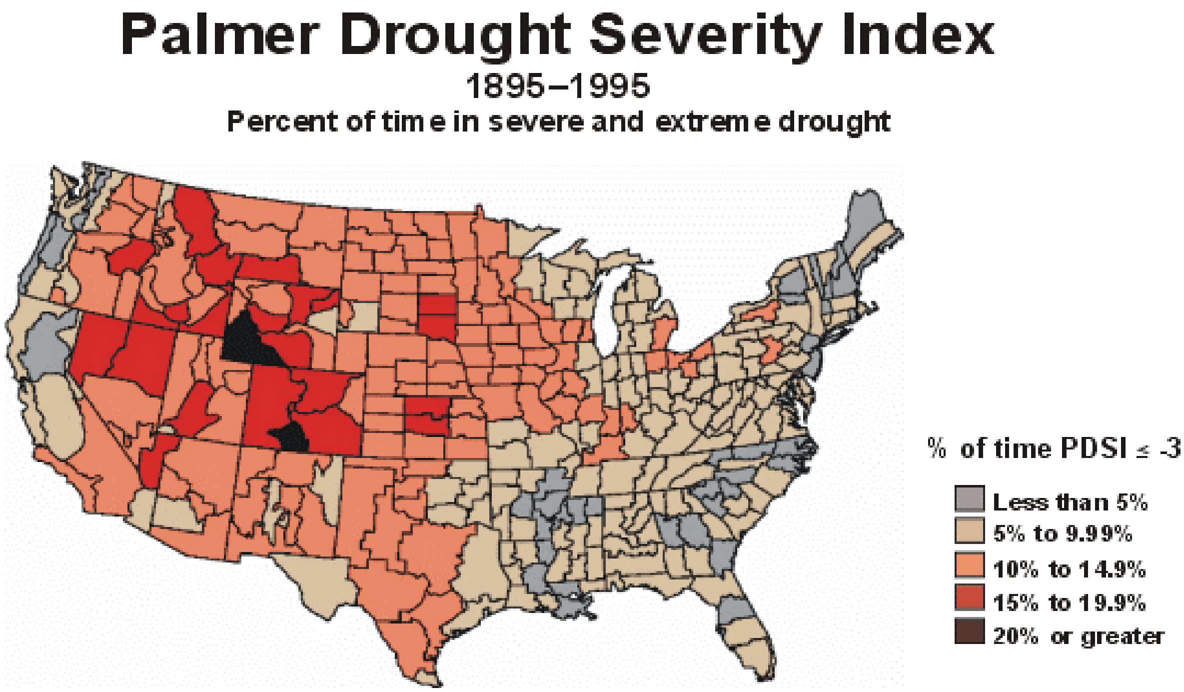


Source: US Drought Monitor of North Carolina

The Palmer Drought Severity Index (PDSI) is another measure of drought that is widely used in the United States for tracking moisture conditions. The PDSI is defined as "an interval of time, generally in months or years in duration, during which the actual moisture supply at a given place rather consistently falls short of the climatically expected or climatically appropriate moisture supply." The range of PDSI is from –4.0 (extremely dry) to +4.0 (excessively wet), with the central half (–2.0 to +2.0) representing the normal or near normal conditions. The PDSI is best used for long-term measurements of drought. For short-term (week-to-week) measurements, it is more useful to use the Crop Moisture Index (CMI), also developed by Wayne Palmer.[22] Drought has ranged from "Abnormal" (D0) to "Exceptional" (D4) in North Carolina and all areas have experienced Exceptional levels of drought historically.

[22] *How Do I Measure Drought? National Drought Mitigation Center: University of Nebraska. Retrieved on December 14, 2017 from: http://drought.unl.edu/ranchplan/DroughtBasics/WeatherDrought/MeasuringDrought.aspx*

Figure 3-28 Palmer Drought Severity Index Summary Map for the United States



Source: National Drought Mitigation Center

Table 3-19 Drought Severity Classification

			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	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20

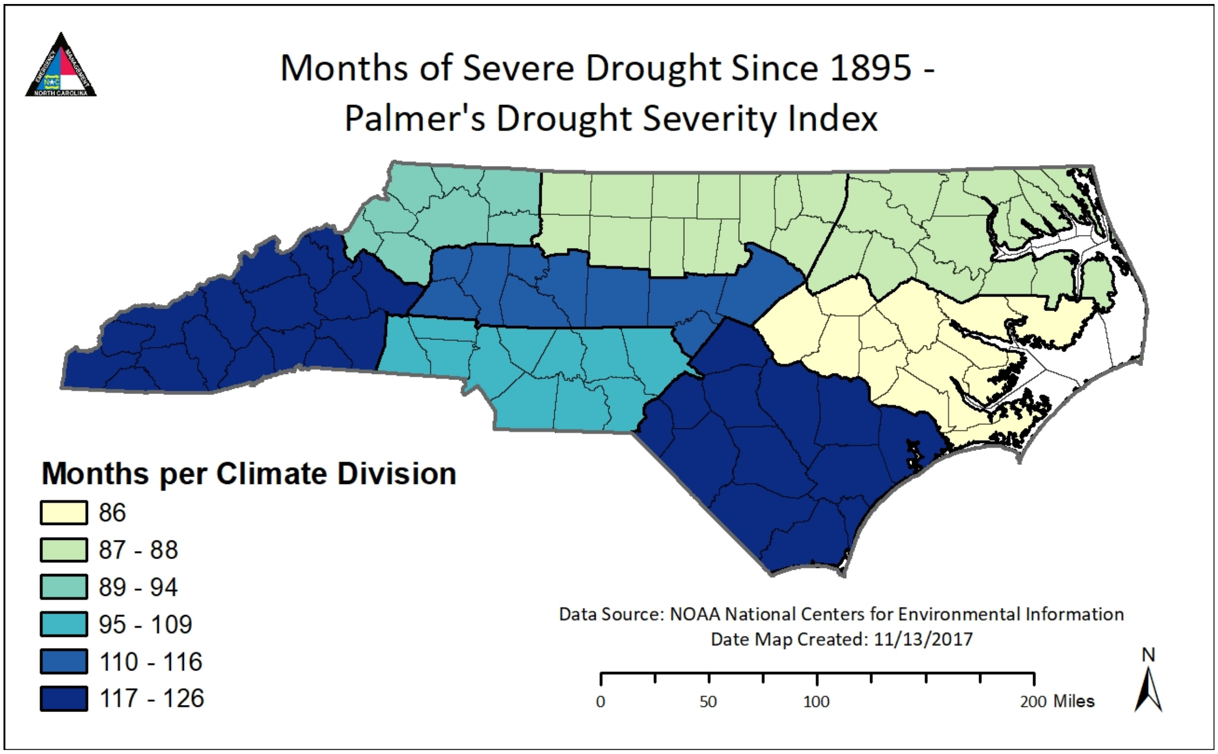
		developing or imminent Voluntary water-use restrictions requested					
D2	Severe Drought	Crop or pasture losses likely Water shortages common Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	Major crop/pasture losses Widespread water shortages or restrictions	-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: http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

3.2.8.2 Location/Spatial Extent

Drought is a common hazard across the entire state. “Severe” drought is a good indicator of the areas of the state that may experience more drought than others. As Figure 3-29 illustrates, the southeastern and western parts of the state have spent the most months in severe drought since 1895.

Figure 3-29 Palmer's Drought Severity Index Months of Severe Drought Since 1895



3.2.8.3 Hazard History

In the recent past, many areas of North Carolina have been affected by drought, to varying degrees. Table 3-20 lists historical drought events that occurred between July 1998 and August 2017; detailed descriptions about selected events follow the table. It is worth noting that any geographic area of the state is susceptible to a drought. Figure 3-30 provides a graphical depiction of the events recorded in the NCEI event database.

Table 3-20 Detailed Drought History

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Alamance	0	0	0	0	0
Alexander	34	0	0	$0	$0
Alleghany	16	0	0	$0	$12,271,076
Anson	0	0	0	$0	$0
Ashe	22	0	0	$0	$12,293,923
Avery	32	0	0	$0	$0
Beaufort	3	0	0	$0	$0
Bertie	0	0	0	$0	$0
Bladen	9	0	0	$0	$0
Brunswick	11	0	0	$0	$0
Buncombe	32	0	0	$0	$0
Burke	49	0	0	$0	$0
Cabarrus	32	0	0	$0	$0
Caldwell	49	0	0	$0	$0

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Camden	0	0	0	$0	$0
Carteret	3	0	0	$0	$0
Caswell	17	0	0	$0	$15,995,005
Catawba	34	0	0	$0	$0
Chatham	0	0	0	$0	$0
Cherokee	0	0	0	$0	$0
Chowan	0	0	0	$0	$0
Clay	0	0	0	$0	$0
Cleveland	34	0	0	$0	$0
Columbus	10	0	0	$0	$0
Craven	3	0	0	$0	$0
Cumberland	0	0	0	$0	$0
Currituck	0	0	0	$0	$0
Dare	6	0	0	$0	$0
Davidson	0	0	0	$0	$0
Davie	32	0	0	$0	$0
Duplin	3	0	0	$0	$0
Durham	0	0	0	$0	$0
Edgecombe	0	0	0	$0	$0
Forsyth	0	0	0	$0	$0
Franklin	0	0	0	$0	$0
Gaston	32	0	0	$0	$0
Gates	0	0	0	$0	$0
Graham	33	0	0	$0	$0
Granville	0	0	0	$0	$0
Greene	3	0	0	$0	$0
Guilford	0	0	0	$0	$0
Halifax	0	0	0	$0	$0
Harnett	0	0	0	$0	$0
Haywood	34	0	0	$0	$0
Henderson	34	0	0	$0	$0
Hertford	0	0	0	$0	$0
Hoke	0	0	0	$0	$0
Hyde	6	0	0	$0	$0
Iredell	32	0	0	$0	$0
Jackson	70	0	0	$0	$0
Johnston	0	0	0	$0	$0
Jones	3	0	0	$0	$0
Lee	0	0	0	$0	$0
Lenoir	3	0	0	$0	$0
Lincoln	34	0	0	$0	$0
Macon	34	0	0	$0	$0
Madison	31	0	0	$0	$0
Martin	2	0	0	$0	$0
McDowell	48	0	0	$0	$0
Mecklenburg	32	0	0	$0	$0
Mitchell	33	0	0	$0	$0
Montgomery	0	0	0	$0	$0
Moore	0	0	0	$0	$0
Nash	0	0	0	$0	$0

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
New Hanover	9	0	0	$0	$0
Northampton	0	0	0	$0	$0
Onslow	3	0	0	$0	$0
Orange	0	0	0	$0	$0
Pamlico	3	0	0	$0	$0
Pasquotank	0	0	0	$0	$0
Pender	8	0	0	$0	$0
Perquimans	0	0	0	$0	$0
Person	0	0	0	$0	$0
Pitt	3	0	0	$0	$0
Polk	35	0	0	$0	$0
Randolph	0	0	0	$0	$0
Richmond	0	0	0	$0	$0
Robeson	11	0	0	$0	$0
Rockingham	17	0	0	$0	$13,157,091
Rowan	33	0	0	$0	$0
Rutherford	35	0	0	$0	$0
Sampson	0	0	0	$0	$0
Scotland	0	0	0	$0	$0
Stanly	0	0	0	$0	$0
Stokes	6	0	0	$0	$12,395,810
Surry	18	0	0	$0	$12,388,243
Swain	35	0	0	$0	$0
Transylvania	34	0	0	$0	$0
Tyrrell	3	0	0	$0	$0
Union	33	0	0	$0	$0
Vance	0	0	0	$0	$0
Wake	0	0	0	$0	$0
Warren	0	0	0	$0	$0
Washington	3	0	0	$0	$0
Watauga	24	0	0	$0	$12,713,868
Wayne	0	0	0	$0	$0
Wilkes	20	0	0	$0	$10,021,767
Wilson	0	0	0	$0	$0
Yadkin	19	0	0	$0	$10,001,391
Yancey	33	0	0	$0	$0
North Carolina	1496	0	0	$0	$111,238,174

Source: NCEI

North Carolina Selected Drought Detailed Event Information

July 1, 1998–July 31, 1998

Dry weather continued through much of the month of July 1998, affecting crops during the critical part of the growing season. Corn and other vegetables sustained the most damage, but a dollar amount related to the crop losses was not available.

Oct. 1, 1998–Oct. 31, 1998

The drought which began during the summer of 1998 continued through October. The only significant rainfall during the month occurred on Oct. 7 and Oct. 8. Cities and counties began to restrict water usage, and stream flows for several mountain locations were reduced to the lowest amounts seen in 50 years.

Aug. 25, 1999–Sept. 5, 1999

In 1999, Brunswick, Columbus, and Robeson Counties were declared Federal Disaster Areas due to hot and dry conditions which continued since July. Dry conditions that began in July 1998, subsided for several months during the latter part of 1998 and the first part of 1999, then returned in June 1999 and continued in many areas through early September. In many areas, crops were either damaged or destroyed. Water levels in creeks, streams, and rivers remained very low. The drought ended in most areas with the arrival of heavy rain from the remnants of Hurricane Dennis, which occurred on Sept. 4 and Sept. 5.

Feb. 1, 2001–May 31, 2001

Effects of the 2001 drought intensified as many areas received absolutely no rain during the month, setting records in several locations for the longest stretch endured without any measurable rainfall. Wells and mountain streams continued to dry up and lake levels continued to drop. Despite beneficial rain during March, the drought continued to grip most of the area. Severe water restrictions were implemented in parts of the North Carolina piedmont, where reservoirs dropped to all-time low levels. In Concord, food establishments were asked to use paper and plastic products, in order to conserve water. Some rivers and lakes reached record-low levels. Well-drilling companies in the North Carolina piedmont recorded twice as much business as usual.

Nov. 1, 2001–Nov. 30, 2001

The National Weather Service declared North Carolina to be in a moderate drought in Nov. 2001. Between Jan. 2001 and Nov. 2001, the weather office in Wilmington NC recorded only 35.84 inches of precipitation, an amount approximately 14 inches below normal. Similar rainfall deficits were experienced around the state. Many areas in North Carolina participating in either voluntary or mandatory water-conservation measures. The Charlotte area recorded an all-time record dry calendar year with just 26.23 inches of rainfall occurring during 2001. (Records have been kept in the area since 1878.) Many communities initiated either mandatory or voluntary water restrictions. At Kings Mountain, a new pump was required at Lake Moss because the water level dropped below two of the three existing pumps. Record low ground water supplies, lake levels, and stream flows were reported across all of western North Carolina.

Aug. 1, 2002–Aug. 31, 2002

The 2002 water supply situation reached crisis levels in some communities, as the effects of a long-term drought continued to plague western North Carolina. Particularly hard hit were several Piedmont communities along the Interstate-77 corridor. The city of Shelby was forced to buy water from surrounding communities and even from private companies and citizens. In Statesville, emergency construction of wells and a dam was necessary to prevent the city from running out of water, as the nearby South Yadkin River reached historically low levels.

Water levels on area lakes fell as much as 10 feet below full pond levels. Most of the larger towns and cities along the I-77 corridor had imposed mandatory water restrictions by the end of the month, including the Charlotte metro area.

Aug. 1, 2003–May 1, 2004

A period of dry weather that began in Aug. 2003 resulted in moderate drought conditions across portions of western North Carolina by late spring of 2004. Streamflow and lake levels began to run below normal, and a few communities instituted water restrictions.

2007-2008

The drought in 2007 was the worst for North Carolina since record keeping began in North Carolina in 1895. In 2007, conditions in the state went from no drought to record drought in less than one year. The year 2007 was recorded by the National Weather Service as the driest year in more than 100 years in North Carolina. Records were set in many areas for number of days of low humidity and number of days with temperatures above 90 F. Forest landowners and many residents in wildfire-prone areas were impacted by the drought. Soil moisture was not a grave problem during the planting season of 2008. However, the lack of rains throughout the spring and summer months stunted or prohibited crop growth in some areas. Some areas had record low yields while some other areas seemed to make it through the drought because of isolated showers which doused fields at the right times of the growing season. At one point, as many as 30 cities and towns were forced to confront the realization that they may run out of water or have to ration water. Many of those were within 100 days of running out of water. In Siler City, officials had to ship in water supplies by truck. Rocky Mount sought and received the state's permission to extend a pipeline to Wilson to keep from running out of water.

January 13, 2009–March 17, 2009

Extreme drought (D3) began impacting Western North Carolina in January 2009, after several months of the region experiencing a severe drought (D2). The most severely impacted counties were the Southwestern counties, from Rutherford to Cherokee County (from East to West).

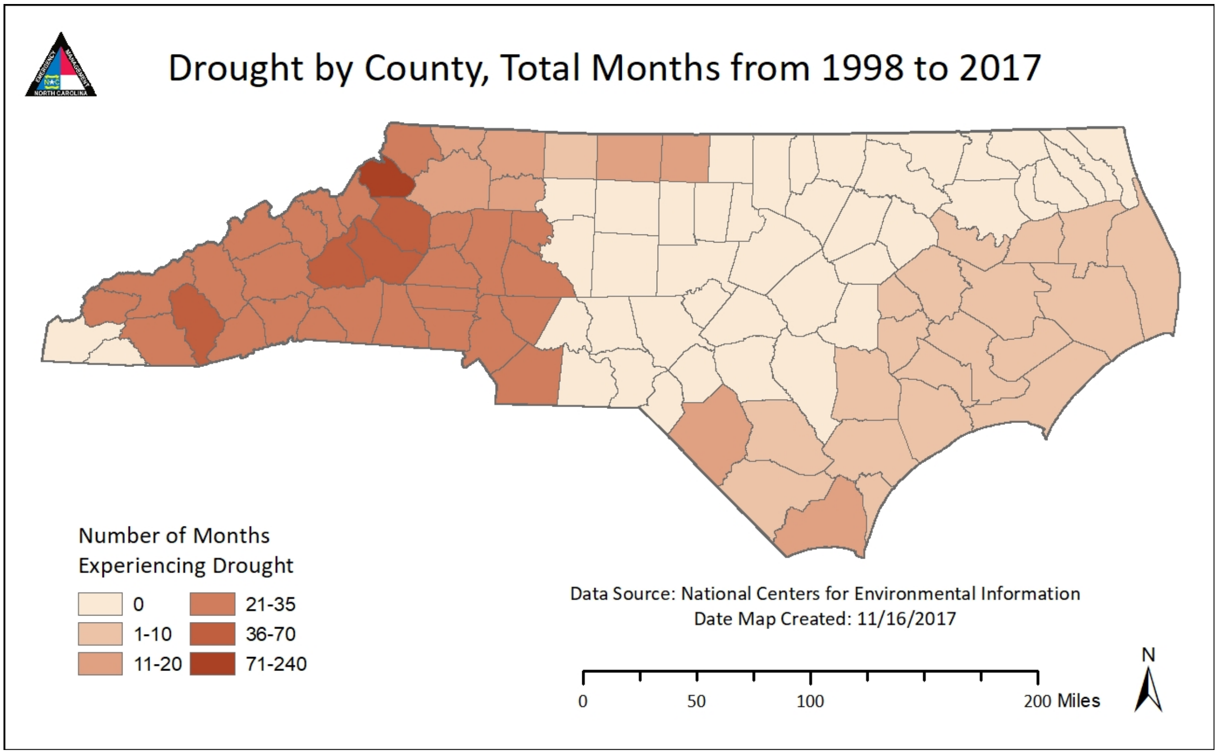
July 05, 2011–August 23, 2011

Severe drought (D2) began impacting Eastern North Carolina in early June and worsened to extreme drought (D3) by early July for several Eastern North Carolina counties. Since the winter of 2010, the region received well below normal precipitation. Streamflows over Eastern North Carolina were well below normal with several sites showing less than ten percentile range of streamflow. Groundwater conditions were listed as much below to record low levels across the region. As of July 8th, Local Climatological Data Sites New Bern and Cape Hatteras observed fifty-four and seventy-six percent of normal precipitation, respectively. As a result of these conditions, the North Carolina Department of Environment and Natural Resources banned open burning in Eastern North Carolina.

January 17, 2012–February 28, 2012

A severe drought (D2) started in January 2012 after several months of diminished precipitation. The conditions continued until the end of February. The affected counties are located in the Southeastern part of the state. The status of some public supply systems, as a result of drought related causes, had mandatory conservation statuses.

Figure 3-30 Drought Events in North Carolina



Source: National Centers for Environmental Information

3.2.8.4 Changing Future Conditions

Changes in weather patterns and climate may have effects on North Carolina's vulnerability to the drought hazard. These changes could impact the probability of drought occurrences, as well as the extent or location of droughts. Lasting drought conditions may be experienced in some areas more frequently. Changing future conditions could also trigger more notable flooding occurrences from infrequent and intense rain storms in areas where flooding does not usually occur.

In the near future, NOAA also predicts much of central North Carolina to have areas of persistent drought and further drought development.[23]

3.2.8.5 Impact

Drought is an atmospheric hazard and it has the potential to impact all existing and future assets, critical facilities and populations. Droughts tend to have greater economic,

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[23] *U.S. Seasonal Drought Outlook. National Weather Service Climate Prediction Center. http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php*

environmental and social impacts than they have on the built environment. Droughts may result in the following impacts:

Economic

- Temporary closure of business and essential facilities (for example: restaurants cannot operate safely without water)
- Increase in food prices
- Increased wildfires
- Loss of incomes
- Loss of hydroelectric power

Environmental

- Crop damage
- Stress on wildlife
- Increased wildfires
- Wind erosion
- Loss of wetlands
- Drying ponds/lakes

Social

- Water conservation requirements
- Reduced quality of life
- Food shortages
- Political conflicts over water rights
- Stress

3.2.8.6 Future Probability

The future incidence of drought is highly unpredictable. Conditions may be localized or widespread, and not much historical data is available, making it difficult to determine the future probability of drought conditions with any accuracy. However, based on historical data, future occurrences are still unlikely (between 1 and 33.3 percent annual probability).

3.2.8.7 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 3, Drought Assessment and Response Plan

3.2.9 Tornadoes/Thunderstorms

3.2.9.1 Description

Tornadoes

A tornado is a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. A condensation funnel does not need to reach to the ground for a tornado to be present; a debris cloud beneath a thunderstorm is all that is needed to confirm the presence of a tornado, even in the total absence of a condensation funnel.

It is spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris.

Thunderstorms

Thunderstorms can produce a variety of accompanying hazards including wind, hail, and lightning. Although thunderstorms generally affect a small area, they are very dangerous and may cause substantial property damage.

Three conditions need to occur for a thunderstorm to form. First, it needs moisture to form clouds and rain. Second, it needs unstable air, such as warm air that can rise rapidly (this is often referred to as the “engine” of the storm). Third, thunderstorms need lift, which comes in the form of cold or warm fronts, sea breezes, mountains, or the sun’s heat. When these conditions occur simultaneously, air masses of varying temperatures meet, and a thunderstorm is formed. These storm events can occur singularly, in lines, or in clusters. Furthermore, they can move through an area very quickly or linger for several hours.

According to the National Weather Service, more than 100,000 thunderstorms occur each year though only about 10 percent of these storms are classified as “severe.” Thunderstorm events have the capability of producing straight-line winds that can cause severe destruction to communities and threaten the safety of a population.

High winds can form due to pressure off the Northeast coast that combines with strong pressure moving through the Ohio Valley. This creates a tight pressure gradient across the region, resulting in high winds which increase with elevation. It is common for gusts of 30 to 60 miles per hour during the winter months.

Downbursts are also possible with thunderstorm events. Such events are an excessive burst of wind in excess of 125 miles per hour. They are often confused with tornadoes. Downbursts are caused by down drafts from the base of a convective thunderstorm cloud. It occurs when rain-cooled air within the cloud becomes heavier than its surroundings. Thus, air rushes towards the ground in a destructive yet isolated manner. There are two types of downbursts. Downbursts less than 2.5 miles wide with a duration of less than 5 minutes and winds up to 168 miles per hour are called “microbursts.” Larger events greater than 2.5 miles at the surface and longer than 5 minutes with winds up to 130 miles per hour are referred to as “macrobursts.”

3.2.9.2 Extent

Tornadoes

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings (particularly mobile homes). Tornadic magnitude is reported according to the Fujita and Enhanced Fujita Scales. Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (Table 3-19). Tornado magnitudes that were determined in 2005 and later were determined using the Enhanced Fujita Scale (Table 3-20). The greatest magnitude reported was an F2 (last reported on May 8, 2009).

Table 3-19 The Fujita Scale (Effective Prior to 2005)

F-Scale Number	Intensity	Wind Speed	Type of Damage Done
F0	GALE TORNADO	40–72 MPH	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	MODERATE TORNADO	73–112 MPH	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	SIGNIFICANT TORNADO	113–157 MPH	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	SEVERE TORNADO	158–206 MPH	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	DEVASTATING TORNADO	207–260 MPH	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	INCREDIBLE TORNADO	261–318 MPH	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6	INCONCEIVABLE TORNADO	319–379 MPH	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Source: National Weather Service

Table 3-20 The Enhanced Fujita Scale (Effective 2005 and Later)

Ef-Scale Number	Intensity Phrase	3 Second Gust (Mph)	Type Of Damage Done
EF0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	SIGNIFICANT	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	SEVERE	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	INCREDIBLE	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Source: National Weather Service

Thunderstorms

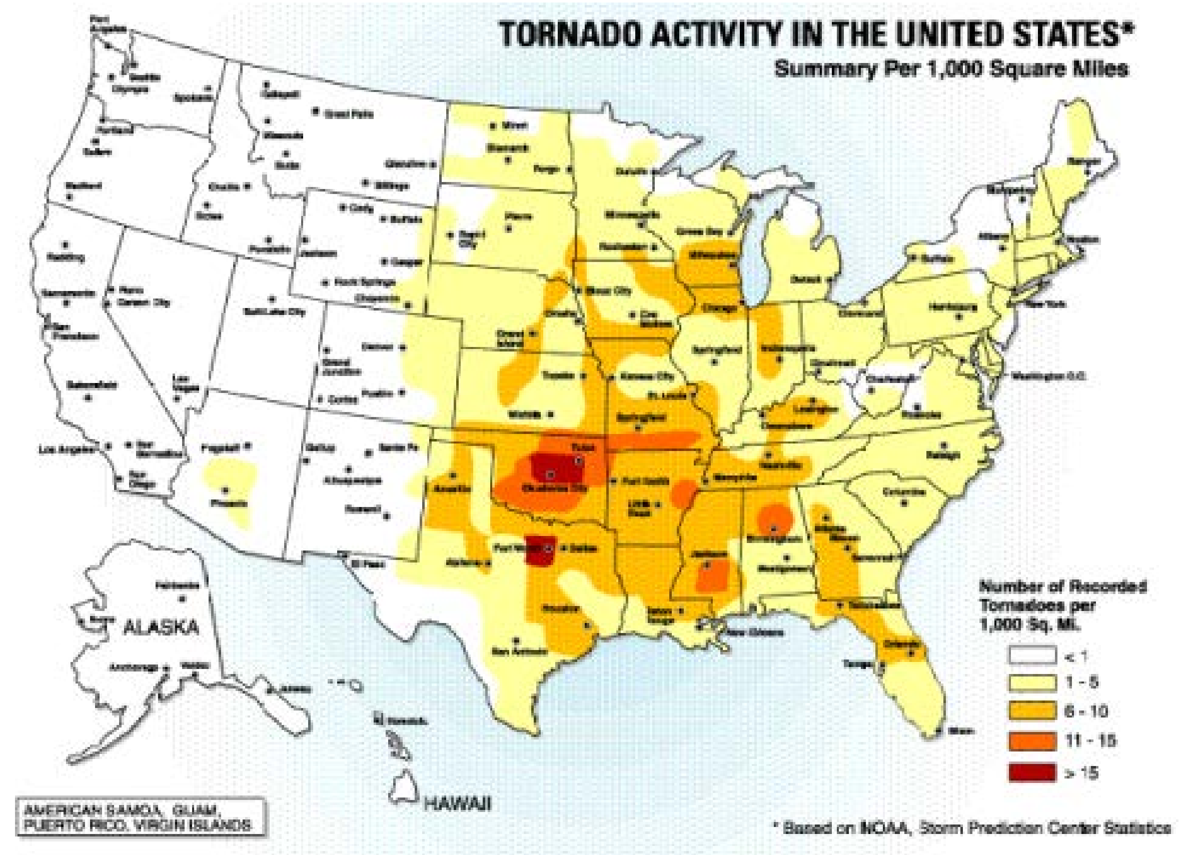
Thunderstorm extent is defined by the wind speeds reported. According to a 60-year history from the NCEI, the strongest recorded wind event in North Carolina was reported in Robeson County on May 11, 2009 at 109 knots (approximately 125 mph). It should be noted that future events may exceed these historical occurrences.

3.2.9.3 Location/Spatial Extent

Tornadoes

Tornadoes occur throughout the State of North Carolina. Tornadoes typically impact a relatively small area, but damage may be extensive. Event locations are completely random and it is not possible to predict specific areas that are more susceptible to tornado strikes over time. It is assumed that the entire State of North Carolina is uniformly exposed to this hazard; however, based on historical data, many of the eastern counties have experienced tornadoes more frequently. Historically, tornadoes are also more common in the Spring and Fall months North Carolina. As Figure 3-31 illustrates, North Carolina is in an area of the United States that experiences moderate tornadic activity compared to the rest of the country.

Figure 3-31 Tornado Activity in the United States

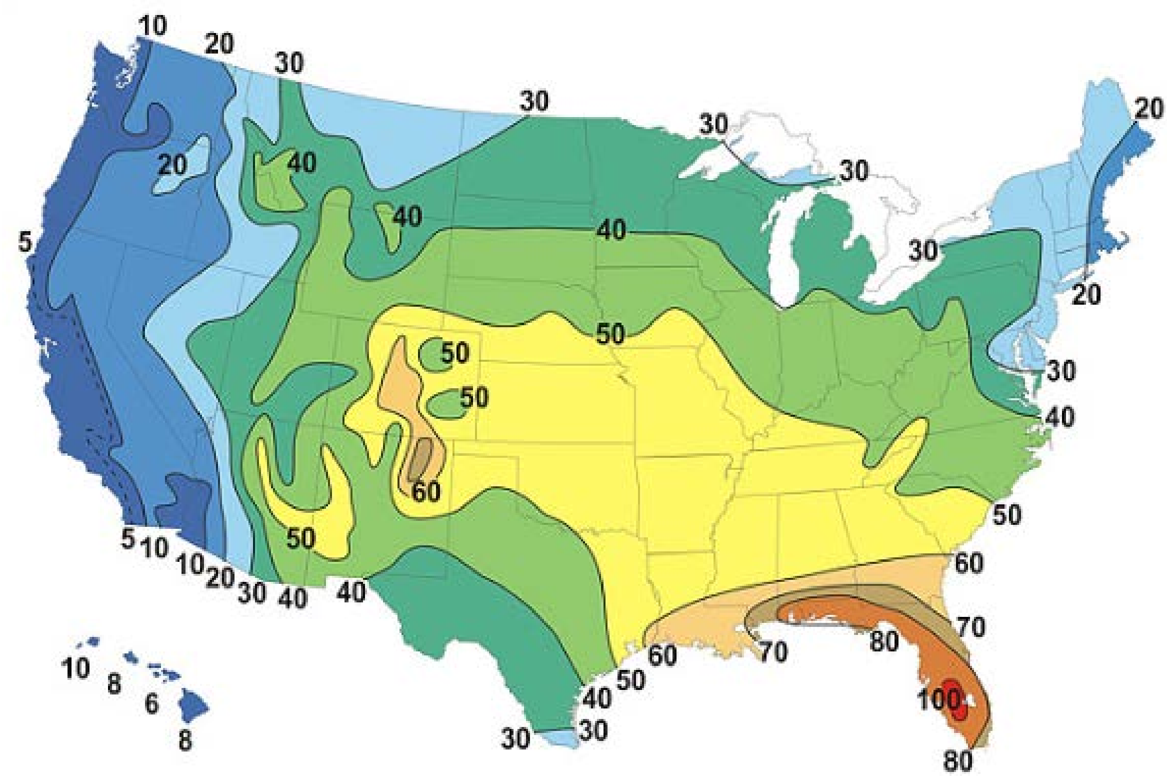


Source: Federal Emergency Management Agency

Thunderstorms

Much like tornadoes, thunderstorms can occur anywhere in North Carolina and risk to thunderstorm activity across the state is more or less the same in all locations as a result. Figure 3-32 depicts the average number of thunderstorm days each year throughout the United States. North Carolina generally falls within the range of 40-60 thunderstorm days a year.

Figure 3-32 Average Number of Thunderstorm Days Per Year



Source: National Weather Services

3.2.9.4 Hazard History

Tornadoes

Between January 1950 and December 2016, 1,385 tornadoes were reported in North Carolina which resulted in 127 fatalities, 2,577 injuries, and $3,000,368,872 dollars in damage. 555 (40%) were classified F0, 515 (37%) were classified F1, 232 (17%) were classified as F2, 58 (4%) were classified as F3, and 29 (2%) were classified as F4. There have been no recorded F5 tornadoes. The counties with the most reported tornadoes are Carteret (54), Onslow (38), Robeson (33), Dare (32), Wake (29) and Duplin (27) Counties.

Table 3-21 summarizes the tornado events by F Scale by county, as listed in the NCEI's Storm Events Database. A graphic representation of the table follows in Figure 3-33.

Table 3-21 Tornado Events of F Scale by County

County	Number of Events (1950-	Magnitude (Fujita Scale)	Maximum F Scale	Fatalities	Injuries	Damage (Inflated to 2017 Dollars)

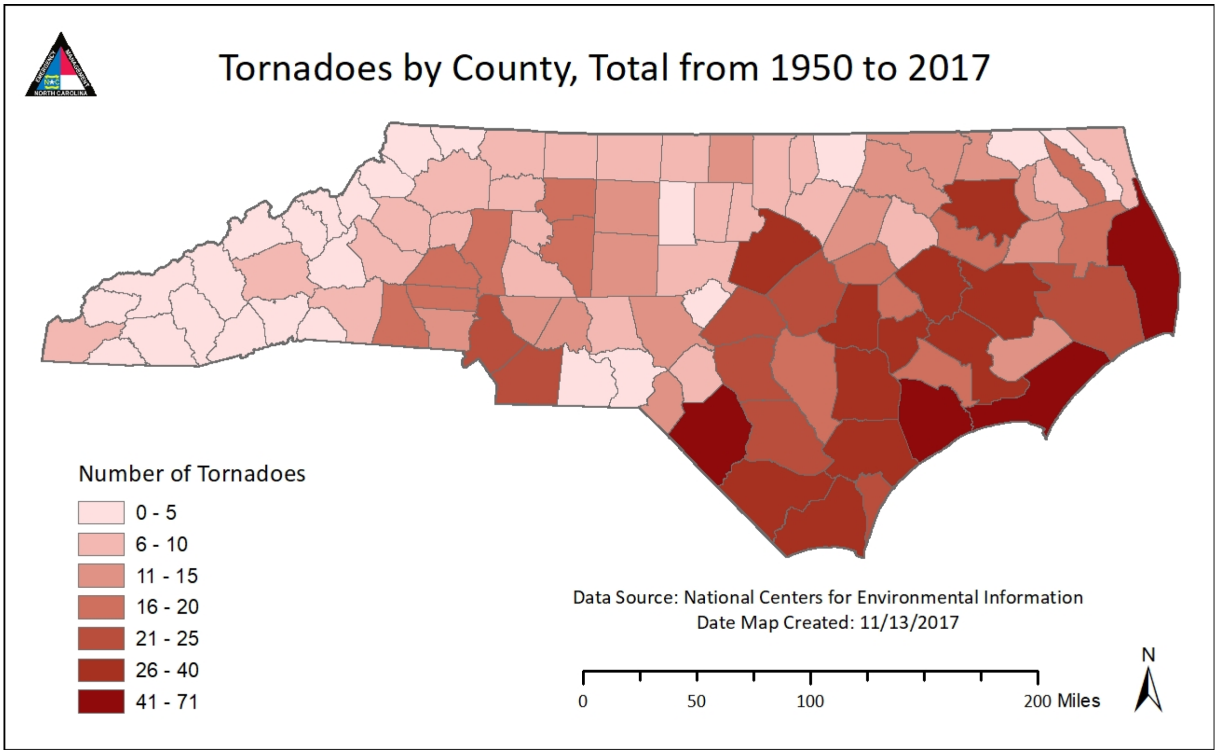
	2017)	0	1	2	3	4	5				
Alamance	5	1	4					1		1	$2,003,247
Alexander	6	3	2	1				2		0	$1,814,402
Alleghany	3		2	1				2		7	$1,625,592
Anson	4	1	2	1				2		1	$5,084,633
Ashe											
Avery	1		1					2		1	$195,888
Beaufort	32	12	10	9	1			3	1	45	$38,485,798
Bertie	29	9	8	7	5			3	18	94	$78,117,775
Bladen	21	8	6	6	1			3	5	8	$485,523
Brunswick	25	16	8	1				2	0	0	$2,114,000
Buncombe	6	1	5					1	0	0	$3,599,723
Burke	7	3	2	2				2	0	8	$15,904,836
Cabarrus	12	4	7	1				2	0	3	$8,598,189
Caldwell	8	3	2	2		1		4	0	3	$3,738,956
Camden	4	3		1				2	0	0	$119,259
Carteret	66	37	23	6				2	0	11	$24,968,233
Caswell	6	3	2	1				2	0	3	$5,122,403
Catawba	16	5	6	4		1		4	0	6	$60,643,322
Chatham	10	5	3	2				2	0	0	$927,213
Cherokee	8	3	3	1		1		4	4	26	$127,919,567
Chowan	13	4	5	3	1			3	1	1	$1,589,672
Clay	5	1	4					1	0	0	$293,299
Cleveland	19	8	8	1	1	1		4	0	36	$52,945,693
Columbus	25	10	9	4	2			3	8	40	$15,999,620
Craven	32	21	7	3	1			2	0	48	$28,933,635
Cumberland	23	7	7	4	3	2		4	5	168	$99,079,510
Currituck	9	6	3					1	0	2	$620,510
Dare	39	23	11	4	1			3	1	22	$11,017,654
Davidson	16	6	8	2				2	2	22	$27,078,966
Davie	7	6		1				2	0	1	$386,202
Duplin	37	9	12	13	2	1		4	0	86	$90,248,666
Durham	8	2	3	3				2	0	5	$57,023,685
Edgecombe	7	1	3		3			3	0	8	$2,844,846
Forsyth	16	4	4	4	4			3	0	58	$146,274,409
Franklin	10	2	5	2		1		4	0	24	$57,068,796
Gaston	13	3	9	1		2		4	1	11	$16,492,804
Gates	5	3	1		1			3	2	10	$6,053,905
Graham	1			1				2	2	11	$1,251,617
Granville	9	1	4	4				2	0	2	$9,131,161
Greene	17	7	5	2	2	1		4	7	33	$97,860,532
Guilford	13	1	9	2	1			3	1	5	$20,647,956

County	Number of Events (1950-2017)	Magnitude (Fujita Scale)						Maximum F Scale	Fatalities	Injuries	Damage (Inflated to 2017 Dollars)
		0	1	2	3	4	5				
Halifax	11	2	5	3		1		4	0	12	$8,743,982
Harnett	23	8	10	4	1			3	1	34	$23,090,282
Haywood	2		2					1	0	1	$1,084,442
Henderson	3		3					1	0	0	$1,197,734
Hertford	14	3	5	6				2	1	13	$71,496,736
Hoke	10	6	2	2				2	1	6	$1,686,540
Hyde	19	10	7	2				2	0	4	$3,276,962
Iredell	18	6	10	2				2	1	4	$8,270,800
Jackson	3	2		1				2	0	0	$1,139,340
Johnston	21	10	8	2	1			3	1	80	$33,382,625
Jones	17	10	2	4	1			3	1	13	$29,474,562
Lee	5	1	2	1	1			3	2	36	$62,797,326
Lenoir	27	11	12	2	1	1		4	0	49	$139,502,044
Lincoln	19	6	9	3		1		4	4	30	$53,383,727
Macon	4	3	1					1	0	0	$1,095,286
Madison	4	1	3					1	0	5	$2,138,283
Martin	19	9	8	2	1			3	0	9	$4,312,761
McDowell	4	3		1				2	0	0	$782,171
Mecklenburg	23	6	11	6				2	0	23	$11,260,346
Mitchell											
Montgomery	7	3	3	1				2	0	7	$12,489,155
Moore	15	6	7	2				2	0	3	$9,492,945
Nash	14	5	4	3	1	1		4	2	23	$19,043,037
New Hanover	18	8	10					1	0	7	$3,938,265
Northampton	14	7	3	4		1		4	0	18	$13,656,457
Onslow	44	28	11	4	1			3	3	53	$23,649,127
Orange	8	4	2	1	1			3	2	11	$734,251
Pamlico	14	9	2	2	1			3	1	45	$26,160,194
Pasquotank	20	9	3	7	1			3	0	30	$10,890,898
Pender	31	17	10	4				2	3	31	$6,321,900
Perquimans	10	2	4	4				2	1	1	$3,544,623
Person	11	4	4	3				2	0	2	$4,008,412
Pitt	33	16	12	3	1	1		4	9	158	$81,470,045
Polk	2		1					1	0	0	$215,013
Randolph	15	3	7	4	1			3	1	6	$12,001,196
Richmond	4	1	2		1			3	0	0	$1,497,487
Robeson	44	16	18	7		3		4	6	334	$22,278,431

County	Number of Events (1950-2017)	Magnitude (Fujita Scale)						Maximum F Scale	Fatalities	Injuries	Damage (Inflated to 2017 Dollars)
		0	1	2	3	4	5				
Rockingham	9	2	6		1			3	2	31	$57,462,502
Rowan	10	1	8	1				2	0	3	$4,679,254
Rutherford	8	3	2	3		1		4	0	10	$705,149
Sampson	18	5	5	3	3	2		4	14	203	$137,647,034
Scotland	11	2	3	1	2	3		4	0	24	$19,342,737
Stanly	11	2	5	4				2	0	1	$14,913,950
Stokes	9	1	7	1				2	0	15	$21,870,452
Surry	7	1	6					1	0	3	$4,226,014
Swain	3	1	1	1				2	0	0	$1,096,958
Transylvania	3	1	1	1				2	0	0	$833,740
Tyrrell	14	5	6	3				2	0	2	$2,560,877
Union	20	5	8	5	1	1		4	1	26	$62,068,232
Vance	6		4		2			2	0	0	$17,722,875
Wake	35	18	9	6	1	1		4	7	213	$658,346,550
Warren	5	3		2				2	0	0	$3,601,991
Washington	11	6	2	3				2	0	6	$3,745,769
Watauga	2	1	1					1	0	2	$108,939
Wayne	26	13	8	3	1	1		4	4	159	$125,913,490
Wilkes	6	1	5					1	0	0	$3,575,938
Wilson	17	7	2	4	4			3	1	20	$14,373,493
Yadkin	9		8	1				2	0	1	$10,735,616
Yancey	2		2					1	0	0	$1,018,230
North Carolina	1,385	555	515	232	58	29			127	2,577	$3,000,368,872

Source: NCEI

Figure 3-33 NC Tornadoes by County from 1950 to 2017



Historical Tornado Events in North Carolina

March 28, 1984: The tornado outbreak on March 28, 1984 was one of the deadliest and most destructive outbreaks in history for North Carolina. There were eleven confirmed tornado touchdowns in North Carolina. There were 799 people injured and 42 people were killed. Impacted counties included Bertie, Bladen, Chowan, Columbus, Cumberland, Duplin, Gates, Greene, Hertford, Lenoir, Nash, Perquimans, Pitt, Robeson, Sampson, Scotland, Union, and Wayne.

August 13, 2004: The remnants of Tropical Storm Bonnie produced a tornado that touched down just south of Rocky Point and moved northeast, causing F0-F2 damage in the amount of $1.3 million, three deaths and 29 injuries. Damage (F0) was first observed near West Strawberry Lane, with roof damage to a couple of structures. The tornado crossed I-40, just southeast of Rocky Point. It then tracked across Martin Marietta Access Road, causing f0-f1 tree damage. The tornado intensified to f1-f2 as it moved into a small community along Hwy 210. Significant damage occurred on Clayton Lane, Nixon Avenue, and Pickett Road. The tornado reached peak intensity as it moved across Cart Wheel Road, where several homes were completely leveled. It continued to track northeast, with F1 tree damage. The tornado crossed the Northeast Cape Fear River and finally dissipated near Shaw Highway, approximately one mile north of Hwy 210. The following is a summary of damage from Pender County Emergency Management. 17 homes destroyed 25 other homes suffered major damage 34 other homes suffered minor damage two businesses suffered major damage one business suffered minor damage. Also, in Bath, an emergency manager reported 24 homes and a church sustained damage from a weak tornado which was on the ground for two miles.

August 14, 2004: Twenty structures were damaged in Nags Head on the Outer Banks. Tropical Storm Charley moved northeast across the Coastal Plains of Eastern North Carolina during the afternoon hours causing $225,000 in property damage. Five weak tornadoes were reported across the area associated with Charley with damage reported. The most significant damage related to a tornado occurred along the Outer Banks in Nags Head.

September 7, 2004: Tornadoes impacted three counties, causing over $1 million in damage. At 12:38pm a tornado touched down near Old Steak Rd and moved north through Evergreen. The tornado caused spotty damage as it continued to Boardman, and then crossed into Robeson County. Three homes/businesses were destroyed and four others were damaged, totaling $700,000 in damage. At 2:53pm a tornado downed many trees and caused damage to four homes, with one shed destroyed, resulting in $200,000 in damage two miles North West of Marietta in Robeson County. At 10:48am a tornado moved north from South Carolina, and produced widespread damage to trees and power lines along its two-mile path across the southwest corner of Mecklenburg County resulting in $150,000 in damage. The roof of a well-constructed home was blown off, and several other homes incurred shingle damage. A sheet of wallboard was torn off a garage wall and blown away. There was additional damage to automobiles and homes due to fallen trees.

November 19, 2006: At approximately 6:30 am, an F3 tornado with up to 200mph winds impacted a mobile home park in the Riegelwood area in Columbus County. There were eight fatalities, 19 injuries, at least 13 destroyed homes, roughly 100 people displaced from their homes, and over $500,000 in property damage.

May 27, 2008: Tornadoes impacted Bertie and Onslow Counties destroying over a dozen homes.

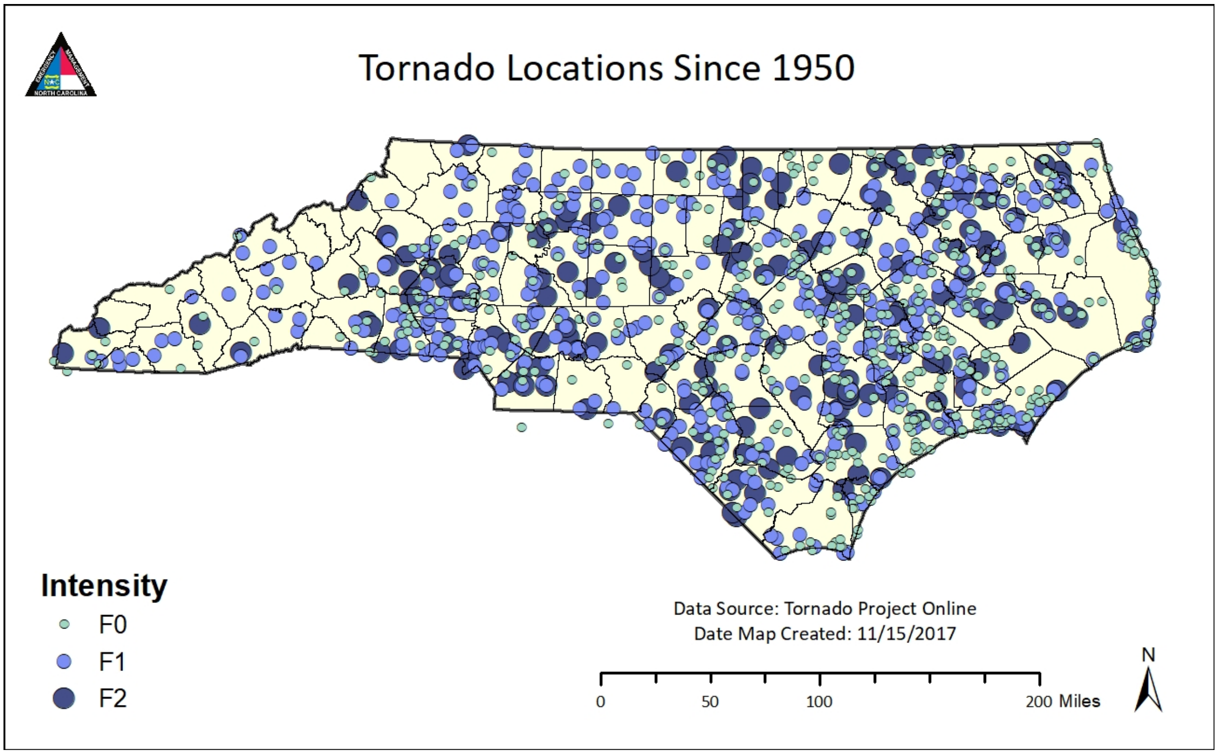
November 17, 2008: Tornadoes impacted Wilson and Johnston Counties.

March 28, 2010: Tornadoes impacted Guilford and Davidson Counties resulting in a state disaster declaration and an SBA declaration.

April 16, 2011 Southeast Tornado Outbreak: The largest tornado outbreak ever observed across eastern North Carolina occurred during the afternoon and evening of April 16th 2011. Several powerful super-cell thunderstorms developed ahead of an approaching cold front as a squall line that earlier descended the Blue Ridge, rapidly intensified as it moved east into the central Piedmont of North Carolina. Conditions ahead of the front were favorable for tornadoes with a moderately unstable atmosphere combined with strong winds that veered with height and produced four long live tornadic supercells that evolved from the linear convective segment. These tornadic supercells went on to produce damage in 38 counties. The tornadoes left 24 dead with approximately 442 injuries. These tornadoes combined to produce over $1.5 billion dollars in damages statewide.

Based on state tornado statistics, North Carolina experiences an average of 39 injuries per year as a result of tornadoes and the maximum number of tornadoes in any year historically was 66 in 1998.[24] Figure 3-34 and Figure 3-35 show the historical tornado locations for North Carolina according to their recorded maximum intensity.

Figure 3-34 Historical F0 – F2 Tornado Locations in North Carolina Since 1950



[24] *Tornadoes of North Carolina. Southeast Regional Climate Center. Retrieved on December 14, 2017 from: https://www.sercc.com/education_files/tornadoes_nc.pdf*

Figure 3-35 Historical F3 – F4 Tornado Locations in North Carolina Since 1950

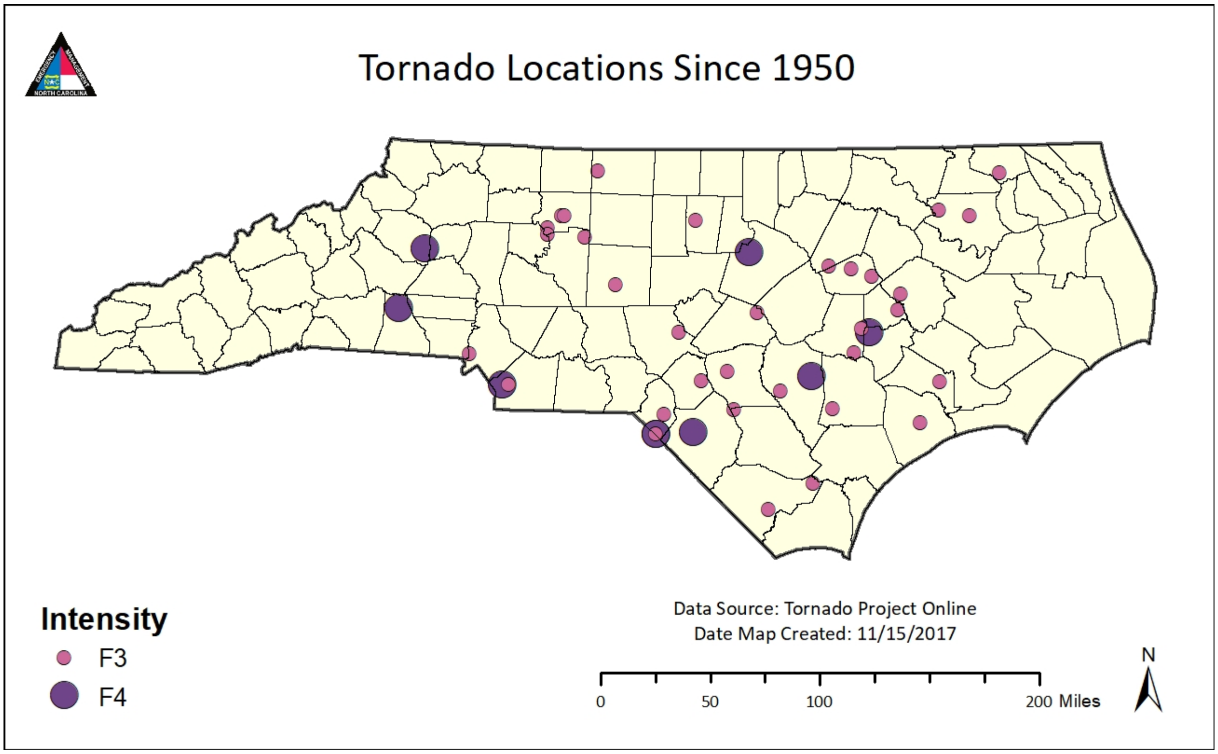


Table 3-22 summarizes thunderstorms that have impacted North Carolina from 1996 to 2017, as listed in the NCEI's Storm Events Database. A graphic representation of the table follows in Figure 3-36.

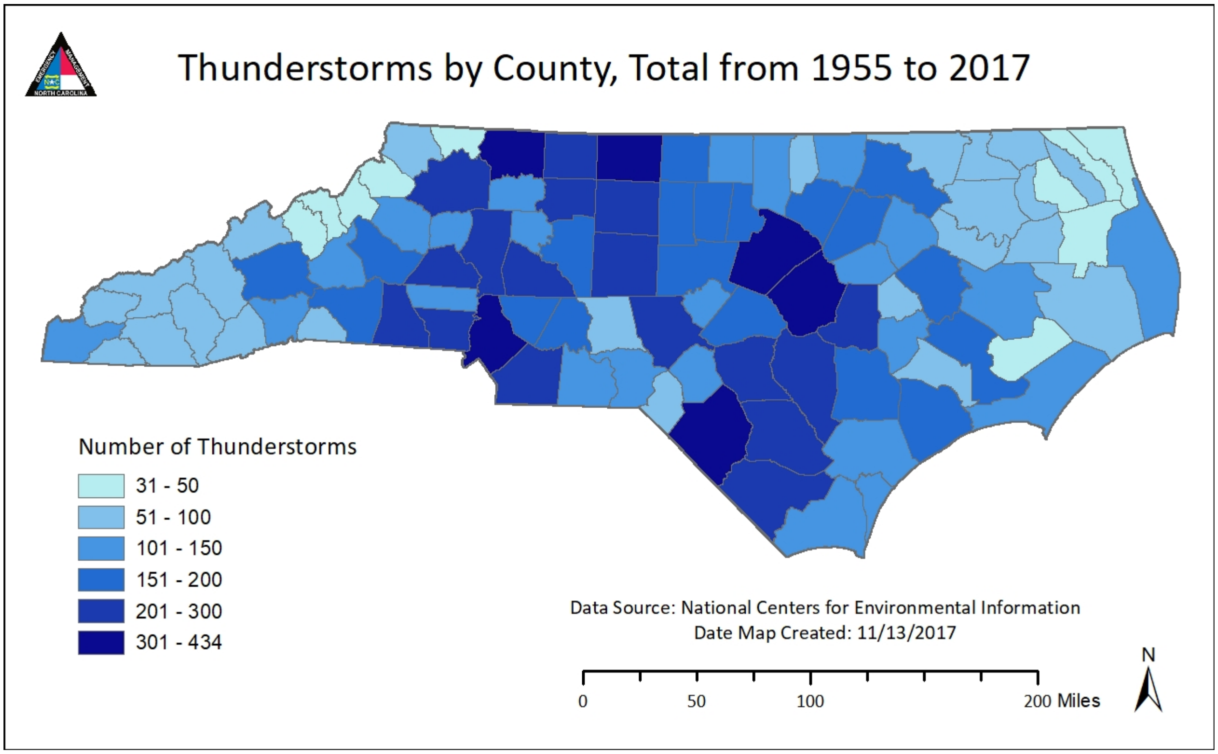
Table 3-22 North Carolina Thunderstorm Summary of Events by County

County	**Number of events** (1996-2017)	**Fatalities**	**Injuries**	**Property Damage** (Inflated to 2017 Dollars)	**Crop Damage** (Inflated to 2017 Dollars)
Alamance	163	0	3	$1,070,943	$199,853
Alexander	103	0	2	$1,338,000	$0
Alleghany	33	0	0	$143,080	$2,194
Anson	139	1	2	$182,499	$46,067
Ashe	54	0	0	$267,872	$0
Avery	43	0	0	$22,759	$0
Beaufort	123	2	41	$357,617	$0
Bertie	77	0	2	$428,462	$0
Bladen	234	0	6	$2,682,417	$2,263
Brunswick	130	0	1	$793,684	$16,195
Buncombe	158	1	9	$553,040	$0
Burke	193	0	2	$664,979	$10,425
Cabarrus	182	0	0	$782,460	$10,425
Caldwell	121	0	0	$505293	$0
Camden	31	0	0	$75958	$0
Carteret	139	0	1	$ 2141410	$0
Caswell	186	0	0	$ 1631940	$32,390
Catawba	239	0	2	$ 2956742	$10,425

County	**Number of events** (1996-2017)	Fatalities	Injuries	**Property Damage** (Inflated to 2017 Dollars)	**Crop Damage** (Inflated to 2017 Dollars)
Chatham	176	0	3	$680,888	$0
Cherokee	136	0	0	$919,180	$212,400
Chowan	52	1	0	$755,931	$0
Clay	64	0	0	$535,350	$69,942
Cleveland	223	0	6	$923,021	$1,042
Columbus	214	0	7	$9,601,817	$7,571
Craven	179	0	2	$363,632	$3,395
Cumberland	229	0	8	$1,749,515	$0
Currituck	45	0	0	$117,530	$0
Dare	114	0	12	$1,008,964	$0
Davidson	192	1	3	$1,959,505	$1,028
Davie	117	0	0	$207,019	$0
Duplin	198	0	6	$1,410,170	$39,327
Durham	174	2	3	$1,103,896	$0
Edgecombe	118	0	1	$1,494,863	$0
Forsyth	229	1	3	$993,204	$1,631
Franklin	168	0	4	$6,405,303	$3,085
Gaston	211	2	4	$773,856	$0
Gates	56	1	2	$108,792	$0
Graham	75	0	3	$55,752	$0
Granville	113	0	0	$306,017	$0
Greene	86	0	1	$381,572	$1,131
Guilford	282	2	2	$1,204,004	$1,131
Halifax	158	0	1	$711,218	$1,028
Harnett	183	1	6	$1,314,125	$13,433
Haywood	59	0	0	$205,551	$0
Henderson	128	0	4	$234,456	$0
Hertford	59	0	1	$214,938	$0
Hoke	101	0	4	$504,494	$0
Hyde	69	0	1	$95,459	$0
Iredell	241	2	0	$1,073,976	$0
Jackson	86	0	2	$662,214	$0
Johnston	308	0	1	$1,175,790	$5,141
Jones	65	0	3	$145,531	$0
Lee	103	0	1	$425,038	$0
Lenoir	136	0	0	$905,017	$809
Lincoln	136	1	1	$551,959	$0
Macon	70	0	1	$539,158	$0
Madison	88	0	0	$52,800	$0
Martin	78	0	0	$521,848	$0
McDowell	150	0	0	$795,800	$0
Mecklenburg	348	0	0	$1,950,903	$0
Mitchell	320	0	0	$2,682	$0
Montgomery	98	0	0	$2,475,520	$0
Moore	205	0	4	$1,490,149	$4,113
Nash	180	0	1	$732,560	$99,527
New Hanover	133	0	5	$2,430,684	$0
Northampton	91	0	0	$614,478	$0
Onslow	169	0	0	$398,613	$0
Orange	174	1	3	$337,536	$2,000

County	**Number of events** (1996-2017)	**Fatalities**	**Injuries**	**Property Damage** (Inflated to 2017 Dollars)	**Crop Damage** (Inflated to 2017 Dollars)
Pamlico	35	0	0	$95,863	$0
Pasquotank	75	0	0	$790,776	$0
Pender	125	0	7	$3,567,920	$16,195
Perquimans	45	1	0	$171,881	$0
Person	138	0	0	$313,608	$3,028
Pitt	197	1	9	$1,106,637	$0
Polk	87	0	2	$40,168	$0
Randolph	258	0	3	$777,880	$7,698
Richmond	114	0	0	$685,543	$2,528
Robeson	309	0	8	$5,469,324	$14,244
Rockingham	341	0	0	$3,576,485	$0
Rowan	261	0	11	$2,075,756	$0
Rutherford	195	4	3	$1,577,437	$0
Sampson	222	0	17	$4,224,936	$49,098
Scotland	96	0	4	$851,930	$0
Stanly	153	0	3	$2,838,029	$10,000
Stokes	253	0	0	$1,178,810	$0
Surry	319	0	11	$2,879,310	$0
Swain	62	1	1	$69,630	$0
Transylvania	67	0	0	$121,119	$0
Tyrrell	34	4	0	$108,953	$0
Union	215	0	1	$1,813,030	$0
Vance	90	0	0	$255,185	$514
Wake	434	1	19	$3,809,146	$4,206
Warren	101	0	0	$397,478	$2,082
Washington	61	0	0	$125,764	$0
Watauga	46	0	1	$246,555	$0
Wayne	207	1	9	$4,710,463	$477,136
Wilkes	255	1	1	$1,350,531	$68,041
Wilson	136	0	6	$263,383	$2,056
Yadkin	143	0	0	$1,555,294	$153,781
Yancey	33	0	0	$59,956	$37,037
North Carolina	14,845	31	226	$101,524,742	$1,645,615

Figure 3-36 NC Thunderstorms by County from 1955 to 2017

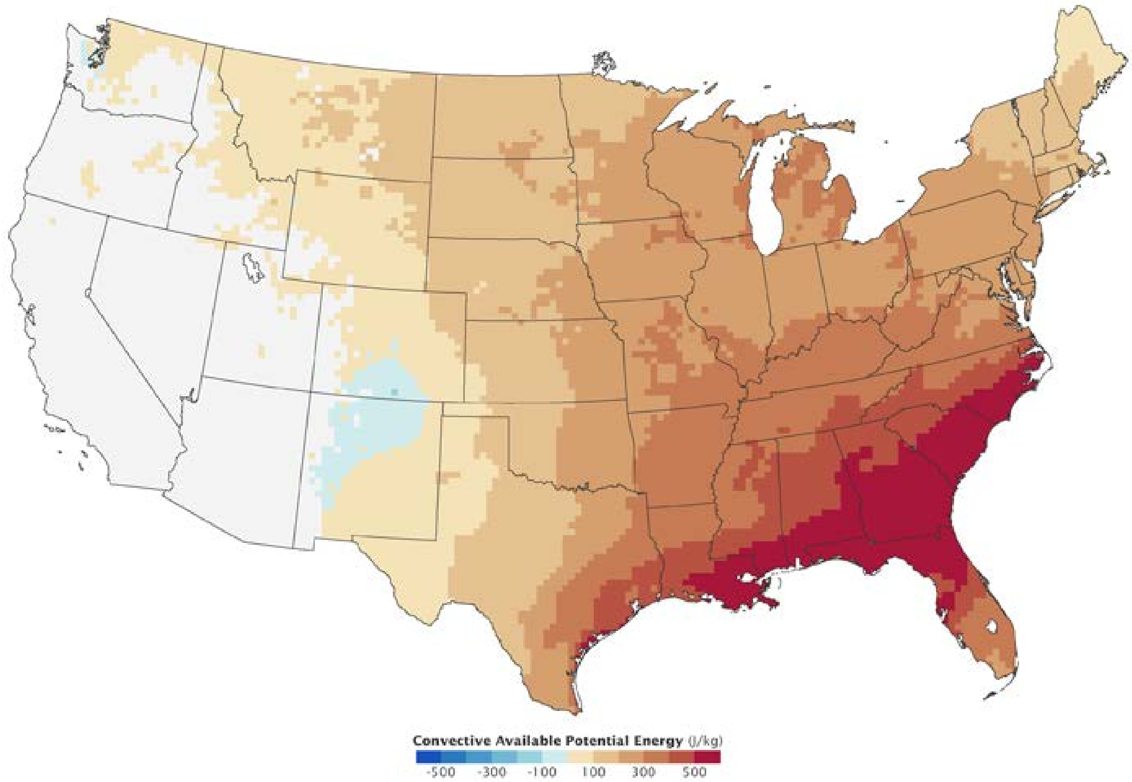


3.2.9.5 Changing Future Conditions

Climate is more than a measure of average conditions; it also is the range of weather variability, which can include the frequency and severity of extreme events like tornadoes and storms. Changing weather patterns may result in more frequent and more severe tornadoes in North Carolina. A US Government Accountability Report in 2017 states that $350 billion has been incurred by the US Government from extreme weather, and these costs are expected to increase as rare events become more common.

Additionally, according to the National Aeronautics and Space Administration (NASA), tornado and thunderstorm events in the future are likely to become more frequent in the southeast as a result of weather extremes. Thunderstorm/tornado potential is measured by an index that NASA created that is 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. Indeed, as Figure 3-37 shows, 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. This indicates that there will potentially be even more frequent thunderstorms/tornadoes in the state going forward.

Figure 3-37: Convective Available Potential Energy Projected Increase by 2072-2099



Source: National Aeronautics and Space Administration

3.2.9.6 Impact

Both tornadoes and severe thunderstorms have the potential to cause critical impacts in parts of North Carolina. That means that multiple deaths/injuries are possible and more than 25% of property in affected area could be damaged or destroyed. Also, complete shutdown of critical facilities for more than one week could occur.

3.2.9.7 Future Probability

Tornadoes

According to historical information, tornado events are becoming annual occurrences for the region. The probability of future tornado occurrences affecting the State is likely (between 36 and 75 percent annual probability). Based on previous data showing that tornadoes often occur in the central and eastern parts of North Carolina, it may be expected they are more probable in these zones as well.

Thunderstorms

Thunderstorms are also common occurrences throughout the state, especially in summer months. Historical data shows that these types of hazards tend to be more common in the central and eastern part of the state as well, so it is possible that they will continue to take places more frequently in these areas. Based on evidence, it is highly likely (66.7 to 100 percent annual probability) that North Carolina will continue to experience thunderstorms in the future.

3.2.9.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.2.10 Geological

3.2.10.1 Description

For the purposes of this plan, geological hazards refer to **landslides**, **sinkholes** and **coastal erosion** because they are the primary geological hazards that have the ability to cause damage to property and potential loss of life. Other geological hazards are not included in this plan include: ground collapse caused by old mines and prospects, rippable vs. non-rippable earth material, expansive soils (shrink swell clays), acid-producing rock, radon in air and groundwater (linked to geology), arsenic in groundwater (linked to geology).

Landslides

A landslide is a downward movement of earth or rock from, driven by gravity. Landslides can be triggered by natural or man-made circumstances, such as heavy rains, earthquakes, rapid snow melt, erosion, or construction.

Every landslide, or slope movement, is different and unpredictable. However, they are typically associated with periods of heavy rainfall and can worsen storm or flood events. Some move slowly, while others are quick moving. Some geological areas are more prone to landslides, such as bases of steep slopes or hillsides. Flatter areas away from slope changes tend to be safer from landslides.

Sinkholes

According to the United States Geological Survey, a sinkhole is an area of ground that has no natural external surface drainage--when it rains, all of the water stays inside the sinkhole and typically drains into the subsurface. Sinkholes can vary from a few feet to hundreds of acres and from less than 1 to more than 100 feet deep. Some are shaped like shallow bowls or saucers whereas others have vertical walls.

Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by groundwater circulating through them. As the rock dissolves, spaces and caverns develop underground. Sinkholes are dramatic because the land usually stays intact for a while until the underground spaces just get too big. If there is not enough support for the land above the spaces then a sudden collapse of the land surface can occur. These collapses can be small, or, as the picture below shows, they can be huge and can occur where a house or road is on top.[25]

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[25] *Sinkholes. United States Geological Survey. Retrieved on December 14, 2017 from: https://water.usgs.gov/edu/sinkholes.html*

Coastal Erosion

Coastal or beach erosion is the wearing away of the beach and dune sediments due to winds, tidal currents, or wave action. Erosion is typically event-driven and tends to happen during periods of strong winds, high tides and waves, such as a storm; however, continued erosion wears away the coastal profile and can create imbalance on shorelines. An eroding beach may lose feet of sand per year.

Erosion clearly affects the environment, but it also is problematic for homes and businesses that are constructed on or near beaches. Severe erosion can cause extreme property loss or damages. Many beaches rely on sandbags to be placed in front of homes and dunes to protect them from falling into the ocean.

3.2.10.2 Extent

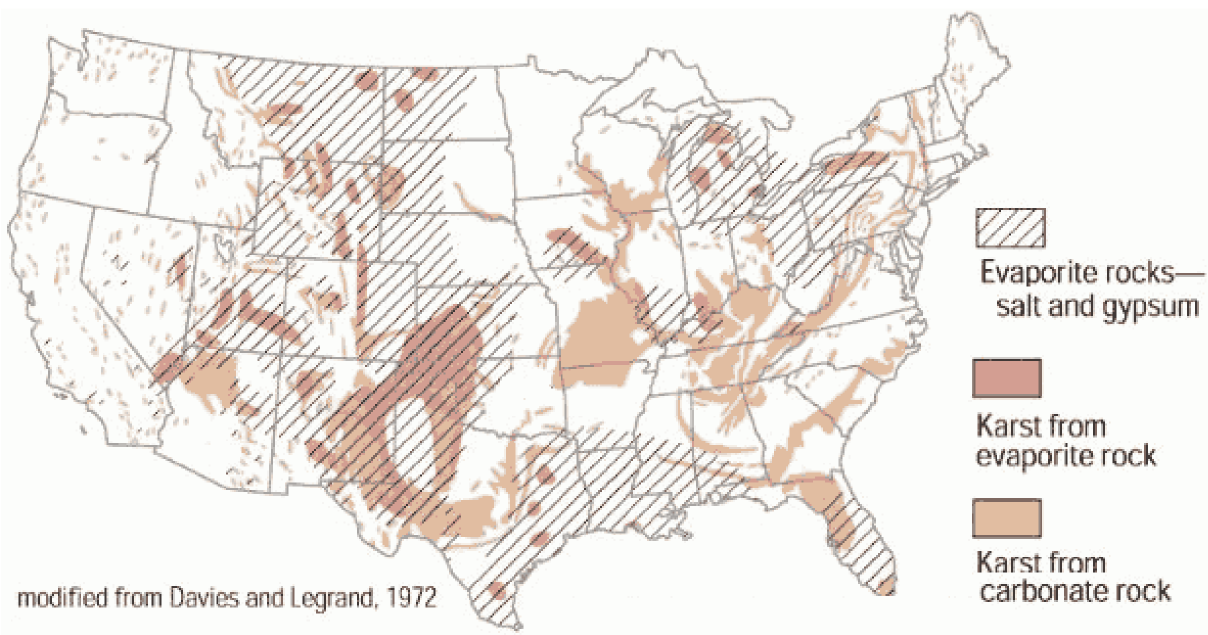
Landslides

Landslide extent can be measured using the size/volume of the debris that was moved during the landslide event. In the western areas of the state where landslides are most prevalent and largest, some landslides have displaced boulders as large as 60 feet in length and 900 tons in weight. Many times, the outflow from these landslide events has moved at upwards of 50 miles per hour, damaging homes and other structures along the way.[26]

Sinkholes

Figure 3-38 below shows areas of the United States where certain rock types that are susceptible to dissolution in water occur. In these areas, the formation of underground cavities can form and catastrophic sinkholes can happen. These rock types are evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite). Evaporite rocks underlie about 35 to 40 percent of the United States, though in many areas they are buried at great depths. In some cases, sinkholes in North Carolina have been measured at up to 20 to 25 feet in depth, with similar widths.

Figure 3-38: United States Geological Survey of Karst Modified from Davies and Legrand, 1972[27]



Coastal Erosion

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[26] *Historical NC Landslide Events. North Carolina Department of Environmental Quality. Retrieved on December 14, 2017 from: https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/geologic-hazards/historical-nc-landslide-events*
[27] *Sinkholes. United States Geological Survey. Retrieved on December 14, 2017 from: https://water.usgs.gov/edu/sinkholes.html*

In North Carolina, the NC Division of Coastal Management and the NC Geological Survey study and calculate shoreline change rates. These vary throughout the state in different locations, but it is notable that, on average, the state is experiencing 1.6 feet per year of erosion based on a study at multiple locations by the NC Department of Environmental Quality. More details on specific locations can be found in that study, which is located at the following URL: https://files.nc.gov/ncdeq/Coastal%20Management/documents/PDF/erosion%20rates/Erosion_Rate_Data_Summary_2011.pdf[28].

Figure 3-39 Severe Beach Erosion on North Carolina Outer Banks

Source: FEMA

3.2.10.3 Location/Spatial Extent

Landslides

Three common types of landslides that affect North Carolina are: debris flows, debris and earth slides, and rockslides. Most recorded landslides in the state have been recorded in the western region, due to changing slopes. Figure 3-40 below shows areas of landslide risk according to the United States Geological Survey.

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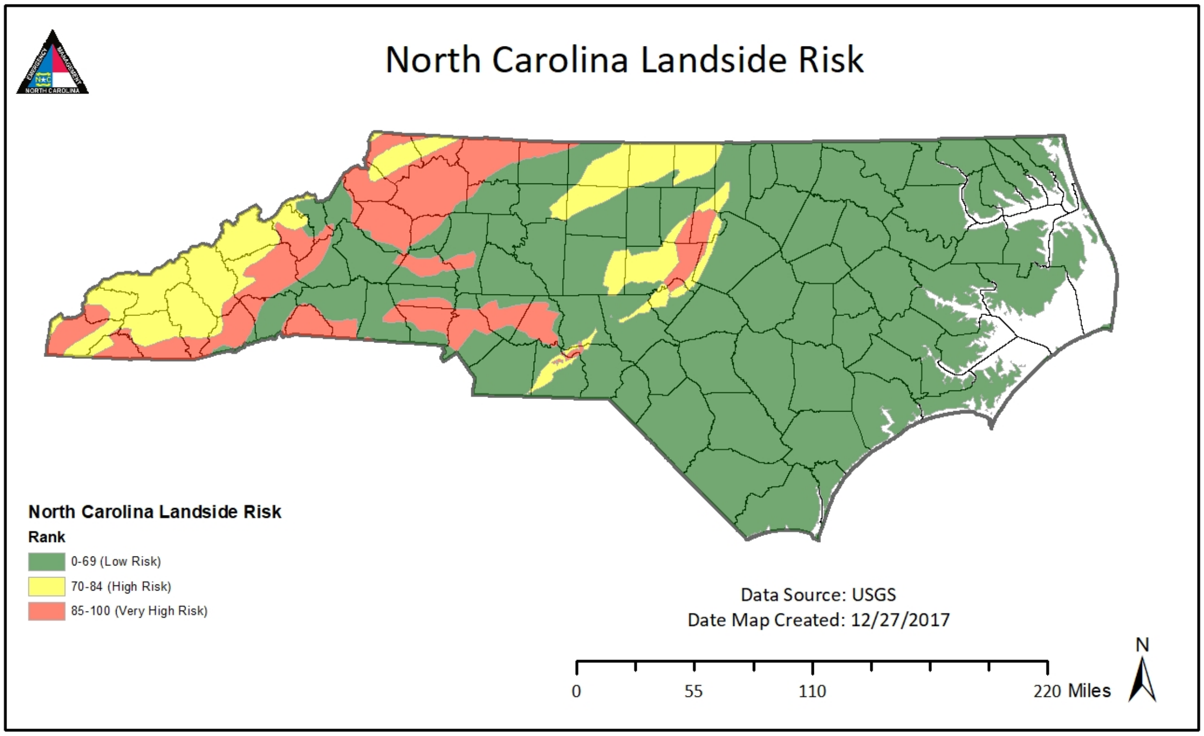
[28] *More details on specific locations can be found in that study, which is located at the following url: https://files.nc.gov/ncdeq/Coastal%20Management/documents/PDF/erosion%20rates/Erosion_Rate_Data_Summary_2011.pdf*

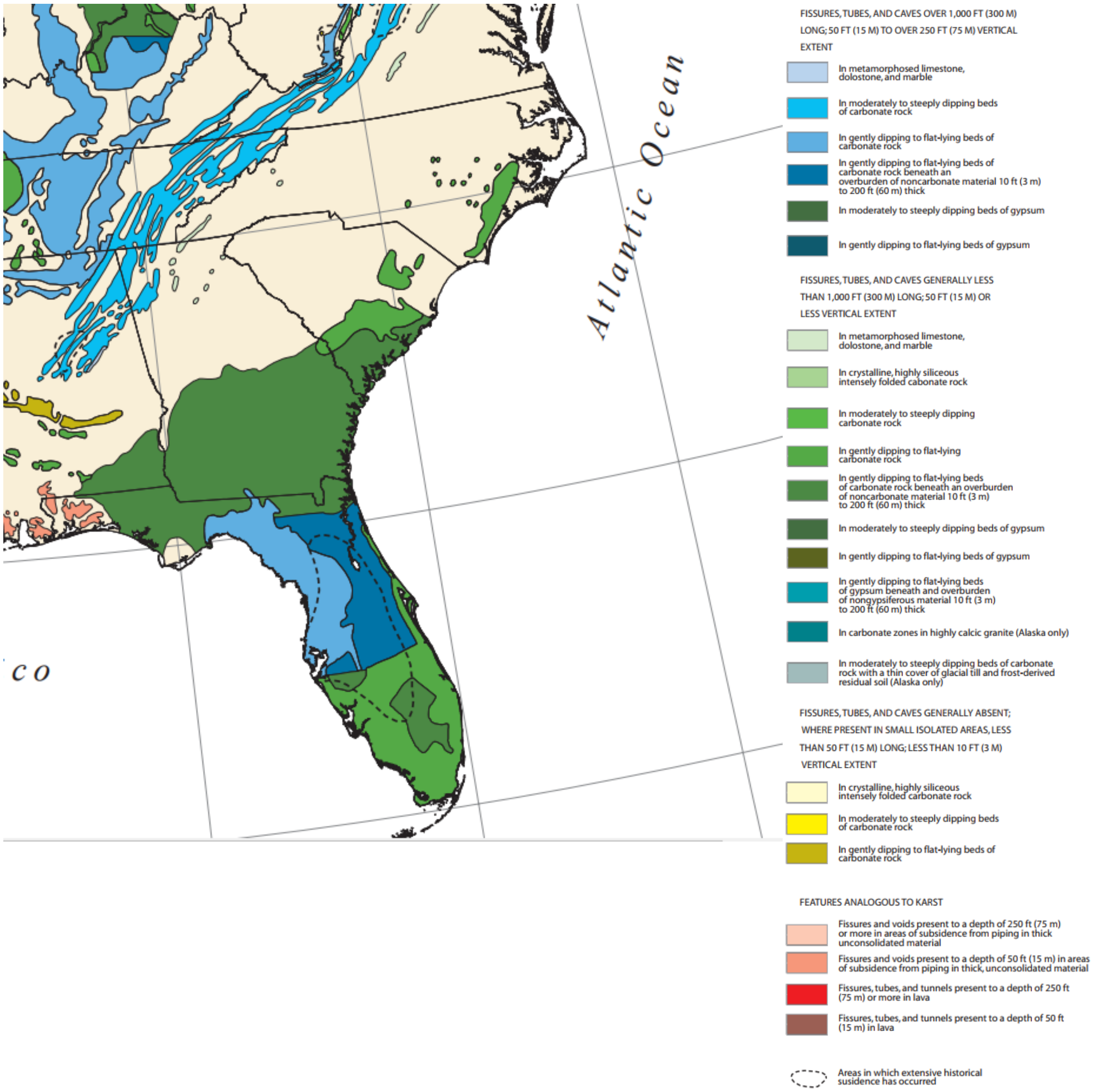
Figure 3-40 North Carolina Landslide Risk Areas



Sinkholes

Figure 3-41 below shows a more recent mapping of the karst features of soil types that have been documented by the United States Geological Survey and which indicate some susceptibility to sinkholes due to the erodibility of the karst soil type. Although this is not the only indicator and should not be used as the sole means for determining sinkhole risk, this information does give some indication as to areas that might be more likely to experience sinkholes in the state.

Figure 3-41: United States Geological Survey of Karst Soils from Davies, et al, 1984[29]



Coastal Erosion

By definition, coastal erosion is unique to the communities on North Carolina's coastline. However, a unique feature of North Carolina's coastline is its barrier islands that often experience erosion along their entire shoreline to some degree. Counties along North Carolina's coast must deal with erosion on both these barrier islands and along their mainland shorelines. These communities often face erosion and accretion in close proximity within a community as erosion in one area often leads to accretion of sediment in another.

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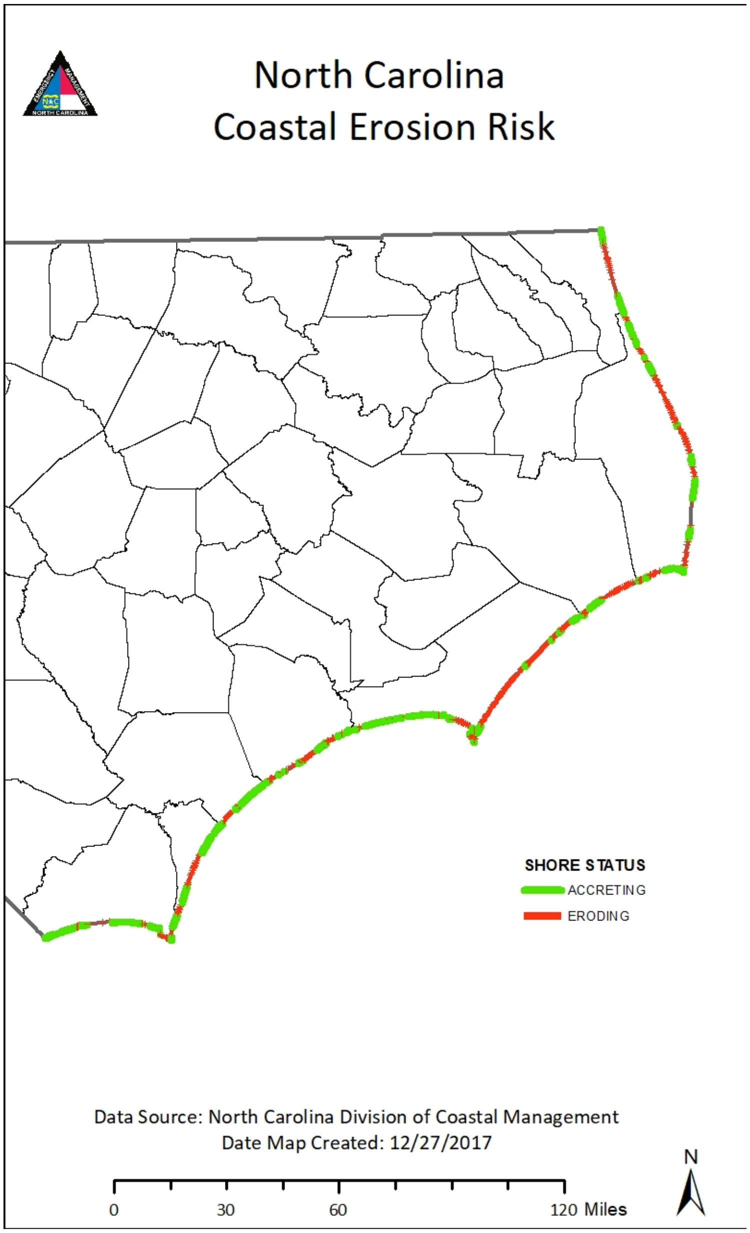
[29] *Digital Engineering Aspects of Karst Map. A GIS Version of Davies, W.E., Simpson, J.H., Ohlmacher, G.C., Kirk, W.S., and Newton, E.G. 1984. Bret D. Tobin and David J. Weary. United States Geological Survey, 2004.*

Figure 3-42 presents a depiction of the North Carolina coastline and shows segments of the shoreline that are either eroding or accreting.

Figure 3-42 Areas of Coastal Erosion



3.2.10.4 Hazard History

Landslides

North Carolina has recently experienced landslide events that have directly caused deaths and property damage. Table 3-23 lists recent landslide events and a brief summary of each event.

Table 3-23 North Carolina Landslide Events 1990-2017

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Lands Creek I	12/23/1990	Swain	debris flow			Mobile home and chlorinator building for Bryson City Municipal water system destroyed. Utility lines downed. Roads heavily damaged by debris.
Oconeechee Mountain, Eno River State Park	2/18/2001	Orange	rock slide			
Bald Mountain Debris Flow 1996	9/4/1996	Rutherford	debris flows			Home destroyed by debris flow triggered by high intensity rain storm
Spruce Pine Rock Slide I	1/28/2002	Mitchell	rock slide			Building planned for use as Chamber of Commerce destroyed
Maggie Valley Debris Flow Dogwood-Wildcat Run	12/13/2003	Haywood	debris flow	1	1	I home destroyed; sedimentation
Mountain Air DS-DF	3-4/x/2004	Yancey	debris slide			Damage to road and golf learning center - expensive repair
Lands Creek II	5/5-7/2003	Swain	debris flow			Sedimentation and large woody debris into drinking water reservoir
Charley Branch (Glory Mtn) 1-5	5/5-7/2003	Swain	debris flow			Damage to private driveway and yard, sedimentation into local water supply
SoHi Trail	5/5-7/2003	Swain	debris flow			Damage to road and property below; sedimentation
Midnight Trail Embankment Failure	5/5-7/2003	Swain	debris flow			Damage to road and property below; sedimentation
Timber Estates Slide	5/5-7/2003	Swain	weathered rock slide			Damage to road and cut slope relatively minor
Tory Lane Debris Slide	5/5-7/2004	Swain	debris slide			Minor damage to house siding, blocked drive way
Nantahala Cabins	5/5-7/2003	Swain	debris slide			Cabin knocked off foundation, damage repaired, retaining wall built
Alarka Creek	5/5-7/2004	Swain	debris flow			Damage to road and property down slope
Bear Rock Estates	9/8/2004	Henderson	debris flow			1 home damaged; sedimentation

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
White Laurel	9/8/2004	Watauga	debris flows			1 home destroyed; 6 condemned until site stabilized; sedimentation
Old CCC Road	9/6-8/2004	Henderson	debris slide-flow			
Elijay Creek	9/16-17/2004	Macon	rock fall, debris flow			Minor damage to house from rockfall; property damage from embankment failure-debris flow
Little Pine	9/16-17/2004	Madison	debris flow			Barn destroyed
Peeks Creek	9/17/2004	Macon	debris flow	5	2	15 homes destroyed; 2 homes damaged; bridge destroyed; road damaged; sedimentation
Fishhawk Mtn Rd PC EF1, EF2	9/16-17/2004	Macon	debris flows			Damage to outer road embankments, sedimentation into Peeks Creek
Wayah I	9/17/2004	Macon	debris flow			Barn destroyed; temporarily blocked Wayah Road
Wayah 2	9/17/2004	Macon	debris flow			Wayah Road temporarily blocked
Nickajack Creek Blowout	2004/09/16-17	Macon	debris blowout			Minor vegetation removal and sedimentation
Starns Cove	9/16-17/2004	Buncombe	debris flows			Arrowood home destroyed; damage to home further down the track.
Bat Cave 1	9/4/1996	Henderson	debris flow			Old cabin destroyed
Hebo Mountain 1, 2	9/6-17/2004	Haywood	debris flow; debris slide			Failed retaining wall, cracks in ground near home
Jonas Ridge	9/6-8/2004	Burke	debris flow			Home destroyed
Honeycutt Mtn. - McNutt	9/6-8/2004	McDowell	debris flow			Home threatened by further movement; scrap and ground cracks near home.
Bear Lake - Setzer	9/16-17/2004	Jackson	debris flow			
Glenville Quad	9/6-17/2004	Jackson	debris flow			Workshop destroyed, road damaged; Two debris flow tracks
Glenville Business Park	9/6-17/2004	Jackson	debris flow			
Glenville DFs	9/6-17/2004	Jackson	debris flow			Destroyed workshop, road heavily damaged.

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Spruce Pine Rock Slide II Toe River Tire	5/11/2005; 12/3/2015	Mitchell	rock slide			Garage and storage building damaged in first slide; main building damaged in second slide in the same cut slope
Bills Mountain	2005; 12/24-26/2015	Rutherford	weathered rock-debris slide			Slide remained periodically active from 2005 to 2016; continued excavation at slide toe likely contributed to slide movement
Broad River Fire Department	7/7/2005	Buncombe	rock slide			Severely damaged Broad River Fire Dept.
Campbell Mountain Estates	7/7-11/2005	Haywood	weathered rock slide			
Old U.S. 64 (Whetstone Ridge)	7/14/2005	Transylvania	debris flow			Modular home pushed off foundation with major structural damage
Bear Lake Preserve	07/x/2005	Jackson	weathered rock slide			Damage to road, and unbuilt lot above road
Cooperhead Ridge	2003, 09/06-06/2004	McDowell	weathered rock slide			
Lake Logan	9/6-17/2004	Haywood	weathered rock slide			Sedimentation into West Fork Pigeon River
Jackson County Airport	8/22/2005	Jackson	debris flows			Sedimentation damage to two properties
Hunters Crossing	9/xx/2005	Haywood	weathered-rock slide			2 homes condemned; 2 damaged and abandoned; water line broken; road damaged; 1-3 homes threatened
Gator Ridge I	9/6-17/2004	Macon	debris flow			Road damage; damage to fish hatchery water source
Black Bear Ridge - Cub Trail	5/x/2006	Haywood	debris slide			Road damaged; 1 home threatened
105 River Roar Rd	9/6-17/2004	Macon	debris slide			foundation cracks; deck and supports sag and lean
Eaglenest Ridge	8/31/2006	Haywood	debris flow			
Triska Court - Conestee Falls	8/17/1994 1/1/2007	Transylvania	debris slide/flow			damage to road and properties below; movement reported in 1994, and 2007
White	2007	Mitchell	debris slide			Septic system compromised
Bear Trail	1/7/2009	Haywood	debris flow		2	1 home destroyed; road damaged; sedimentation
Rising Sun	1/7/2009	Haywood	debris flow			Sedimentation

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Blossomtown 1, 2	2006 02/10/2010	Macon	weathered rock slide			Road access to home blocked by scarp; landslide movement into developed area down slope.
Moody Debris Flow Bear Creek Road	1/x/2009	Haywood	debris flow			Property condemned, scarp near garage, cracks in deck foundation
Waynesville Quarry	3/13/2009	Haywood	rock slide			Buried drill rig; major remediation effort required for stabilization and regaining access to quarry floor
Tanner Trail	2009	Haywood	debris slide			Scarps, toe bulge
Serentity Forest	2009	Buncombe	debris slides			Damage to development roads
Fulcher Vistas	9/16-17/2004	Macon	debris slides			Development roads and private property damaged in two locations; private property damaged at 1 location
Watauga Road BSM	1970	Macon	earth slide			Older home destroyed; damage to newer home
Sagee Mtn	10/x/2009	Macon	debris flow			Erosion, sedimentation on USFS land below initiation zone
Wildflower	11/14-16/2009	Macon	debris slide-flow			Road damaged; 1 home threatened; sedimentation
Thomas Slide	12/x/2009	Madison	weathered rock slide			Driveway damaged, home threatened
Skyland Drive	12/2009 thru 01/2013	Jackson	debris slide			Bulge in Skyland Drive, scarps in North Fork Rd; scarps damaging private drive and affecting septic system
Waterdance EF-DF	02/06-07/2010	Jackson	debris flow			Damage to road and sedimentation into river
Chocolate Drop	2009	Polk	debris slides			Sedimentation into creeks, road damage, and damage to unbuilt lots below road; no homes threatened
Basswood Drive DS	2/5/2010	Rutherford	debris slide			Damage to road
Cosmus	1/25/2010	Rutherford	rock slide-rock fall			Damaged corner of house and roof

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Ghost Town - Rich Cove	2/5/2010	Haywood	debris slide-flow			3 homes damaged; 18 homes threatened; sedimentation; reactivated on 1/17/2013 with minor damage
Ghost Town Cracks	06/x/2011	Haywood	subsidence			Extensive asphalt cracking, MV Sheriff's Dept. noted expanded cracking in 5/2011; cracking in concrete in foundation area of amusement ride
Logan Slide	08/x/2009	Jackson	debris slide			Damage to outbuilding
Taylor - 2730 Silvermine Rd.	2/5/2010	Swain	debris slide			Relatively minor damage to home
Dove Landing Echoing Ridge Road	12/25/2009	Buncombe	debris flow			Damage to development roads
Holiday Drive	12/1/2010	Henderson	debris flow			
Barnes	12/x/2009	Jackson	weathered rock slide			Property damage, utility pole damage. Potential for damage to mobile home from slide.
Reinold	3/6/2011	Swain	debris slide			Damage to porch, driveway; slope behind house needed stabilization
Sneed-EBCI	10/xx/2008	Jackson	weathered rock slide			Minor damage to yard and outbuilding
Wadsworth/Zerelli Glenville	9/16-17/2004	Jackson	debris flow			Corner of house severely damaged
Bear Lake - 281	pre-2011	Jackson	debris slide			
Gunter Fork	7/14-15/2011	Haywood	debris flows			Damage to Gunter Fork Trail
Saluda RR	9/6-17/2004	Polk	debris flow; debris slide			Damage to inactive Railroad line; embankment gone beneath tracks; sedimentation into Pacolet River
Balsam Corner	7/14-15/2011	Swain	debris flows			Debris flows probably triggered flood damage to Cherokee Hatchery 13 km downstream
Indian Creek	7/19/2012	Haywood	debris flow			Damage to roads and slope below house; sedimentation

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Chimney Rock State Park Rockfall, Debris Slide	11/14/2012	Rutherford	rock fall - debris slide			Segment of trail severely damaged; segment of timber and steel beam walkway destroyed
Cornerstone Drive	2010	Haywood	debris slide			Scarps on adjacent field. Property damage, slide probably still active
Mountain Heritage	1/14-17/2103	Jackson	debris flow			Damage to development road, and community property; unstable slope remained
Watauga Vista Stacy	1/14-17-/2013	Macon	debris flow			Damage to garage, driveway and slopes above; unstable slope remained
Hinton	01/14-17/2013	Madison	debris slide			Damage to outer edge of driveway; driveway threatened
Hopkins	1/17/2013	Watauga	debris flow			Property damage, and damaged outbuilding
343 Skyline Drive	1/14-17-2013	Haywood	debris flow			Severe damage to home
Gator Ridge 2	1/14-17/2013	Macon	debris flow			Road damage; damage to fish hatchery water source
Moore Little Choga	1/14-17/2013	Macon	debris flow			Property damage; unstable slope remained
Villages of Plott Creek - Hertwig	1/14-17/2013	Haywood	debris flow			Damage to development roads; damage to vacant lot
Wren Way Waynesville	2/4/2013	Haywood	debris slide - flow			Damage to home; Litigation over Waynesville water line leak
Spring Valley (Weaver Bethel)	5/6/2013	Haywood	debris slide			Property damage and damage to development roads
Evergreen Farm Trail	5/8/2013	Haywood	debris slide			Property damage; cut slope in debris deposit
Dandelion Drive	5/23/2013	Jackson	earth-debris slide			Community access road threatened
Baker Wilderness Trail	2004, 2013	Buncombe	earth-debris slide residuum			Property damage; back yard subsiding; unstable slope remained
Herron Branch	7/4-6/2013	Jackson	debris flow			Development road damaged; property damage; debris dams remained in stream channel
Jump Cove	4/1/2013	Buncombe	debris slide			Severe damage to home
Roberts Hill Road	4/27-28/2013	Madison	debris slide			Mobile home destroyed and property damage
Norfolk Southern RR	5/6/2013	McDowell	debris slide-flow	1		1 fatality after reports of landslide in area

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Blue Ridge Parkway Tanbark	2013	Buncombe	debris slide			Business temporarily closed
Shadow Lane	7/18/2013	Haywood	debris slide residuum			Driveway damaged; community road inaccessible
Bills Mountain II	2006, 2013(?)	Rutherford	debris flow			Road, lots damaged in Bills Mtn.; failed onto existing weathered rock slide downslope
Bills Mountain III	05/04-06/2013	Rutherford	debris flow			Road, lot damaged in Bills Mtn. Damage to drinking water source of downstream owner
Bills Mountain IV	201?	Rutherford	debris flow			Road, lots damaged in Bills Mtn.
Bills Mountain V	2013	Rutherford	debris flow			Road, lots damaged in Bills Mtn.
Bills Mountain VI	05/04-06/2103	Rutherford	debris flow			Road, lots damaged in Bills Mtn. ; Cut failure in toe of active weathered rock slide
Hawks Ridge 1, 2, 3	1/14-17-2013	Jackson	debris flow			Property damage; development road damaged; unstable slope remained
145 Black Oak Drive	7/5/2013	Buncombe	debris slide-flow			Condemned home demolished; road blocked and unstable slope remained
194 Embankment Failure	7/4-6/2013	Avery	debris slide-flow			Major damage to U.S. 194, home reported destroyed, other properties damaged
Kelley - Esmeralda Inn	5/5/2013	Rutherford	debris flow			Road embankment failure in Cliffside development; paved area not damaged; sedimentation into creek and property of the Esmeralda Inn
Hidden Meadows Helton	xx/xx/2013	Henderson	debris slide			embankment failure resulted I 110-foot long crack in pavement with approx. 2 inches of vertical displacement
Blue Ridge Parkway, NC Segment	09/06-08/2004	McDowell	debris flow			Parkway closed for extended period for major repairs of embankment and cut slope failures

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Blue Ridge Parkway, NC Segment	09/06-08/2004	Transylvania, McDowell	weathered rock slide, debris slide			Parkway closed for extended period for major repairs of embankment and cut slope failures
Blue Ridge Parkway, NC Segment DMR-007	x/x/2006 x/x/2009		weathered rock slide			Slide movement in 2002, and noted again in 2004. 2009 -Bulge in pavement, unstable slopes above BRP at tunnel portal
Bateman	xx/xx/2013	Buncombe	subsidence-debris slide			Subsidence and scarps in embankment; some affecting deck supports; homeowner reported previous failure in 2004 below current area of subsidence
Dry Falls	various	Macon	rockfall			numerous small rockfall boulders in area of overhang, no known damage to trail, no known injuries
Bridal Veil Falls	12/xx/2003	Macon	rockfall			2003 rockfall blocked and damage to road beneath Bridal Veil Falls; later rockfall did not hit road, fell on inside shoulder beneath overhang
187 Settacoo	01/14-17/2013	Swain	debris slide			Foundation and porch damage
John Bull	01/14-17/2013	Jackson	debris slide			Slope damage below driveway
Long View	01/14-17/2013	Jackson	debris slide			Retaining wall to repair initial embankment failure was cracked
Parrot Cut Slope	x/x/2014	Macon	rockfall			Minor rockfall and ravel behind retaining wall
High Cliffs - Old Fort Road	01/14-17/2013	Buncombe	debris flow			debris flow deposited material onto property; previous property owner reported damaged RV camper; damage to High Cliffs road, and material deposited onto Old Fort Road.
Spruce Pine - Toe River Tire 2	12/3/2015	Mitchell	rockslide			Damage to west side of main building, wall collapse; Owner reported to have decided to relocate business

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Rhododendron Drive	08/xx/2014	Buncombe	debris slide			Slide scarps along edge of driveway; potential damage to properties down slope
Mill Creek	12/24/2105	Macon	debris flow			Backyard with landscaping and deck damaged; sediment onto road and properties below; building inspector issued a no-occupancy order for home where failure originated.
Azalea Ridge	12/24/2015	Macon	debris flow			Damage to development road and downslope property
Florida Hills	12/24/2108	Macon	blowout - debris flow			Sediment against house, but no major structural damage; damage to private road
The Ridges	12/24/2015	Clay	debris flow			Development roads damaged in three locations; access to private residence blocked for several months
Mill Creek Road	10/3/2015	McDowell	weathered rock slide			Cut slope failure with debris slide and minor debris flow activity;
Smoky Mountain Country Club	7/5/2013	Swain	debris slides			Sedimentation into downslope properties; retaining wall constructed at site 4
Ridgehaven	7/4/2013	Buncombe	debris slide			Scarp propagated upslope from initial 07/04/2016 cut slope failure: smaller debris slide upslope beneath deck foundation pier
Hiddenite Mine Collapse	9/17/2014	Alexander	weathered rock slide	1		1 person killed in open pit mine wall collapse
Stonegate Coleman	2007, 2016	Buncombe	debris slide subsidence			Minor property damage to landscaped area; no threat to home; sinkhole may be related to buried woody debris
Harahan Train Tracks Trail	2006-2016	Cherokee	subsidence (1); debris slides (3)			Fill (unlikely mine-related) subsidence in driveway; small debris slides in embankments; porch foundation posts tilted

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
West Jefferson	1/17/2017	Ashe	weathered rock slide			Moisture and impact damage to three businesses in shopping center
AVL CCR Fill	9/7/2017	Buncombe	earth slide-flow			Damage to embankment slope of CCR fill - 40-foot long scarp, and seepage from embankment
Skyview Place	10/23/2017	Buncombe	debris slide - flow			Road embankment failure on Skyview Place Rd (City of Asheville jurisdiction) . Sedimentation onto road below; No immediate threat to residences observed
Chimney Rock SP Parking Lot Retaining Wall	10/23/2017	Rutherford	debris flow			60 foot wide section of stone retaining wall collapsed; slide debris onto CRSP access road below. CRSP temporarily closed. Settlement and pavement cracks in the area

Source: NC Department of Environmental Quality

Historically, landslides tend to occur in the same general area where previous landslides have occurred. Therefore, areas that have experienced landslides in North Carolina are prone to experiencing landslides in the future.

Sinkholes

In North Carolina, most sinkholes occur in the southern coastal plain. This is due to the high concentration of limestone in the southern half of the state compared to the relatively sandy soil in the north. Sinkholes are also common in Western North Carolina, and according to a search of local media outlets across the state, the area has experienced more than 40 sinkholes over the past 20 years. The following are examples of historical sinkhole events that have occurred in North Carolina, but many additional sinkholes have occurred, damaging roads and buildings.

May 27, 2009 – Torrential tropical rains resulted in a sinkhole on a stretch of U.S. 421 in Wilkesboro (Wilkes County), greatly affecting traffic flow in the Triad.

September 14, 2011 – A sinkhole appeared near two homes in Jacksonville (Onslow County) during the heavy rains from Hurricane Irene and continued to grow each time more rain fell.

August 10, 2012 – A large sinkhole closed a small road in Wadesboro (Anson County) near Highway 74 and Highway 52. As a result, three buildings in the area had to close, including a local homeless shelter which required finding temporary housing for the people staying at the shelter.

August 9, 2014 – Heavy rains produced a sinkhole in Hampstead (Pender County) near Azalea and Country Club Road.

August 1, 2016 – A man drove into a weather-related sinkhole on Glenn Road between Club Boulevard and Bundy Avenue in Durham (Durham County). The man was rescued but sustained injuries. The sinkhole stretched from one side of the road to the other and was estimated to be 10 to 15 feet deep.

October 11, 2016 – Rain from Hurricane Matthew created a sinkhole at least one quarter of a mile wide across Bingham Drive in Fayetteville (Cumberland County).

November 27, 2016 – A man was rescued after being stranded in a 12-foot sinkhole in Durham (Durham County). The victim sustained undisclosed injuries after being suck for hours.

October 27, 2017 – A sinkhole formed in a restaurant parking lot in Woodfin (Buncombe County), swallowing part of a small tanker truck. By the next day, the hole had grown to about 20 feet deep, making a large part of the parking lot unusable.

Coastal Erosion

In recent history, North Carolina has experienced many events that have led to beach erosion. In 1996, more than $2 billion worth of property damage was caused by Hurricane Fran, and most of the dunes were wiped out on Topsail Island. Later in September 2003, Hurricane Isabel eroded the beach and caused a 1,700-foot gap in Hatteras Island. The new inlet that was formed cut NC Highway 12 in half and was 24 feet deep in some spots. In 2005, Hurricane Ophelia eroded the beach in the Outer Banks, and parts of Surf City lost 25 feet of beach. A damage assessment reported that 90 percent of beach access stairs in Topsail beach were damaged and destroyed. The same storm caused a new inlet to be formed near Cape Lookout.

3.2.10.5 Changing Future Conditions

Landslides

An increase in the number and intensity of severe storms will result in more frequent heavy rains and flooding. Since heavy rains and flooding can trigger landslides, landslides may occur more often in the future.

Sinkholes

Similar to landslides, sinkholes can be triggered by heavy rains and flooding. An increase in the number and intensity of severe storms, and resulting heavy rains and flooding, may also result in sinkholes developing more frequently.

Coastal Erosion

Weather extremes may negatively affect coastal erosion rates. If continuing extreme storms occur as predicted, shoreline imbalances may happen more frequently. Changing sea levels also affect erosion rates, and these levels are expected to rise globally and locally. Furthermore, as population increases and more people move to coasts, erosion rates are likely to quicken.

3.2.10.6 Impact

Landslides

Landslides may affect large areas at one time, and they can be slow or quick moving. In North Carolina, they have tended to impact the western side of the state more often and have caused 5 injuries and even 8 fatalities in the recent past. The biggest impact from caused by landslides is property damage and loss. In severe cases, landslides have caused damages to roads, impacting transportation between large groups of people. Although they are not easily predictable, landslides have harsher impacts after periods of severe rainfall.

Sinkholes

Sinkholes are relatively unpredictable, which causes greater impacts when they do occur. Historical evidence shows that sinkholes tend to occur in the southeastern part of the state, making impacts much more extreme to homeowners in that area.

Coastal Erosion

While erosion can happen anywhere in North Carolina, greater impacts are generally seen in the eastern part of the state. Many coastal communities are affected by erosion every year, especially after severe storms and during hurricane season. Homeowners of beach front properties may be impacted more than others; in extreme circumstances, some homes have been completely moved to prevent toppling into the ocean. As population continues to increase in coastal areas, the impacts of erosion may become even greater. Although coastal communities try to solve erosion issues by dredging and sandbagging, these are often only temporary solutions to a much more long-term issue.

3.2.10.7 Future Probability

Landslides

Although North Carolina has experienced landslides, most occurrences were not extremely damaging. Most of these events have occurred in the western part of the state, where there is more area with drastic slope changes. Historical data shows that it is unlikely (between 1 and 33.3 percent annual probability) that more landslides will affect North Carolina in the future.

Sinkholes

Sinkholes have also affected parts of North Carolina in recent history, but most of those impacts have been in the southeastern region of the state. While many sinkholes have been relatively small, it is still unlikely (between 1 and 33.3 percent annual probability) that they will continue to affect North Carolina in the future.

Coastal Erosion

The state has shown to be more likely to experience erosion, especially in coastal areas. In areas with faster moving water, such as inlets or coves, erosion is even more probable. Based on historical occurrences, it is unlikely (between 1 and 33.3 percent annual probability) that North Carolina will continue to experience this type of geological hazard.

3.2.10.8 NCEOP Reference

Landslides, Sinkholes, Coastal Erosion

Annex C, Appendix 6, Hazards and Threats

3.2.11 Infectious Disease

3.2.11.1 Description

Communicable, or infectious, 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. The impact of communicable disease can range from the mild effects of the common cold to the extreme lethality of pneumonic plague or anthrax. The public health system in the United States was developed in large part as a response to the often urgent need to respond to or prevent outbreaks of communicable diseases. Through public health methods of disease reporting, vaccinations, vector control, and effective treatments, most communicable 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, even in the most modern of communities. In this section, some of the more significant potential communicable disease concerns are described.

The threats discussed in this section usually do not occur on a regular basis, though some are more frequent. The diseases described herein do not originate from intentional exposure (such as through terrorist actions) but do present significant issues and concerns for the public health community. There are numerous infectious diseases that rarely, if ever, occur in the State of North Carolina, such as botulism or bubonic plague. Some highly dangerous diseases which could potentially be used as biological weapons, such as anthrax, pneumonic plague, and smallpox, are safely housed and controlled in laboratory settings such as at the Center for Disease Control and Prevention (CDC). Other diseases have not (yet) mutated into a form that can infect humans, or otherwise lie dormant in nature.

There have been several significant viral outbreaks from emerging diseases in recent years of both national and international importance. The Zika virus and West Nile virus are viruses that are typically passed to humans or animals by mosquitoes and made major news as emergent disease threats. Meanwhile, diseases that are spread directly between human beings such as Severe Acute Respiratory Syndrome (SARS) and Ebola have also been identified as serious threats. While each of these conditions caused a great deal of public health concern when they were first identified, SARS has virtually disappeared, West Nile virus occurs with low frequency and causes serious disease in only a very small percentage of cases, Ebola has been more or less contained and a vaccine is in development, and many people infected with Zika will not experience symptoms from the disease.

Other communicable diseases pose a much more frequent threat to the citizens of North Carolina. Some of the infectious diseases of greatest concern include influenza, particularly in a pandemic form, as well as norovirus, and multiple antibiotic-resistant tuberculosis. Even in one of its normal year-to-year variants, influenza (commonly referred to as “flu”) can result in serious illness and even death in young children, the elderly and immune-compromised persons. But there is always the potential risk of the emergence of influenza in one of the pandemic H1N1 forms, such as in the “Spanish Flu” outbreak of 1918-19, which killed over 50 million people worldwide. Every year, North Carolina sees hundreds of cases of influenza, leading to hundreds of hours of lost productivity in businesses due to sick employees. Of note, a vaccine for influenza is produced every year and, according to the CDC, is highly effective in preventing the disease.

Norovirus is recognized as 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. Especially vulnerable populations to this virus include those living or staying in nursing homes and assisted living facilities and other healthcare facilities such as hospitals. Norovirus could also be a threat in the event of large public gatherings such as sporting events, concerts, festivals, and so forth. North Carolina often 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.

Public health threats can occur at any time and can have varying impacts. Discussions between public health professionals, planning officials, and first response agencies are essential in order to facilitate safe, effective, and collaborative efforts toward outbreaks.

3.2.11.2 Extent

Extent is difficult to measure for an infectious disease event as the extent is largely dependent on the type of disease and on the effect that it has on the population (discussed above). Extent can be somewhat defined by the number of people impacted, which depending on the type of disease could number in the tens of thousands within the state.

3.2.11.3 Location/Spatial Extent

Infectious diseases can occur in any location and are not easily predictable in terms of where they will occur. Dense concentrations of population may be more susceptible to a widespread outbreak due to the proximity of people to one another, the disease itself could originate anywhere. Due to the nature of the infectious disease threat, it is difficult to identify a precise location where this type of event would occur. Moreover, a large-scale event would have impacts that spread throughout the State. Therefore, all areas in North Carolina are considered equally susceptible to infectious diseases.

3.2.11.4 Hazard History

In 2003, the SARS outbreak that began in Southeast Asia began showing up in the United States. There were three confirmed case of SARS in Georgia in 2003. Since that time there have not been any reported cases of SARS.[30] No cases of Ebola were reported in the State of North Carolina, though several locations in the United States did experience cases.

Vector-Borne Diseases

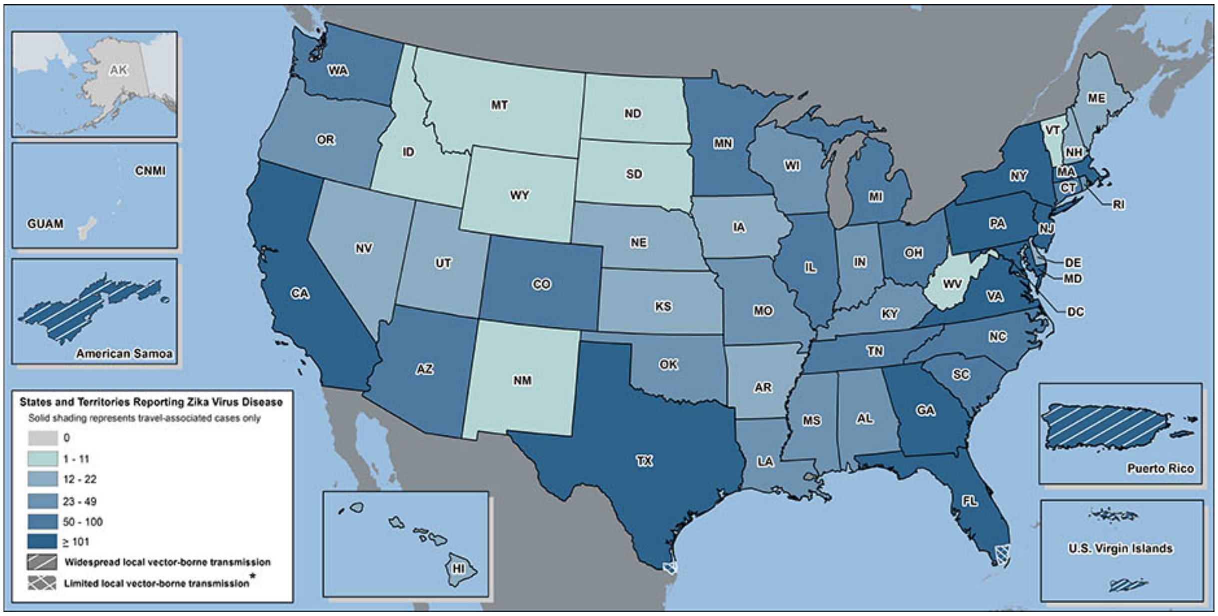
Bacterial, viral and parasitic diseases that are transmitted by mosquitoes, ticks and fleas are collectively called "vector-borne diseases" (the insects and arthropods are the "vectors" that carry the diseases). Although the term "vector" can also apply to other carriers of disease — such as mammals that can transmit rabies or rodents that can transmit hantavirus — those diseases are generally called zoonotic (animal-borne) diseases.

The most common vector-borne diseases found in North Carolina are carried by ticks and mosquitoes. The tick-borne illnesses most often seen in the state are Rocky Mountain Spotted Fever, ehrlichiosis, Lyme disease and Southern Tick-Associated Rash Illness (STARI). The most frequent mosquito-borne illnesses, or "arboviruses," in North Carolina include La Crosse encephalitis, West Nile virus and Eastern equine encephalitis. An outbreak of the West Nile Virus began showing up in the United States in 1999, with North Carolina reporting 63 cases from that time through the end of 2016.

A map showing the number of Zika cases reported in each state in 2016 can be found in Figure 3-43. According to the Centers for Disease Control, there were 97 cases of Zika in the State of North Carolina in 2016, and only five reported cases in 2017.

[30] *Severe Acute Respiratory Syndrome (SARS) Report of Cases in the United States. Centers for Disease Control and Prevention. Retrieved on December 14, 2017 from: https://www.cdc.gov/media/presskits/sars/cases.htm*

Figure 3-43 Number of Zika Cases Reported in 2016 by State

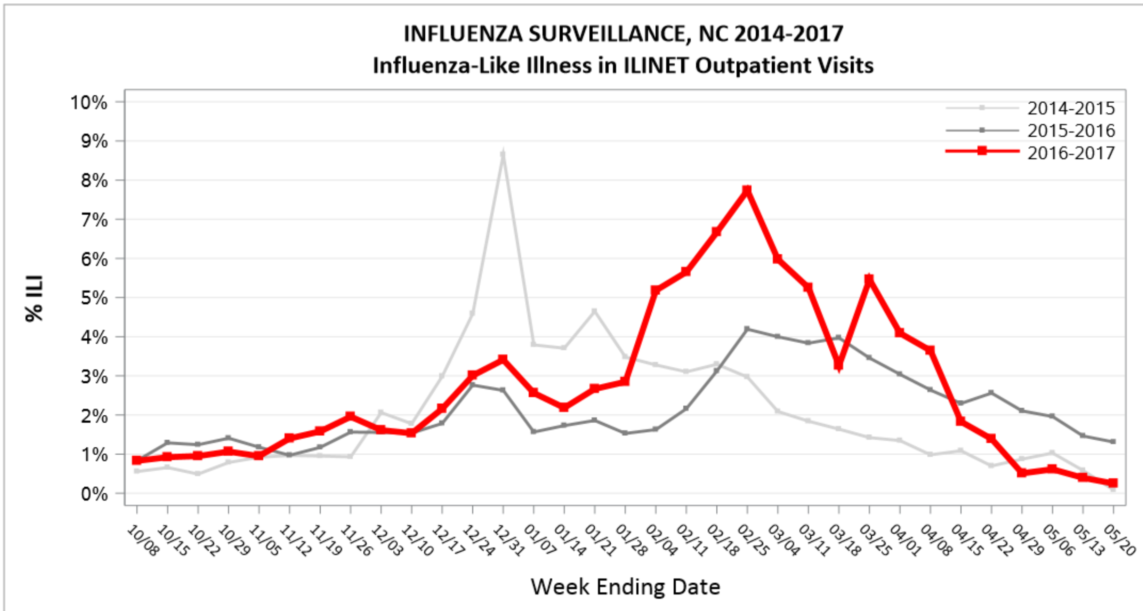


Source: Centers for Disease Control

As stated previously, diseases like influenza and norovirus are regularly occurring health issues in North Carolina. These conditions are not legally reportable to county or state public health agencies, so data on disease incidence is not readily available. These diseases are monitored through local epidemiological surveillance systems in hospitals and health departments and any potential outbreaks are investigated promptly.

Influenza: There were over 452,000 Influenza cases report in North Carolina in the 2016-2017 Flu season, contributing to 219 Influenza related deaths. Most of these deaths occurred between February and April 2017. These events are displayed in Figure 3-44 below.

Figure 3-44 Influenza Surveillance, NC 2014-2017



Source: http://www.flu.nc.gov/

3.2.11.5 Changing Future Conditions

There have been many studies conducted between climatic conditions and infectious diseases, and trends show there is a link. Many diseases, such as malaria, dengue fever, and yellow fever are spread through mosquitoes that reproduce and thrive in warm, wet conditions. According to the World Health Organization, Malaria epidemic risk has shown to increase nearly five-fold after El Niño events; therefore, if warming surface temperatures and increased precipitation trends continue, North Carolina may be more susceptible to disease occurrence.

3.2.11.6 Impact

There have already been two reported deaths for the 2017-2018 Flu season.

Economic Impact: Influenza also has negative effects on the North Carolina economy. It accounts for 7-10 lost work days per case, and there were over 3 million combined lost work days during the 2016-2017 Flu season.

3.2.11.7 Future Probability

It is difficult to predict the future probability of infectious diseases due to the difficulty with obtaining information on this type of hazard. The most common and probable disease in the state has shown to be influenza; however, 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 future.

3.2.11.8 NCEOP Reference

Annex B, Appendix 6, Communicable Disease and Biohazard Response Plan
Annex C, Appendix 6, Hazards and Threats

3.3 TECHNOLOGICAL HAZARD IDENTIFICATION

3.3.1 Hazardous Substances

3.3.1.1 Description

Hazardous Materials

For the purposes of this plan, NCEM defines a hazardous substance as any element, chemical, substance, compound, mixture, agent, solution or substance that an accidental or deliberate release of may cause disease or harm to human health and the environment. Hazardous substances may have one or more of the following intrinsic properties: explosiveness, flammability, ability to oxidize (or accelerate a fire), human toxicity, or corrosiveness. Hazardous materials are found in many different forms and quantities that can potentially cause property damage, injuries, long-lasting health effects, and death. Many of these materials are used and stored on a daily basis in homes and businesses, and transported through major highways, waterways, pipelines, and railways. Each hazard has a different threshold level and can be naturally occurring, which creates many risks in the event of an emergency.

Hazardous material (HAZMAT) incidents consist of solid, liquid and/or gaseous contaminants that can occur at fixed facilities or mobile sources. Many HAZMAT emergencies result from accidents or negligent behavior, but some may be purposefully designed, such as a terror attack. These incidents can be acute or long-lasting and can cause fires or explosions, potentially affecting vast populations of people and wildlife.

HAZMAT incidents may also be a result of natural hazard events, such as hurricanes, earthquakes, or floods. In these circumstances, response efforts may be hindered, which can intensify the disaster. An example of this occurred after Hurricane Floyd hit North Carolina in 1999; many communities were left with flooded junkyards, deceased livestock, disturbed cemeteries, along with environmental pollutants such as uncontrolled fertilizer spills and floating propane tanks.

In 1984, a chemical plant leak in Bhopal, India resulted in the death of thousands of people. Approximately six months later, a similar incident occurred in West Virginia. These two events raised concerns about community preparedness in the event of a chemical emergency, which led to the establishment of the Emergency Planning and Community Right-To-Know Act (EPCRA) in 1986. This act has created requirements for local, state, and federal governments in the event of toxic chemical emergencies, which include planning and response efforts. The information is available to the public to increase awareness and protect public and environmental health. Furthermore, emergency notification requirements call for the release of specific information, including the name of the released chemical, quantity released, method of release (air, water, and/or land), anticipated health risk involved, proper precautions, and emergency contact information. More information about EPCRA can be found here: https://www.epa.gov/epcra/what-epcra

3.3.1.2 Extent

The extent of hazardous materials incidents can be defined in terms of the amount of material releases. The United States Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains a database of reported mobile hazardous materials incidents. According to that database, the largest release of a hazardous substance in North Carolina occurred in Hertford County in 1978 when 187,000 LGA units of gasoline was released during a highway HAZMAT incident.

Measuring extent of hazardous substance accidents is difficult because there are so many different types of hazardous substances. EPCRA reporting requirements have led to the publication of a consolidated list of chemicals subject to EPCRA, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Clean Air Act that can be accessed by anyone online at: https://www.epa.gov/sites/production/files/2015-03/documents/list_of_lists.pdf

The EPA's List of Lists also provides the threshold for the quantities of materials that must be reported by facilities if those materials are stored on-site. These thresholds, by hazardous material, can also be considered hazard extents for hazardous materials.

3.3.1.3 Location/Spatial Extent

Most fixed HAZMAT operations in North Carolina are in rural areas, away from large cities. However, many mobile HAZMAT emergencies occur from transportation accidents on major highways and railways in metropolitan areas. "Hot spots" have been identified and tend to happen in heavily populated areas. Some of these locations are recorded by the Department of Transportation and can be accessed at: https://www.phmsa.dot.gov/

As a result of the 1986 accidents and establishment of EPCRA, the Environmental Protection Agency publishes some hazardous material information for the public. The EPA collects information from industrial facilities when toxic agents are released and/or transferred, and this data is reported to the Toxic Release Inventory (TRI). According to the EPA, in October 2017 there are 776 TRI facilities in North Carolina. These facilities are mapped in Figure 3-45.

Figure 3-45 TRI Facilities in North Carolina

Another source of location data for hazardous materials facilities includes SARA Tier II facilities reported to the EPA as part of the agency's Risk Management Plan rules (not available to the public).

3.3.1.4 Hazard History

For mobile HAZMAT incidences, the PHMSA database of hazardous materials incidents indicates that for North Carolina, there have been 20,312 reported incidents dating back to 1971. This accounts for reported previous occurrences of mobile HAZMAT events than for any other hazard event types combined.

There is no known database of fixed facility HAZMAT incidents.

3.3.1.5 Changing Future Conditions

Some HAZMAT emergencies may be triggered by natural disasters and changing climatic conditions may cause more extreme weather events. Furthermore, as North Carolina's population continues to grow, more people become increasingly vulnerable to incidents involving hazardous substances. Therefore, it is important to critically monitor all hazardous fixed facilities and transportation routes and continue to attempt to prevent future incidents from occurring through continued preparedness, monitoring and training.

3.3.1.6 Impact

HAZMAT accidents can potentially affect large populations of people and wildlife. Impacts may go unnoticed for several hours, days, or weeks depending on the substance released, which can cause long-term effects. Although impacts can be widespread, the most vulnerable populations tend to be localized near the following: railroads, pipelines, highways, and/or fixed facilities.

3.3.1.7 Future Probability

Unfortunately, there isn't a "typical" type of HAZMAT emergency. While most incidents are the result of negligent behavior, transportation accidents or criminal acts, it is difficult to predict the probability or type of a future occurrence. However, due to historical occurrences, people living along major highways or near HAZMAT operations may be most at risk. North Carolina is known to have one of the best HAZMAT response teams in the country, but it is still highly likely (between 66.7 and 100 percent annual probability) that a hazardous materials incident may occur in any given year.

3.3.1.8 NCEOP Reference

Annex B, Appendix 5, Oil-Petroleum Products Spill Response Plan
Annex C, Appendix 6, Hazards and Threats

3.3.2 Radiological Emergencies – Fixed Nuclear Facilities

3.3.2.1 Description

A nuclear and radiation accident is defined by the International Atomic Energy Agency as "an event that has led to significant consequences to people, the environment or the facility. Often, this type of incident results from damage to the reactor core of a nuclear power plant, which can release radioactivity into the environment. The degree of exposure from nuclear accidents has varied from serious to catastrophic.

The Radiation Emergency Preparedness (REP) program, which was established in 1979 after a nuclear accident at Three Mile Island Nuclear Generating Center, coordinates the national effort to state and local governments with mitigation strategies involving nuclear power plants. The program deals with fixed nuclear facilities (FNF) within or having a portion of the 10-mile Emergency Planning Zone (EPZ) within the country, including North Carolina. More information about the REP Program can be found here: https://www.fema.gov/radiological-emergency-preparedness-program

Globally, there are around 430 operational reactors, and 200 of them are expected to retire by the year 2040 (Source: IEA). However, in North Carolina, nuclear energy contributed the largest share of the state's electricity generation in 2016 with 32.5%. The state also produced 5.3% of the nation's total electricity from nuclear power in 2016, ranking fourth in the nation. (Source: https://www.eia.gov/state/?sid=NC).

Harris Nuclear Plant

The Harris Nuclear Plant is located in New Hill, North Carolina, about 20 miles south west of Raleigh. It commenced operation on May 2, 1987 and its current license of operation expires in 2046. The plant staffs approximately 800 people and generates electricity for more than 550,000 homes in the surrounding areas[31].

[31] *https://www.duke-energy.com/our-company/about-us/power-plants*

Figure 3-46: Harris Nuclear Plant

Source: https://www.nrc.gov/info-finder/reactors/har1.html

The plant is surrounded by North Carolina's "triangle" region, which includes Raleigh, Durham, and Chapel Hill. Located within a half hour of the plant, Research Triangle Park (RTP) is the nation's leading and largest technology research and science park. Raleigh-Durham International Airport is around 25 miles away, and three of the state's largest universities (Duke, NC State, and UNC-Chapel Hill) are also in the same area.

As of September 2017, the Harris Nuclear Plant is one out of three of the only plants in the country to have no NRC findings; therefore, there have been no hazardous occurrences reported in recent history.

The following counties are located within a 50-mile radius of the plant's center:

- Wake
- Franklin
- Durham
- Orange
- Chatham
- Granville
- Harnett
- Johnston
- Sampson
- Cumberland
- Lee
- Moore
- Randolph
- Guilford
- Alamance
- Caswell
- Person
- Vance
- Nash
- Wilson
- Wayne
- Duplin
- Hoke
- Montgomery

Brunswick Nuclear Plant

The Brunswick Nuclear Plant is located just north of Southport, North Carolina on the Cape Fear River. The plant is a two-unit boiling water reactor location, and the units commenced operation in 1975 and 1977. This was the first nuclear power plant built in North Carolina and it has a capacity of 1,870 megawatts.

Figure 3-47: Brunswick Nuclear Plant

Source: https://www.nrc.gov/info-finder/reactors/bru1.html

Covering 1,200 acres, the plant is less than thirty miles outside of downtown Wilmington, and less than forty miles from Wrightsville Beach. It is also adjacent to many woodlands, wetlands, and the Atlantic Ocean. Its proximity to tourist destinations make the surrounding areas very economically and environmentally vulnerable, and the nearby populations are steadily increasing[32].

[32] *https://www.census.gov/quickfacts/fact/table/wilmingtoncitynorthcarolina/PST045216*

The following counties are located within a 50-mile radius of the plant's center:

- Pender
- New Hanover
- Brunswick
- Onslow
- Columbus
- Bladen
- Sampson

McGuire Nuclear Station

The McGuire Nuclear Station is located on Lake Norman in Mecklenburg County, about 17 miles north of Charlotte. Lake Norman was built by Duke Energy in 1963 and is the state's largest man-made lake. The first unit of the station commenced operation in 1981, and the second in 1984. It has a capacity to produce 2,316 megawatts of power and employs more than 1,200 employees[33].

Figure 3-48: McGuire Nuclear Station

Source: https://www.nrc.gov/info-finder/reactors/mcg1.html

The plant lies in between North Carolina's largest city, Charlotte, and the Hickory/Statesville area. These highly populated nearby cities are home to many universities, big industries, and airports. In Charlotte alone, the population rose by 1.8% from 2015-2016, and population and employment are continuing to increase[34]. As more people move to the surrounding area, the population is therefore more vulnerable to potential emergencies at the McGuire Nuclear Station.

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[33] *https://nuclear.duke-energy.com/2013/06/25/mcguire-nuclear-station-focuses-on-operational-excellence-and-community-outreach*
[34] *https://datausa.io/profile/geo/charlotte-nc/*

The following counties are located within a 50-mile radius of the plant's center:

- Iredell
- Wilkes
- Rowan
- Davidson
- Davie
- Forsyth
- Yadkin
- Lincoln
- Mecklenburg
- Catawba
- Cabarrus
- Anson
- Montgomery
- Stanly
- Randolph
- Union
- Gaston
- Burke
- Caldwell
- Alexander

The following fixed nuclear facilities are located outside of the state, but have 50-mile emergency management zones that affect North Carolina:

- Catawba Nuclear Station
- H. B. Robinson Nuclear Generating Station
- Oconee Nuclear Station
- Watts Bar Nuclear Plant
- Virgil C Summer Nuclear Generating Station
- Sequoyah Nuclear Plant
- Surry

Catawba Nuclear Station

The Catawba Nuclear Station is located on Lake Wylie in York County, South Carolina; however, it is jointly owned by North Carolina Municipal Power Agency Number One. Its first unit began operating in 1985, followed by the next unit in 1986. It has a capacity for 2,290 megawatts of power, and is only 11 miles southwest of Charlotte, NC[35].

[35] *https://www.duke-energy.com/our-company/about-us/power-plants*

Figure 3-49: Catawba Nuclear Station

Source: https://www.nrc.gov/info-finder/reactors/cat1.html

The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Mecklenburg
- Gaston
- Lincoln
- Cabarrus
- Iredell
- Stanly
- Rowan
- Union
- Rutherford
- Cleveland
- Burke
- Anson
- Catawba

H.B. Robinson Nuclear Generating Station

The H.B. Robinson Nuclear Generating Station is located in Hartsville, South Carolina. It began operation in 1970, and renewed its contract in 2004.

Figure 3-50: H.B. Robinson Nuclear Generating Station

Source: https://www.nrc.gov/info-finder/reactors/rob2.html

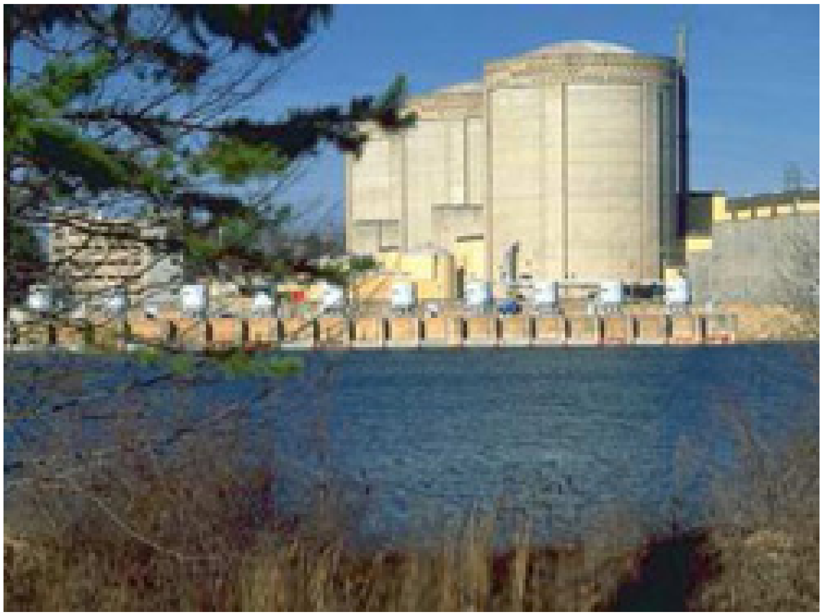
The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Union
- Richmond
- Robeson
- Anson
- Scotland

Oconee Nuclear Station

The Oconee Nuclear Station is located near Seneca, South Carolina. It began operation in 1973 and is currently operating under a renewed license until 2033. With three nuclear stations, it is one of the nation's largest nuclear plants.

Figure 3-51: Oconee Nuclear Station



Source: https://www.nrc.gov/info-finder/reactors/oco1.html

The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Clay
- Macon
- Jackson
- Transylvania
- Henderson
- Polk
- Buncombe
- Haywood
- Swain

Surry Power Station

The Surry Power Station is located in Surry, Virginia, about 17 miles away from Newport News. Its license of operation was issued in 1972 and is currently operating under a renewed license until 2032. The plant generates enough power for 420,000 homes.

Figure 3-52: Surry Power Station

Source: *https://www.nrc.gov/info-finder/reactors/sur1.html*

The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Gates
- Pasquotank
- Hertford
- Camden
- Northampton
- Currituck

Watts Bar Nuclear Plant

The Watts Bar Nuclear Plant is located in Spring City, Tennessee, about 60 miles from Knoxville. It first began operation in 1996, and recently commenced a second unit in 2016. It is currently licensed to operate until 2055.

Figure 3-53: Watts Bar Nuclear Plant

Source: *https://www.nrc.gov/info-finder/reactors/wb2.html*

The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Cherokee
- Swain
- Graham

Sequoyah Nuclear Plant

The Sequoyah Nuclear Plant is located in Soddy-Daisy, Tennessee near Chattanooga. The plant received its operating license in 1980 and is scheduled to remain operational until 2020.

Figure 3-54: Sequoyah Nuclear Plant

Source: https://www.nrc.gov/info-finder/reactors/seq1.html

The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Cherokee

Virgil C. Summer Nuclear Station

The Virgil C. (V.C.) Summer Nuclear Station is located in Jenkinsville, South Carolina. It has a combined license that was issued in 2012.

Figure 3-55: V.C. Summer Nuclear Station

Source: https://www.nrc.gov/info-finder/reactors/sum2.html

The following North Carolina counties are located within a 50-mile radius of the plant's center:

- Union

3.3.2.2 Extent

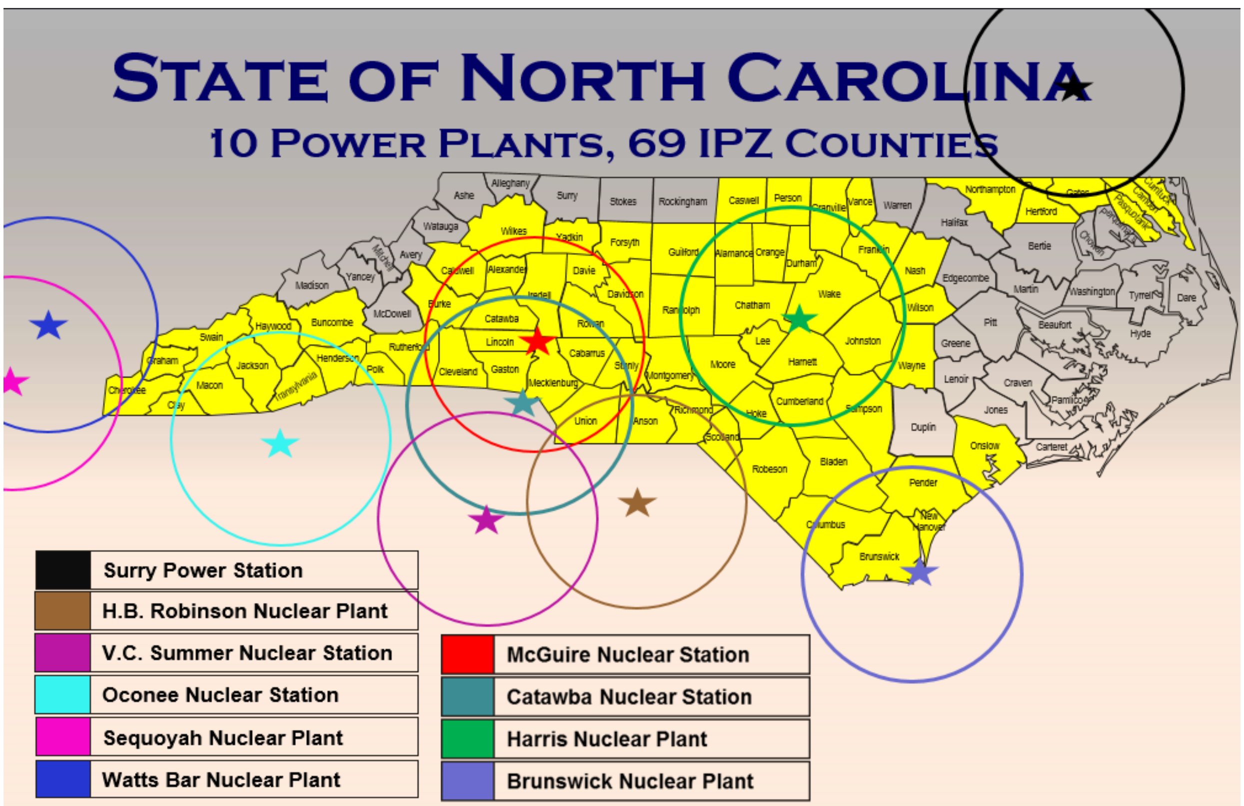
Only 31 of North Carolina's 100 counties are not located in ingestion pathway (IPZ) from a nuclear facility. The primary focus of the REP is on the four nuclear power plants that are located in the state and/or surrounding EPZ counties, which are:

- Brunswick NPP - Brunswick & New Hanover Counties
- Harris NPP - Wake, Chatham, Lee, and Harnett Counties

- McGuire NS - Mecklenburg, Gaston, Lincoln, Catawba, and Iredell Counties
- Catawba NS - Mecklenburg, and Gaston Counties

The program also supports the EPZ planning for Sequoyah, Watts Bar, Oconee, Summer, Robinson, and Surry facilities located in adjacent states and monitor the research reactor, NCSU PULSTAR in Wake county and Fuel Rod Fabrication Facility at Global Nuclear in New Hanover County. The following figure displays all nuclear power plants in North Carolina and those within 50 miles of the border. (See Figure 3-56)

Figure 3-56 North Carolina Radiological Emergency Preparedness



Source: NC Emergency Management

The EPZ represents the time critical decision area where concern for safety of the general public and emergency workers drives emergency management decision making. The goal is to protect the health and safety of the public living in the vicinity of the nuclear power facility by providing reasonable assurance that appropriate protective measures can be taken offsite in the event of a radiological emergency. In North Carolina, each nuclear facility has two planning zones. A ten-mile radius around each plant would be expected to evacuate in the event of an emergency (Figure 3-56). Secondly, the Ingestion Pathway Zone (IPZ) is a 50-mile radius zone. The IPZ has been designed to mitigate contamination of the human food chain by a radiological accident at a nuclear power plant. The ingestion pathway is characterized by radionuclides being deposited on surfaces, potentially contaminating foods such as milk, fresh vegetables, and water supplies.

Historically, there have been no major release events at North Carolina REP facilities and one reported situation where the nuclear material was being monitored for criticality that occurred within the in 2008 at the fuel rod fabrication facility. The probability is considered very unlikely due to the extensive accident prevention and emergency preparedness programs that these facilities support. The consequence of the worst-case scenario is considered catastrophic.

Concerns that an event at a REP facility may impact the continuity of response operations has led to planning changes over the past few years where these facilities have moved response equipment storage areas and other facilities outside the 10-mile EPZ. While it would be likely that a major event could impact local Emergency Operations Centers (EOCs) in some jurisdictions, these could be relocated or transferred to the State EOC if needed, given the long time-scales for these events. With these improvements, an event at a REP facility would be expected to have a minor impact on continuity of operations. Due to the nature of the hazard and the general over estimation of the radioactive hazards by the public a significant event at a nuclear facility would present a challenge to public confidence. To increase mitigation, State and local governments are also required to conduct off-site radiological emergency preparedness activities within the EPZs of all nuclear power facilities every two years. An updated schedule of activities for 2018 can be found here: https://www.fema.gov/radiological-emergency-preparedness-program-exercise-evaluation-calendar

Existing REP plans are believed to have adequate measures in place to address these concerns.

In summary:

- The REP program has primary responsibility for preparedness for four fixed nuclear facilities that are in or may significantly impact the state.
- An additional 6 facilities have portions of the 50-mile IPZ within the state.
- A test reactor and fuel rod assembly facility are monitored by the program.

The NRC

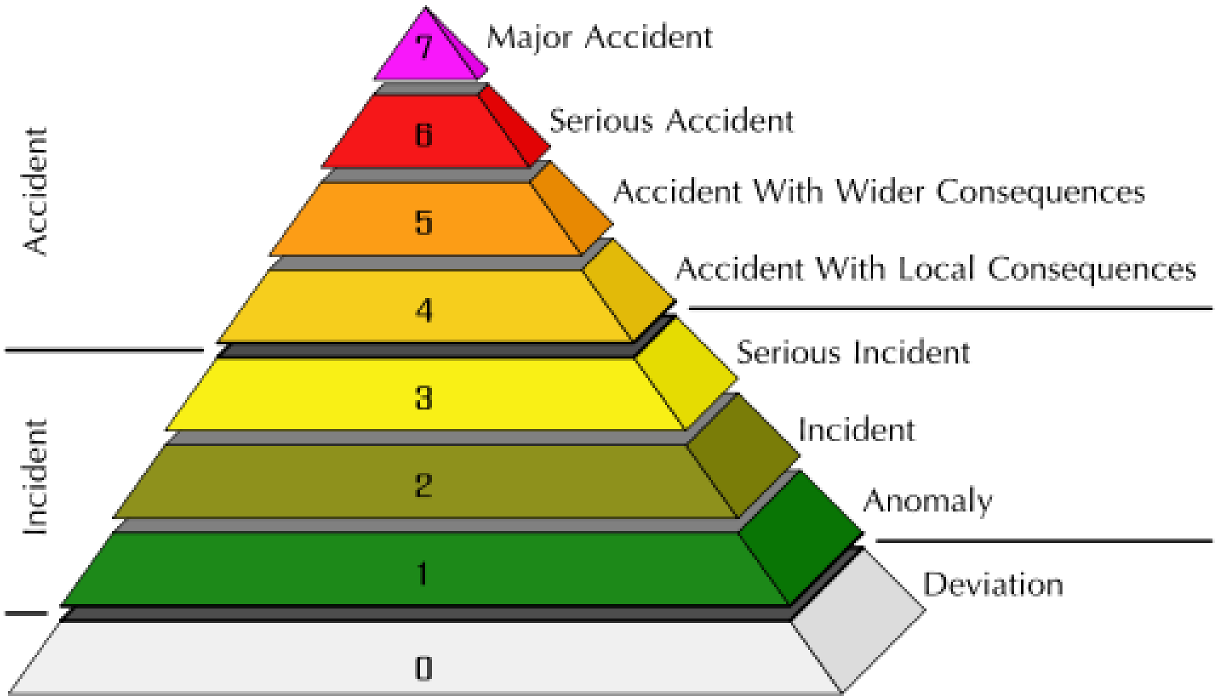
The US Nuclear Regulatory Commission (NRC) is an agency that was formed by Congress in 1974 to ensure the safe use of radioactive materials. The NRC regulates commercial nuclear power plants and other uses of nuclear materials. The agency is headed by commissioners that formulate policy, issue orders, and enforce regulations.

The IAEA

The International Atomic Energy Agency (IAEA) is an agency that was established in 1957 in response to fears and expectations associated with nuclear technology. Its statute was unanimously approved by 81 nations in 1956 as the world's "Atoms for Peace" organization to promote safe, secure, and peaceful nuclear technologies.

The IAEA has developed a scale called the International Nuclear and Radiological Event Scale (INES) which provides a quantifiable means of assessing the extent of a nuclear event. This scale uses a logarithmic which means that each increasing level on the scale represents an event 10 times more severe than the previous level.

Figure 3-57 International Nuclear and Radiological Event Scale

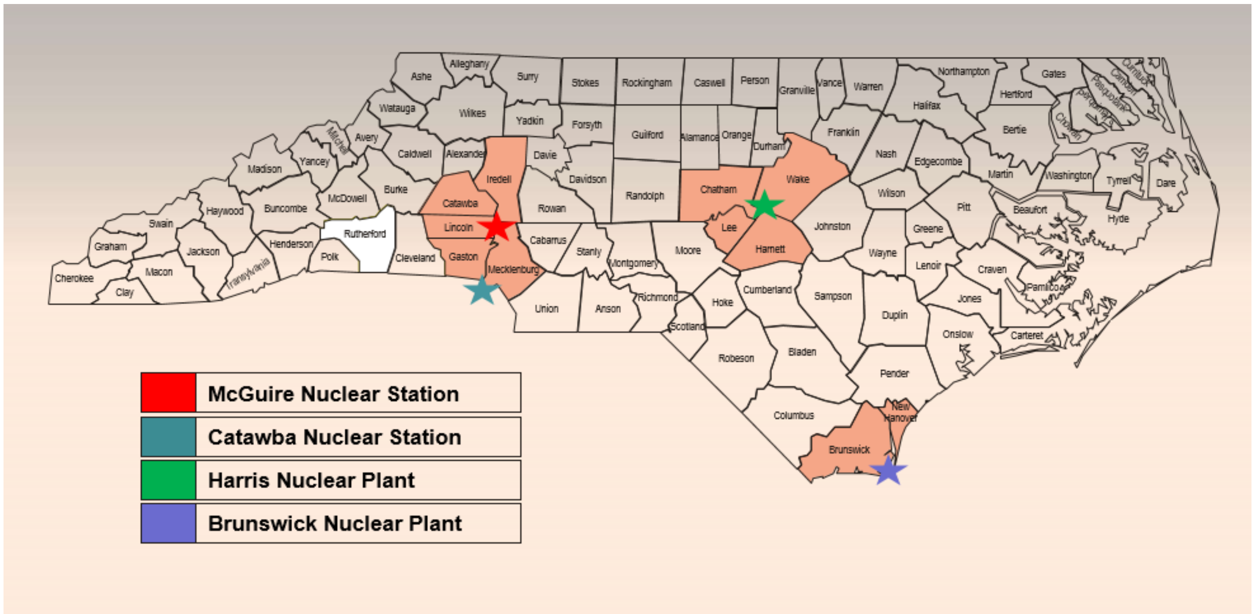


Source: International Atomic Energy Association

3.3.2.3 Location/Spatial Extent

There are 4 nuclear power plants in North Carolina, which are displayed in Figure 3-46. In the event of an emergency, areas surrounding these plants would be the most affected areas; however, farther areas could potentially be harmed as well, depending on natural factors such as wind direction.

Figure 3-46 Nuclear Power Plants within a 10-mile EPZ in North Carolina



Source: NC Emergency Management

3.3.2.4 Hazard History

Although North Carolina has no history of major radiological emergencies, the State still prepares for the worst-case scenario. Much radiological concern came after the deadly emergency that struck Japan in March 2011. After a 9.0 earthquake and tsunami hit the Fukushima Dai-ichi Nuclear Power Plant, radioactive material was released and transported globally, even reaching parts of the US. Immediately after the earthquake, the US Center for Disease Control (CDC) activated its Emergency Operations Center (EOP) in anticipation of effects spreading across the country. While high levels of contaminants did not reach the US Pacific Coast, there was still fear of American interactions with Japan and the possibility of cross-contamination. The CDC worked, and still works, with federal, state, and local governments to provide public health protective action recommendations in the event of a similar emergency.

3.3.2.5 Changing Future Conditions

Although North Carolina has not recently experienced nuclear catastrophes, severe weather is one of the causes of potential harm to nuclear facilities. The possibility of extreme weather due to changing climatic conditions is increasing, so it is critically important to continue to monitor radiological facilities in the state.

North Carolina’s population growth is also a concern for nuclear emergencies; as the population increases, more people become subject to radiological effects. In the event of a disaster, millions of people could be harmed or killed. This growth is especially apparent in the areas surrounding the Harris Nuclear Plant, which is partially due to technological advances and increasing employment at Research Triangle Park. As more people move to or commute to the area, they are also more susceptible to a hazardous event occurrence.

The NRC and local governments study and develop evacuation time estimates (ETEs), which are part of the planning basis for each nuclear power plant. They are required to be performed to estimate the time needed to evacuate the public in the event of a disaster, and they are updated based on population growth near nuclear facilities. In North Carolina, the most recent ETE update took place in 2017 because of population booms. The number of Wake County residents in a 10-mile zone of a nuclear facility rose from 84,654 in 2008 to 118,967 in 2017. As the state’s population continues to grow, it will be important to advance mitigation strategies as well.

3.3.2.6 Impact

The impacts of a nuclear emergency could potentially be catastrophic. Radioactive contamination can spread quickly, or immediately by explosion, putting millions of people at risk. However, it is also important to consider the agricultural and economic impacts of an emergency.

One of North Carolina’s main economic resources is agriculture, and many people’s jobs are dependent upon the land. North Carolina’s agricultural economy would clearly be acutely impacted after an emergency, but the effects would be long-lasting; land would continue to be unusable for years and possibly even decades. The Price-Anderson Nuclear Industries Indemnity Act (commonly known as the Price-Anderson Act) is a Federal law that was passed in 1957 to address this type of issue. The Act’s purpose is to provide compensation for nuclear radiological emergencies and can offer $12.6 billion to a state in need. This money is financed through reactor companies themselves, and any emergencies that require more monetary compensation would require Congressional approval.

While nearly $13 billion may seem like a huge compensation, it would not be enough to keep the state’s economy afloat. Furthermore, initial funding is not available until 3-5 days after the event. Contaminated land could completely ruin the industry for North Carolina, the nation’s leading producer of tobacco and sweet potatoes. Therefore, it is crucial to consider how a radiological emergency could impact the state’s agriculture and economy and to do everything necessary to prevent one from occurring. Guidance should also be developed to cover funding gaps for the public.

3.3.2.7 Future Probability

The future incidence of radiological hazards is highly unpredictable. Conditions may be localized or widespread, and no historical data is available, making it difficult to determine the future probability of emergency conditions with any accuracy. However, based on historical evidence, the likelihood that North Carolina will experience a radiological emergency in the near future is unlikely (between 1 and 33.3 percent annual probability).

3.3.2.8 NCEOP Reference

3.3.3 Terrorism

3.3.3.1 Description

Terrorism is defined in the United States by the Code of Federal Regulations is “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.” Terrorist acts may include assassinations, kidnappings, hijackings, bombings, small arms attacks, vehicle ramming attacks, edged weapon attacks, incendiary attacks, cyber-attacks (computer based), and the use of chemical, biological, nuclear and radiological weapons. For the purposes of this plan, cyber-attacks are included as a separate hazard.

Historically the main categories of weapons of mass destruction (WMDs) used in terror attacks are Chemical, Biological, Radiological, Nuclear, and Explosive (collectively referred to as CBRNE). As we rank these categories, considering immediate danger posed, impact, probability, technical feasibility, frequency, and historical success, they are typically ranked in the following way.

Explosive – Explosive attacks lead all others due to their immediate danger to life and health, immediate and measureable impact, high probability, low cost/easy degree of technical feasibility, and a long history of successful attacks.

Chemical - Chemical attacks can pose immediate danger to life and health depending upon the materials used. Chemicals are easy to access, low cost, and easy to deploy. Chemical terrorism can have high and persistent impacts to people and places. These types of attacks are probable and have enjoyed historical success.

Radiological – Radiological attacks can pose significant threats to life and health depending upon the specific materials used. Radiological materials while restricted and regulated are accessible to people with some knowledge in this discipline. While radiological incidents have occurred, they occur less frequently than explosive and chemical attacks.

Biological – Biological attacks can pose significant threats to life and health. They are typically deployed as diseases and bio-toxins. They require some degree of technical expertise in order to be deployed successfully. While biological incidents have occurred, they occur less frequently than explosive and chemical attacks.

Nuclear - While yielding a very high impact, the Nuclear attack is extremely rare due to the fact that it is cost prohibitive and very technically difficult to achieve. This type of attack, however, could be state sponsored which makes it viable.

OTHER - Terrorism Hazard Assessment must also account for modern trends and changes. An additional “OTHER” category should be considered that includes small arms attacks, vehicle ramming attacks, edged weapon attacks, and incendiary attacks.

3.3.3.2 Extent

A terror threat could potentially occur at any location in the State. However, the very definition of a terrorist event indicates that it is most likely to target people as well as critical or symbolic locations. Ensuring and protecting the continuity of critical infrastructure and key resources (CIKR) of the United States is essential to the Nation's security, public health and safety, economic vitality, and way of life. CIKR includes physical and/or virtual systems or assets that, if damaged, would have a detrimental impact on national security, including large-scale human casualties, property destruction, economic disruption, and significant damage to morale and public confidence. Table 3-24 shows the U.S. Department of Homeland Security's (DHS) identified main critical infrastructure sectors.

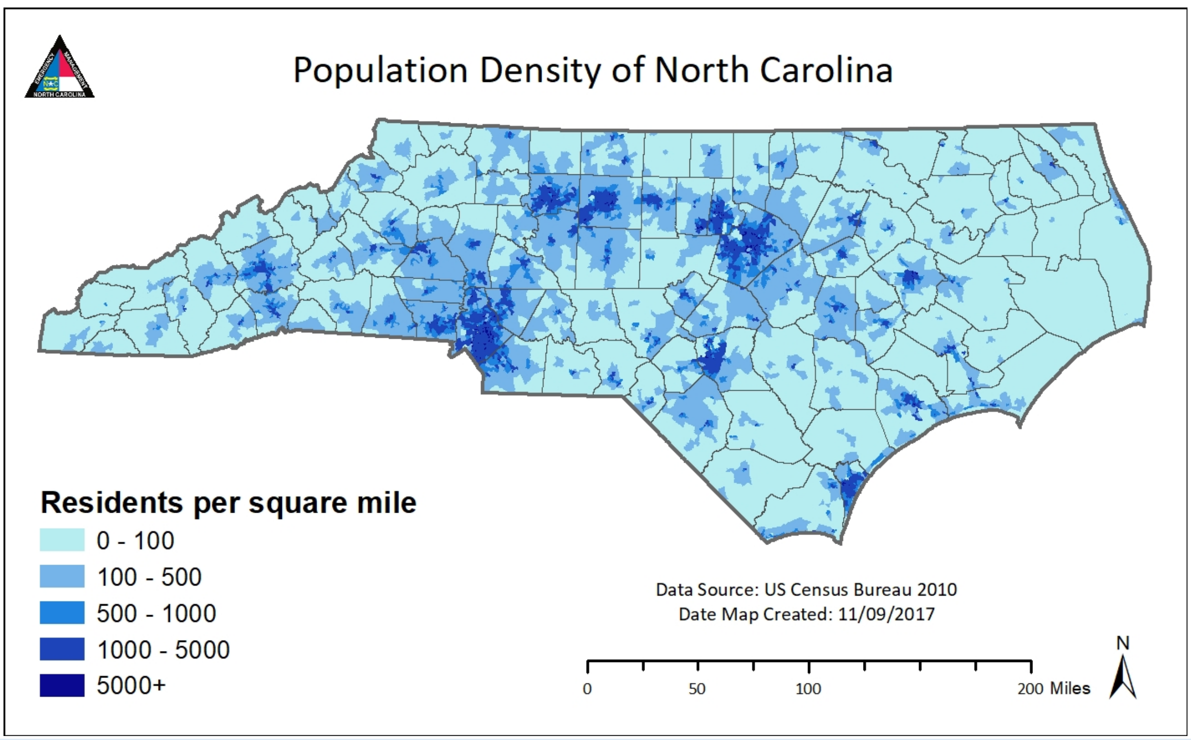
Table 3-24 U.S. Department of Homeland Security Critical Infrastructure Sectors

U.S. Department of Homeland Security Critical Infrastructure Sectors	
Areas of Assembly	Energy
Agriculture and Food	Government Facilities
Banking and Finance	Healthcare and Public Health
Chemical	Information Technology
Commercial Facilities	National Monuments and Icons
Communications	Nuclear Reactors, Materials, and Waste
Critical Manufacturing	Postal and Shipping
Dams	Transportation Systems
Defense Industrial Base	Water
Emergency Services	

3.3.3.3 Location/Spatial Extent

All parts of North Carolina are vulnerable to a terror event; however, terrorism tends to target more densely populated areas. The following map displays the population density in the state and therefore more vulnerable areas.

Figure 3-58 Population Density of North Carolina



3.3.3.4 Hazard History

Although there have been no major terror attacks in North Carolina, there have been several terror related incidents including: 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.

3.3.3.5 Changing Future Conditions

Population growth continues to change the face of North Carolina. North Carolina is now the ninth most populated state in the Nation. Population growth necessarily raises the odds of incidents involving terror within the state.

Terrorism is also driven by trends, technology, and information exchange. Terrorist propaganda and literature continues to play a role in educating terrorists in attack trends, tactics, technology, and procedures.

3.3.3.6 Impact

Terrorism can impact people, property, government, the economy, and the environment. Impact can be minimal or severe depending on the type of attack and how successful it is. Attacks against people can result in a small number of injuries or may result in a large number of deaths and injuries. Effects to property can be negligible or may require entire city blocks to be rebuilt. Terrorism can impact government services by exhausting personnel and equipment. Terrorism also has the capability of disrupting the economy with the impact being measured in US dollars. Environmental impacts can be insignificant or may be measureable and persistent requiring remediation. It is incumbent that Federal, State, and Local government work together to minimize the impacts of terrorism through planning, training, and effective law enforcement/emergency response.

3.3.3.7 Future Probability

North Carolina has experienced no major terrorist attacks but has had a number of terror related incidents. Thus, the probability of future occurrences of a terrorist attack, while unlikely (between 1 and 33.3 percent annual probability) is a real possibility that the state must be prepared for.

3.3.3.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.3.4 Cyber

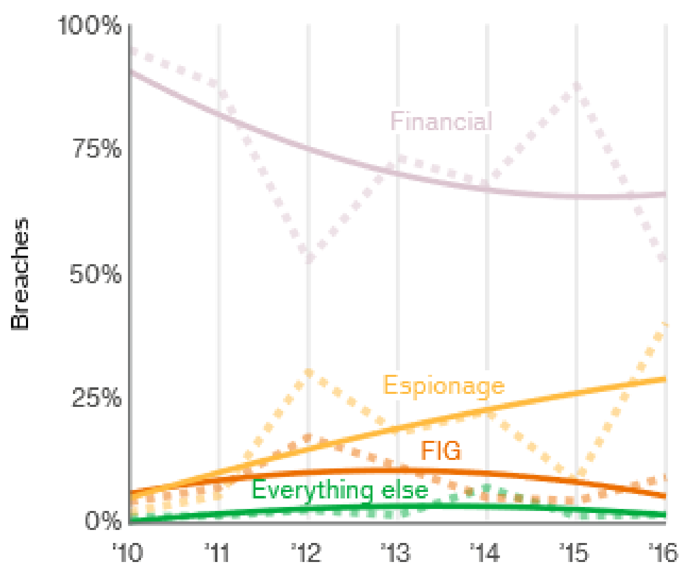
3.3.4.1 Description

Cyberattacks are deliberate attacks on information technology systems in an attempt to gain illegal access to a computer, or purposely cause damage. As the world becomes more technologically advanced and dependent upon computer systems, the threat of cyberattacks is becoming increasingly prevalent. Also known as computer network attacks, cyberattacks are difficult to recognize and typically use malicious code to alter computer data or steal information.

Mitigating and preparing for cyberattacks is challenging because of how diverse and complex attacks can be. However, 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.

Cyberattacks can happen in both the public and private sector. They may be carried out by a specific individual, or by groups from afar. Many attacks attempt to steal money or to disturb normal operations. According to the 2017 Verizon Report of Data Breaching, 93% of all data breaches had a financial or espionage motive, and espionage cases are rising.

Figure 3-59 Threat Actor Motives Over Time



Source: 2017 Verizon Data Breach Investigations Report

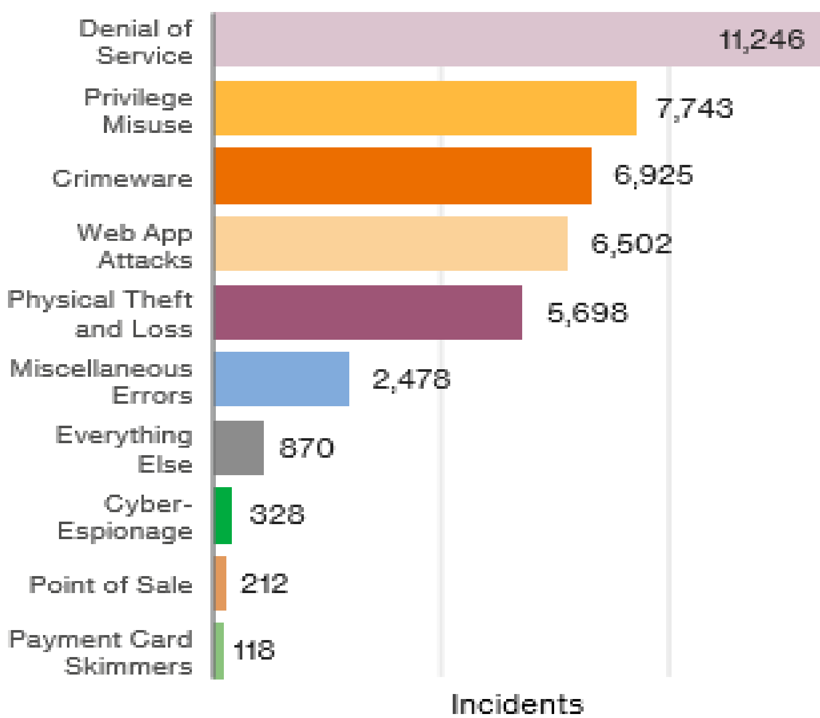
There are many types of cyberattack incident patterns, which include:

- Web App Attacks: Incidents in which web applications were attacked, which can include exploiting code-level vulnerabilities in the application.
- Point-of-Sale Intrusions: Remote attacks against environments where card-present retail transactions are conducted.
- Insider and Privilege Misuse: Unapproved or malicious use of organizational resources.
- Miscellaneous Errors: Incidents in which unintentional actions directly compromise an attribute of a security asset.
- Physical Theft and Loss: Incidents where an information asset went missing.
- Crimeware: Instances involving malware that do not fit into a more specific pattern.

- Payment Card Skimmers: Incidents involving skimming devices physically implanted on an asset that reads magnetic stripe data from payment cards.
- Cyber-espionage: Unauthorized network or system access linked to state-affiliated actors.
- Denial-of-Service Attacks: Any attack intended to compromise the availability of networks and systems that are designed to overwhelm systems, resulting in performance degradation or interruption of service.

The figure below displays cyberattack incident patterns from the 2017 Verizon Data Breach Investigations Report.

Figure 3-60 Percentage and count of incidents per pattern



Source: 2017 Verizon Data Breach Investigations Report

3.3.4.2 Extent

There is no generally recognized scale for measuring magnitude or severity of cyber-attack events.

3.3.4.3 Location/Spatial Extent

Cyberattacks occur all over the world and are difficult to predict. The 2017 Verizon report documents attacks in 82 countries. However, the Verizon report also indicates that the "Public" industry is far more susceptible to breaches than other industries. The 2016 Verizon report states there were 21,239 reported cyberattack incidents in the "Public" industry, and the next closest industry after that was the "Entertainment" industry with 5,534 incidents.

Figure 3-61 Number of security incidents by victim industry and organization size

	Incidents			
	Total	Small	Large	Unk
Total	42,068	606	22,273	19,189
Accommodation (72)	215	131	17	67
Administrative (56)	42	6	5	31
Agriculture (11)	11	1	1	9
Construction (23)	6	3	1	2
Education (61)	455	37	41	377
Entertainment (71)	5,534	7	3	5,524
Finance (52)	998	58	97	843
Healthcare (62)	458	92	108	258
Information (51)	717	57	44	616
Management (55)	8	2	3	3
Manufacturing (31-33)	620	6	24	590
Mining (21)	6	1	1	4
Other Services (81)	69	22	5	42
Professional (54)	3,016	51	21	2,944
Public (92)	21,239	46	20,751	442
Real Estate (53)	13	2	0	11
Retail (44-45)	326	70	36	220
Trade (42)	20	4	10	6
Transportation (48-49)	63	5	11	47
Utilities (22)	32	2	5	25
Unknown	8,220	3	1,089	7,128
Total	42,068	606	22,273	19,189

Source: 2017 Verizon Data Breach Investigations Report

3.3.4.4 Hazard History

In North Carolina, the Department of Information Technology specializes in cybersecurity and risk management. Within the department, the NC Information Sharing and Analysis Center gathers information on cyber threats within the State raise cybersecurity.

In 2016, North Carolina reported the highest number of cybercrimes in the “non-payment/non-delivery” sector.

Figure 3-62 North Carolina Cybercrimes with Victim Counts in 2016

Crime Type by Victim Count			
Crime Type	*Victim Count*	*Crime Type*	*Victim Count*
419/Overpayment	614	Health Care Related	10
Advanced Fee	384	IPR/Copyright and Counterfeit	58
Auction	442	Identity Theft	345
BEC/EAC	254	Investment	28
Charity	10	Lottery/Sweepstakes	119
Civil Matter	28	Malware/Scareware	62
Confidence Fraud/Romance	326	Misrepresentation	102
Corporate Data Breach	74	No Lead Value	121
Credit Card Fraud	274	Non-payment/Non-Delivery	1,844
Crimes Against Children	19	Other	218
Criminal Forums	0	Personal Data Breach	569
Denial of Service	28	Phishing/Vishing/Smishing/Pharming	399
Employment	467	Ransomware	67
Extortion	468	Re-shipping	25
Gambling	1	Real Estate/Rental	280
Government Impersonation	319	Tech Support	298
Hacktivist	2	Terrorism	6
Harassment/Threats of Violence	364	Virus	29
Descriptors*			
Social Media	455	Virtual Currency	38

Source: FBI Internet Crime Complaint Center

Although North Carolina has not reported any major catastrophic cyberattacks, they are unpredictable and could happen at any time.

3.3.4.5 Changing Future Conditions

Digital data continues to be the predominant format of data and there are no indications that will change. Therefore, it will be important to closely monitor computer systems as our technological capabilities expand.

3.3.4.6 Impact

Most cyberattacks have negligible impacts; however, it is possible for a cyberattack to have catastrophic impacts if the data breach is significant enough or if critical, protected information gets into the hands of terrorist groups. One of the primary challenges of cyberattacks for North Carolina state government and local government partners is the fact that government agencies may not fully understand their vulnerabilities. It also may be difficult to pinpoint when or how a cyberattack initially happens, which can lead to prolonged and extensive attacks in some situations.

3.3.4.7 Future Probability

Cyberattacks occur daily, but most impacts are negligible or limited. However, it is possible that a cyberattack could occur that could be catastrophic. Based on historical occurrences and the increasing digital dependency, it is unlikely (between 1 and 33.3 percent annual probability) that North Carolina may experience a severe cyberattack in the future.

3.3.4.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.3.5 Electromagnetic Pulse

3.3.5.1 Description

The United States Department of Energy defines electromagnetic pulses (EMPs) as "intense pulses of electromagnetic energy resulting from solar-caused effects or man-made nuclear and pulse power devices." EMPs can be naturally occurring or human-caused hazards. Examples of natural EMP events include:

- Lightning electromagnetic pulse
- Electrostatic discharge
- Meteoric electromagnetic pulse, and
- Coronal mass ejection, also known as a solar electromagnetic pulse.

A human-caused EMP (such as a nuclear EMP) is a technological hazard that can cause severe damage to electrical components attached to power lines or communication systems. One of the most complex aspects of EMPs is the fact they are invisible, unpredictable, and rapid. They can also overload electronic devices that people heavily rely on every day. EMPs are harmless to people biologically; however, an EMP attack could damage electronic systems such as planes or cars. This could cause destruction of property and life and potentially generate disease or societal collapse.

In 2015, Congress amended the Homeland Security Act of 2002 by passing the Critical Infrastructure Protection Act (CIPA), which protects Americans from an EMP. It also required reporting of EMP threats, research and development, and a campaign to educate planners and emergency responders about EMP events.

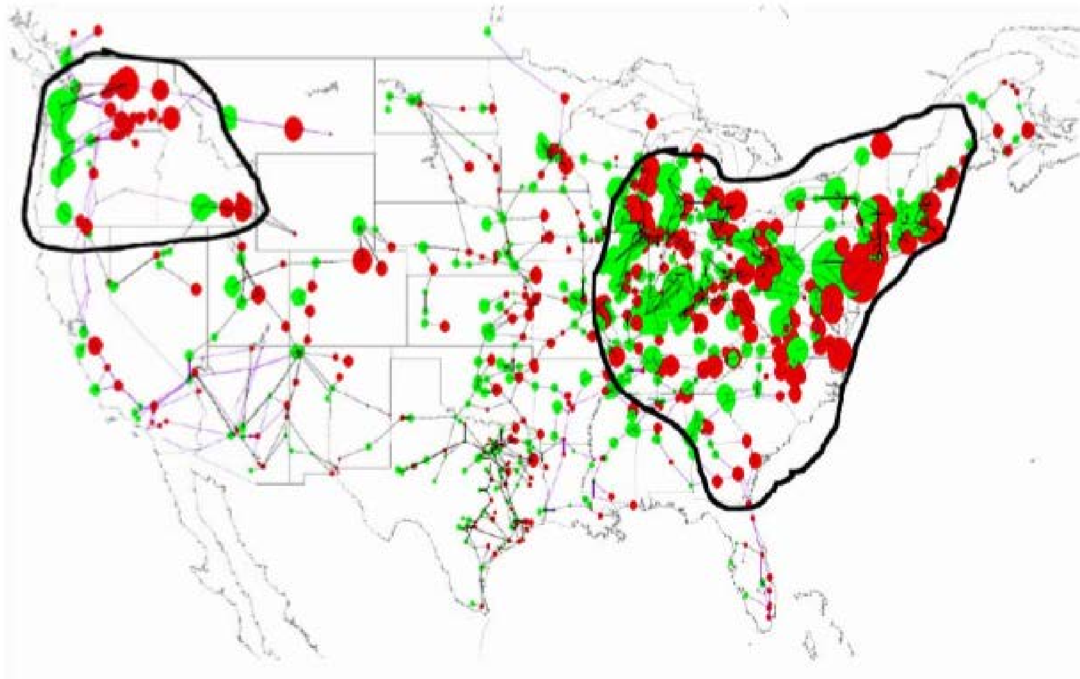
3.3.5.2 Extent

The strength and area impacted by an EMP depends on the type. For example, a nuclear device detonated at high altitudes can generate a pulse with tens of kilovolts per meter and impact a radius from hundreds to thousands of kilometers. This type of event can disable very large electrical and electronic systems such as power and long-haul communications.

3.3.5.3 Location/Spatial Extent

An EMP can happen in any location and are relatively unpredictable. However, due to the technological advances in the United States, the country may be more susceptible to an EMP attack. Highly populated areas may be more prone to damages from an EMP; cities such as Charlotte or Raleigh in North Carolina may be more at risk.

Figure 3-63 Areas of Probable Power System Collapse as a Consequence from EMP



Source: Federal Energy Regulatory Commission Report on Electromagnetic Pulse: Effects on the US Power Grid

3.3.5.4 Hazard History

North Carolina has not experienced an EMP occurrence.

3.3.5.5 Changing Future Conditions

One of the most problematic threats of EMPs is the little common understanding of consequences between local, State, and Federal authorities. However, as technology increases globally, more can be learned about the effects of an EMP occurrence.

3.3.5.6 Impact

EMPs can impact telecommunications, electronics and control systems, relays, lighting arrestors, power lines, tower structures, transformers and protective relays. Nuclear and high-altitude EMPs have the potential to damage or destroy areas for hundreds of miles. An EMP detonated at high altitude can maximize the impacts and damage a larger area.

3.3.5.7 Future Probability

The probability of an EMP is unlikely (between 1 and 33.3 percent annual probability) but any occurrence could have catastrophic impacts.

3.3.5.8 NCEOP Reference

Annex B, Appendix 9

Annex C, Appendix 6, Hazards and Threats

3.4 VULNERABILITY ASSESSMENT

3.4.1 Demographics

3.4.1.1 Census 2010

The 2010 Census represents the last official federal comprehensive population count. The 2010 Census was overseen by the U.S. Census Bureau. In North Carolina, the State Demographics branch of the Office of State Budget and Management is responsible for producing population estimates and projections. Table 3-25 provides population counts for each county in the State per the 2010 Census and the North Carolina State Demographics Office. The table also lists the percent growth rate in each county from 2010-2017 according to NC State Demographics 2017 estimates. Overall, the population in the State is up by about 0.5% since 2010.

Table 3-25 North Carolina 2017 Populations and Growth Changes by County

Rank (2017 Population)	**County**	**Population** (2010 Census)	**Population** (2017 NC State Demographics Estimate)	**Percent Growth 2010-2017**
1	Mecklenburg County	919,628	1,054,835	14.70%
2	Wake County	900,993	1,046,791	16.18%
3	Guilford County	488,406	521,330	6.74%
4	Forsyth County	350,670	371,511	5.94%
5	Cumberland County	319,431	327,127	2.41%
6	Durham County	267,587	306,212	14.43%
7	Buncombe County	238,318	256,088	7.46%
8	Union County	201,292	226,606	12.58%
9	New Hanover County	202,667	223,483	10.27%
10	Gaston County	206,086	216,965	5.28%
11	Cabarrus County	178,011	201,590	13.25%
12	Johnston County	168,878	191,450	13.37%
13	Onslow County	177,772	187,136	5.27%
14	Pitt County	168,148	177,220	5.40%
15	Iredell County	159,437	172,916	8.45%
16	Davidson County	162,878	164,926	1.26%
17	Alamance County	151,131	159,688	5.66%
18	Catawba County	154,358	156,459	1.36%
19	Randolph County	141,752	143,416	1.17%
20	Orange County	133,801	141,796	5.98%
21	Rowan County	138,428	139,933	1.09%
22	Robeson County	134,168	133,235	-0.70%
23	Harnett County	114,678	130,881	14.13%
24	Brunswick County	107,431	126,953	18.17%
25	Wayne County	122,623	124,150	1.25%
26	Henderson County	106,740	114,209	7.00%
27	Craven County	103,505	103,445	-0.06%
28	Cleveland County	98,078	97,144	-0.95%
29	Moore County	88,247	95,776	8.53%
30	Nash County	95,840	94,005	-1.91%

Rank (2017 Population)	**County**	**Population** (2010 Census)	**Population** (2017 NC State Demographics Estimate)	**Percent Growth 2010-2017**
31	Rockingham County	93,643	91,393	-2.40%
32	Burke County	90,912	88,851	-2.27%
33	Wilson County	81,234	81,661	0.53%
34	Caldwell County	83,029	81,449	-1.90%
35	Lincoln County	78,625	81,168	3.23%
36	Chatham County	63,505	72,243	13.76%
37	Surry County	73,673	72,113	-2.12%
38	Carteret County	66,469	68,890	3.64%
39	Wilkes County	66,340	68,740	3.62%
40	Rutherford County	67,810	66,421	-2.05%
41	Franklin County	60,619	64,705	6.74%
42	Sampson County	63,431	63,124	-0.48%
43	Stanly County	60,585	60,791	0.34%
44	Haywood County	59,036	60,682	2.79%
45	Lee County	57,866	59,616	3.02%
46	Pender County	52,217	59,090	13.16%
47	Granville County	59,916	59,031	-1.48%
48	Duplin County	58,505	58,969	0.79%
49	Lenoir County	59,495	57,307	-3.68%
50	Columbus County	58,098	56,505	-2.74%
51	Watauga County	51,079	53,922	5.57%
52	Edgecombe County	56,552	53,318	-5.72%
53	Hoke County	46,952	53,262	13.44%
54	Halifax County	54,691	51,766	-5.35%
55	Beaufort County	47,759	47,526	-0.49%
56	Stokes County	47,401	46,097	-2.75%
57	McDowell County	44,996	45,075	0.18%
58	Richmond County	46,639	44,939	-3.65%
59	Vance County	45,442	44,244	-2.64%
60	Jackson County	40,271	42,241	4.89%
61	Davie County	41,240	42,013	1.87%
62	Pasquotank County	40,661	39,864	-1.96%
63	Person County	39,646	39,284	-0.91%
64	Yadkin County	38,406	37,532	-2.28%
65	Alexander County	37,198	37,428	0.62%
66	Dare County	33,920	35,964	6.03%
67	Scotland County	36,157	35,244	-2.53%
68	Macon County	33,992	34,376	1.13%
69	Bladen County	35,190	33,741	-4.12%
70	Transylvania County	33,090	33,482	1.18%
71	Cherokee County	27,444	27,905	1.68%
72	Montgomery County	27,798	27,418	-1.37%
73	Ashe County	27,281	26,924	-1.31%
74	Currituck County	23,547	25,809	9.61%
75	Anson County	26,948	25,448	-5.57%
76	Hertford County	24,669	24,136	-2.16%
77	Martin County	24,505	23,172	-5.44%
78	Caswell County	23,719	22,910	-3.41%
79	Madison County	20,764	21,340	2.77%

Rank (2017 Population)	**County**	**Population** (2010 Census)	**Population** (2017 NC State Demographics Estimate)	**Percent Growth 2010-2017**
80	Greene County	21,362	21,168	-0.91%
81	Polk County	20,510	20,334	-0.86%
82	Northampton County	22,099	20,000	-9.50%
83	Warren County	20,972	19,907	-5.08%
84	Bertie County	21,282	19,854	-6.71%
85	Yancey County	17,818	17,678	-0.79%
86	Avery County	17,797	17,516	-1.58%
87	Mitchell County	15,579	15,126	-2.91%
88	Chowan County	14,793	14,383	-2.77%
89	Swain County	13,981	14,346	2.61%
90	Perquimans County	13,453	13,335	-0.88%
91	Pamlico County	13,144	12,821	-2.46%
92	Washington County	13,228	12,195	-7.81%
93	Gates County	12,197	11,478	-5.89%
94	Clay County	10,587	10,915	3.10%
95	Alleghany County	11,155	10,848	-2.75%
96	Camden County	9,980	10,418	4.39%
97	Jones County	10,153	9,845	-3.03%
98	Graham County	8,861	8,558	-3.42%
99	Hyde County	5,810	5,517	-5.04%
100	Tyrrell County	4,407	4,141	-6.04%

Source: North Carolina State Demographics Office

3.4.1.2 Projected Population Growth

The State Demographics Office also produces population growth estimates for each county. Table 3-26 provides a summary of projected population growth rates through 2036.

Table 3-26 North Carolina Population Growth Estimates Through 2036

Population							
County	July 2010	July 2015	July 2020	July 2025	July 2030	July 2035	July 2036
Alamance	151,582	157,522	167,375	177,741	188,157	198,573	200,656
Alexander	37,255	37,952	38,405	38,745	38,999	39,189	39,219
Alleghany	11,146	11,190	11,517	11,844	12,173	12,499	12,566
Anson	26,868	26,155	26,156	26,157	26,157	26,157	26,156
Ashe	27,250	27,332	27,086	26,876	26,728	26,625	26,608
Avery	17,745	17,816	17,912	18,007	18,102	18,199	18,216
Beaufort	47,781	47,829	47,827	47,826	47,827	47,827	47,828
Bertie	21,217	20,533	20,010	19,502	18,996	18,490	18,388
Bladen	35,159	35,011	35,009	35,013	35,010	35,011	35,012
Brunswick	108,181	123,535	138,430	154,332	170,230	186,128	189,307
Buncombe	238,801	254,836	270,328	285,823	301,321	316,816	319,915
Burke	90,688	89,114	89,727	90,003	90,124	90,179	90,185
Cabarrus	178,652	195,714	217,101	238,084	258,895	279,779	283,952
Caldwell	82,955	82,577	83,109	83,411	83,577	83,666	83,680
Camden	9,983	10,224	10,223	10,223	10,224	10,223	10,222
Carteret	66,693	69,826	71,265	72,706	74,146	75,584	75,874
Caswell	23,683	23,606	23,612	23,613	23,614	23,612	23,612
Catawba	154,315	155,828	157,209	158,588	159,969	161,349	161,626
Chatham	63,783	71,815	78,625	85,438	92,249	99,058	100,421
Cherokee	27,428	27,770	28,094	28,316	28,502	28,654	28,681
Chowan	14,745	14,541	13,932	13,321	12,711	12,102	11,979
Clay	10,583	11,036	11,294	11,543	11,778	12,003	12,049
Cleveland	97,987	97,871	98,334	98,544	98,637	98,681	98,687
Columbus	57,918	57,206	57,089	57,090	57,088	57,090	57,089
Craven	104,184	103,691	101,893	101,074	100,714	100,556	100,539
Cumberland	327,331	328,860	325,775	325,216	325,117	325,101	325,102
Currituck	23,663	25,627	28,473	31,319	34,164	37,012	37,581
Dare	33,987	36,001	37,798	39,083	40,005	40,664	40,772
Davidson	162,886	165,193	169,118	173,068	177,018	180,969	181,759
Davie	41,281	41,743	42,975	44,208	45,441	46,674	46,920
Duplin	58,678	59,868	59,866	59,866	59,866	59,866	59,867
Durham	271,382	297,219	322,728	348,110	373,364	398,490	403,500
Edgecombe	56,637	54,367	53,777	53,188	52,596	52,006	51,887

Population							
County	July 2010	July 2015	July 2020	July 2025	July 2030	July 2035	July 2036
Forsyth	351,458	366,543	384,537	404,725	425,225	445,765	449,873
Franklin	60,838	64,206	68,065	71,976	75,886	79,794	80,577
Gaston	206,068	212,636	222,780	232,927	243,072	253,216	255,247
Gates	12,161	11,739	11,637	11,617	11,615	11,614	11,615
Graham	8,868	8,761	8,595	8,508	8,463	8,438	8,433
Granville	57,600	58,547	60,508	62,493	64,478	66,466	66,863
Greene	21,237	21,158	21,073	21,072	21,073	21,073	21,074
Guilford	489,487	517,124	536,923	553,524	567,448	579,125	581,224
Halifax	54,548	52,423	50,621	48,814	47,012	45,209	44,848
Harnett	115,731	127,127	134,189	141,178	148,167	155,154	156,552
Haywood	58,956	60,631	63,105	65,575	68,048	70,521	71,014
Henderson	106,950	112,511	118,807	124,682	130,161	135,271	136,249
Hertford	24,735	24,426	24,309	24,196	24,080	23,966	23,941
Hoke	47,570	51,776	58,774	65,004	70,888	77,246	78,468
Hyde	5,797	5,631	5,625	5,557	5,490	5,423	5,408
Iredell	159,797	170,230	185,140	200,059	214,975	229,894	232,875
Jackson	40,345	41,597	43,151	44,703	46,259	47,810	48,119
Johnston	169,638	184,519	205,975	227,712	249,508	271,316	275,677
Jones	10,079	10,423	10,426	10,425	10,424	10,424	10,425
Lee	57,871	58,908	58,907	58,907	58,908	58,907	58,909
Lenoir	59,451	58,338	58,017	57,696	57,378	57,056	56,991
Lincoln	78,412	81,397	86,794	92,187	97,581	102,977	104,056
Macon	33,939	34,771	36,367	37,962	39,556	41,152	41,471
Madison	20,777	21,663	22,430	23,197	23,964	24,733	24,887
Martin	24,460	23,746	23,263	22,779	22,296	21,812	21,715
McDowell	45,077	45,370	45,927	46,215	46,355	46,423	46,430
Mecklenburg	923,316	1,035,605	1,144,013	1,254,246	1,364,481	1,474,714	1,496,762
Mitchell	15,536	15,335	15,296	15,292	15,291	15,290	15,291
Montgomery	27,944	27,826	28,162	28,496	28,832	29,168	29,235
Moore	88,589	94,492	100,788	106,435	111,479	115,983	116,826
Nash	95,867	94,370	93,920	93,471	93,025	92,576	92,485
New Hanover	203,289	220,231	234,826	249,424	264,016	278,612	281,530
Northampton	22,007	21,073	20,889	20,704	20,518	20,332	20,296
Onslow	186,977	194,636	205,607	216,578	227,549	238,521	240,716
Orange	134,044	140,144	147,929	155,679	163,385	171,058	172,586
Pamlico	13,093	13,174	13,201	13,231	13,260	13,289	13,296
Pasquotank	40,652	39,731	40,330	40,411	40,423	40,422	40,423

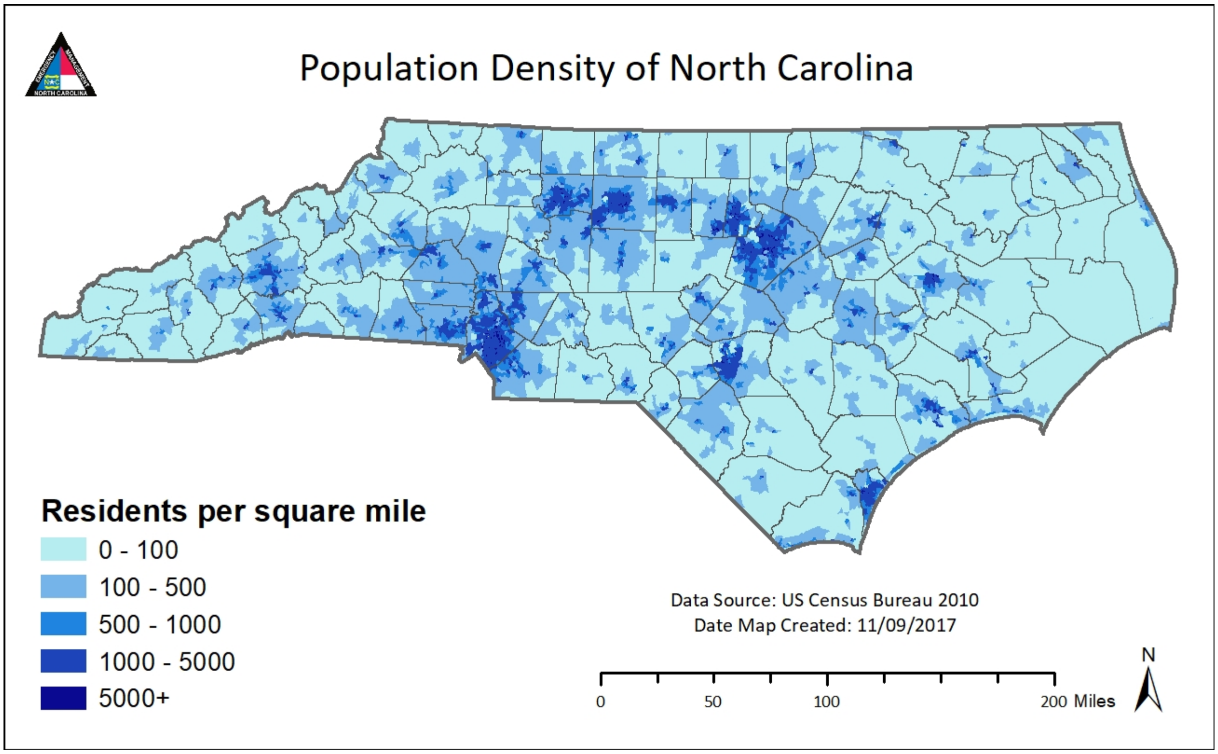
Population							
County	July 2010	July 2015	July 2020	July 2025	July 2030	July 2035	July 2036
Pender	52,361	57,941	64,102	70,254	76,410	82,566	83,797
Perquimans	13,484	13,648	14,112	14,778	15,475	16,173	16,315
Person	39,421	39,574	40,214	40,745	41,184	41,543	41,606
Pitt	168,822	175,532	179,437	183,346	187,251	191,158	191,942
Polk	20,450	20,828	21,278	21,636	21,922	22,148	22,187
Randolph	141,944	142,943	143,683	144,423	145,163	145,902	146,052
Richmond	46,605	45,353	45,058	44,754	44,450	44,149	44,088
Robeson	134,392	133,375	132,087	130,797	129,510	128,218	127,962
Rockingham	93,651	92,084	91,713	91,636	91,621	91,619	91,620
Rowan	138,327	140,122	144,335	148,551	152,766	156,981	157,825
Rutherford	67,735	67,617	67,883	68,024	68,082	68,113	68,117
Sampson	63,460	63,993	63,992	63,992	63,994	63,993	63,993
Scotland	36,077	35,821	34,933	34,063	33,189	32,315	32,140
Stanly	60,557	61,234	62,340	63,460	64,577	65,696	65,921
Stokes	47,336	46,763	46,642	46,571	46,530	46,505	46,501
Surry	73,693	73,195	73,197	73,198	73,194	73,195	73,194
Swain	13,996	14,953	15,714	16,474	17,234	17,996	18,149
Transylvania	33,065	33,745	35,308	36,868	38,430	39,994	40,308
Tyrrell	4,400	4,217	4,216	4,215	4,217	4,215	4,215
Union	202,117	219,992	240,175	260,360	280,541	300,722	304,757
Vance	45,303	45,097	45,162	45,197	45,218	45,231	45,234
Wake	906,964	1,007,631	1,119,118	1,230,780	1,342,440	1,454,103	1,476,434
Warren	20,935	20,473	20,491	20,516	20,541	20,566	20,569
Washington	13,162	12,589	12,192	11,796	11,401	11,004	10,925
Watauga	50,981	53,737	56,744	59,752	62,757	65,764	66,363
Wayne	122,855	124,984	128,020	132,844	135,616	139,698	140,458
Wilkes	69,244	69,663	69,664	69,664	69,663	69,664	69,661
Wilson	81,247	81,689	84,504	87,770	91,092	94,420	95,088
Yadkin	38,436	37,705	37,022	36,620	36,378	36,231	36,208
Yancey	17,797	17,959	18,062	18,165	18,267	18,372	18,393
North Carolina	**9,574,408**	**10,056,683**	**10,584,376**	**11,116,784**	**11,643,181**	**12,167,836**	**12,272,264**

Source: North Carolina OSBM, Standard Population Estimates, Vintage 2016 and Population Projections, Vintage 2017

3.4.1.3 Population Diversity Map

Figure 3-58 illustrates the population density per square mile across the State as it was reported by the U.S. Census Bureau in 2010 at the census block level. The 2010 total population in the State according to Census data was 9,535,483 persons. As can be seen in the figure, a majority of the State has less than 100 people per square mile, and Mecklenburg and Wake Counties have the highest population concentrations in the state. More specific information on the estimated number of people living within identified hazard areas is provided throughout this section.

Figure 3-64 Population Density in North Carolina



3.4.1.4 State Collected Synthetic Census Data

NCEM's Risk Management department purchased RTI International's U.S. Synthetic Household Population™ dataset. This data provides an accurate representation of the complete household and person population throughout the United States. The database includes locations and descriptive sociodemographic attributes derived from completely public data sources. It statistically matches the real household population and contains no personally identifiable information. One of the primary goals of the data is to create a dot for every person and every home. NCEM-RM has worked to associate those dots with specific buildings in the statewide building inventory developed by NCEM-RM.

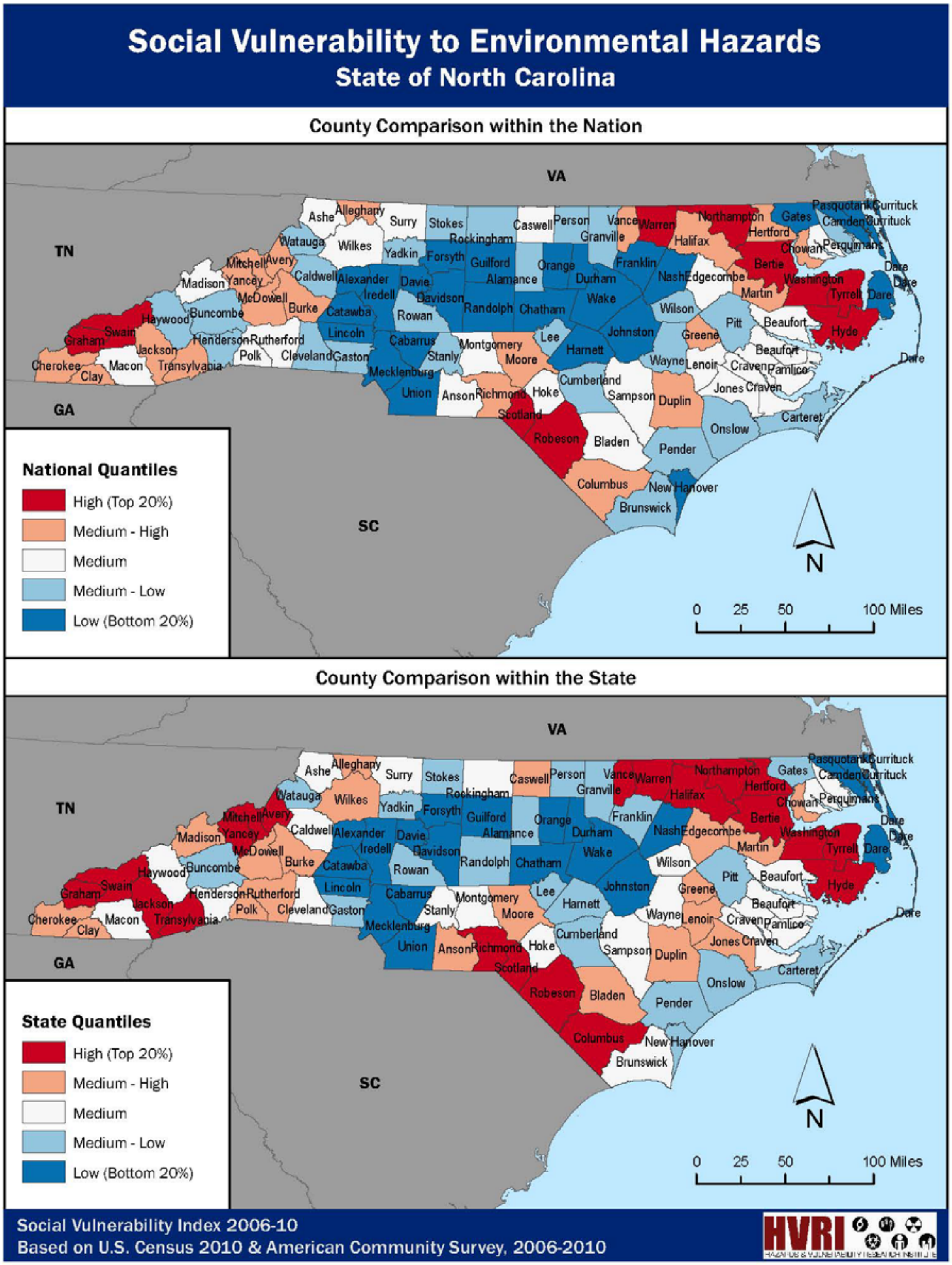
For this version of the State Plan update, the synthetic populations data was used to evaluate how vulnerability changes for the fixed nuclear radiological hazard. For future updates of this plan, Risk Mitigation staff will work to conduct analyses that will provide summaries of risk associated with changes in day and night-time populations and differences in seasonal populations.

3.4.1.5 Social Vulnerability

In addition to identifying those assets potentially at risk to identified hazards, it is important to identify and assess those particular segments of the resident population in the State that are potentially at risk to these hazards.

Figure 3-59 provides social vulnerability results for the State as developed by the University of South Carolina's Hazards and Vulnerability Research Institute. Their method of evaluating 29 socioeconomic variables was used to indicate where there is potential social vulnerability when comparing counties to other counties nationally and against other counties in North Carolina. On the national level, most of the counties in the State fall within the "low" and "medium-low" social vulnerability category when compared with other counties in the country. In comparing North Carolina counties against themselves, counties in the mountains and in the coastal plain are more socially vulnerable than those in the piedmont.

Figure 3-65 Social Vulnerability of the State of North Carolina



3.4.2 Land Use and Development

3.4.2.1 Changes in the Past Ten Years

With changes in population come changes in land use and development patterns. As a result, land use and development patterns in North Carolina continue to change. In some places this growth is more rapid than others. This section explores changes in land uses in general terms for three different regions, which include the mountains, piedmont and coastal plain.

From 2007 to 2017, most of the mountain and coastal plain counties remained rural. Agriculture and forestry are important economic activities in both parts of the state. Tourism is especially important to the economy of the mountains and the coast. The fishing industry is important along the coast. There are few urban counties in either area. Only Buncombe (Asheville) in the mountains, and Cumberland (Fayetteville) and New Hanover (Wilmington) on the coastal plain are predominantly urban.

The piedmont region is in the central part of the state and includes 32 counties. North Carolina's biggest cities are in the piedmont. Ten piedmont counties are largely urban—Alamance, Cabarrus, Catawba, Durham, Forsyth, Gaston, Guilford, Mecklenburg, Orange, and Wake. The remaining piedmont counties are largely rural. Farming is a more important part of the economy in the eastern piedmont counties than in the western piedmont. Manufacturing (especially of textiles, clothing and furniture) is particularly important in the western piedmont counties, where even many rural counties have a considerable amount of industry.

New Residents, New Jobs

Three kinds of development contributed most to population growth in North Carolina counties during the second half of the twentieth century. New and rapidly expanding businesses created jobs and led to increased population in some counties. Much of this kind of growth occurred in the piedmont, with Mecklenburg and Wake counties having the greatest population increase. Military base development contributed much to the population growth in some coastal plain counties, especially Cumberland (Fort Bragg) and Onslow (Camp LeJeune). Resort and retirement community developments also contributed to major population growth in several counties, particularly in the mountains (Henderson, Watauga) and at the beach (Brunswick, Currituck, Dare).

In each case, additional jobs were also created as people moved into these developing counties. Whether they came to take jobs created by expanding businesses, to serve on military bases, or to retire, new residents needed housing, food, clothing, banking and other goods and services. This need led to the expansion of other businesses and to the creation of additional jobs. As a result of the development of new jobs, people in counties with population growth generally have higher incomes than those who live in counties with little or no population growth.

Population growth creates the need for additional government services. Not only are there more people to be served, but the kinds of services needed may also change as the population increases. For example, housing developments are springing up along the North

Carolina countryside, creating some of the same problems that cities experience. Many counties have begun providing water, sewers, and other services to housing developments in unincorporated areas. New school buildings and other public facilities are also needed as the population increases. County governments must pay for these new facilities and hire new employees to serve their larger population.

Needs of Counties That Have Not Grown

In North Carolina, many counties that are primarily agricultural had little population growth or even experienced a decrease in population in the second half of the 20th century. Machines replaced people for many farming operations, including tobacco and cotton during this period. In 1947, 42 percent of North Carolinians worked in agriculture. A 2016 report produced by North Carolina State University indicates that the number of number is now at 17 percent[36]. In some rural counties, manufacturing or tourist jobs replaced agricultural jobs. In other counties, however, there were few new jobs to replace those lost on the farms. These are the counties that lost population or had little population growth. These are also the counties where per capita income is lowest.

Counties with constant or declining population often have special problems. High unemployment and low wages mean that a larger proportion of the population needs financial assistance and health care from the county government. At the same time, poorer people pay less in taxes. A county with a low per capita income may have trouble raising funds to assist its needy residents.

(Excerpted in part from Local Government in North Carolina by Gordon P. Whitaker. 2003. North Carolina City and County Management Association.)

Growth pressures and rapid expansion can affect how willing or able a local government is to respond to changes in vulnerability as populations increase. Pressure to build in remaining open space may lead some counties to allow development to encroach on floodplains and other hazardous areas. Counties and municipalities must be careful to provide services, such as water and sewer, to support new development only in areas that are not hazardous. Counties with declining populations must not be so eager to grow that they, too, encourage new development in inappropriate areas.

3.4.2.2 Current Conditions

Statewide there are areas that have been experiencing steady growth and development and some areas that have experienced population loss between 2010 and 2017. Brunswick, Wake, Mecklenburg, Durham, Harnett, Chatham, Hoke, Johnston, Cabarrus, Pender, Union and New Hanover Counties have all experienced greater than 10% population increases and can be expected to have higher rates of development when compared to the rest of the State, resulting in an increased number of structures that are vulnerable to the potential

[36] *2016 State Agribusiness Values – Michael L. Walden. PhD.*

impacts of the identified hazards. Therefore, development and population growth have impacted the State's vulnerability since the previous State hazard mitigation plan was approved and there has been an increase in the overall vulnerability.

3.4.2.3 Projected Future Changes

It is also important to note that as development increases in the future, greater populations and more structures and infrastructure will be exposed to potential hazards if development occurs in hazard areas. According to the Office of State Budget and Management, North Carolina counties where growth rates are anticipated to be greater than 10% between 2010 and 2020 include the following: Alamance (10.9%), Brunswick (31.7%), Buncombe (13.7%), Cabarrus (22.1%), Chatham (25.2%), Cherokee (12.8%), Clay (13.1%), Currituck (19.4%), Dare (11.6%), Durham (18.6%), Franklin (15.2%), Harnett (19.9%), Henderson (13.6%), Hoke (23.7%), Iredell (16.7%), Jackson (11.1%), Johnston (24.9%), Lincoln (11.9%), Madison (10.9%), Mecklenburg (24.3%), Moore (15.6%), New Hanover (17.5%), Onslow (13.5%), Pender (24.4%), Swain (10.4%), Union (19.7%), Wake (24.0%), Watauga (16.9%). Statewide, the growth rate is expected to be 11.4% with the majority of counties expected to experience some form of growth. Twenty-seven (27) counties are expected to lose population during this same time period.

3.4.3 Economic Vulnerability

As has been experienced in recent events such as Hurricane Matthew and the 2016 wildfires, economic impacts as a result of natural hazards can be significant. Economic losses following a disaster can be very detrimental to the vitality of a community and to the State as a whole. One methodology for determining economic vulnerability is to identify the major employers in the State, evaluate the types of businesses and the locations of those major employers, and take into consideration factors that may already be contributing to distressing a local economy and consider how a hazard event might exacerbate those conditions.

3.4.3.1 Major Employers

The top 25 employers in North Carolina, as of first quarter 2017 employment size are included in the table below.

Table 3-27 Top 25 NC Employers as of Q1 2017 by Employment Size

Name	Industry
1. Walmart Associates Inc	Retail Trade
2. Duke University	Educational Services
3. Food Lion	Retail Trade
4. Wells Fargo Bank NA	Finance and Insurance
5. Lowes Home Centers Inc	Retail Trade
6. Bank of America	Finance and Insurance
7. Harris Teeter LLC	Retail Trade
8. Branch Banking and Trust Co	Finance and Insurance
9. American Airlines Inc	Transportation and Warehousing
10. Smithfield Foods	Manufacturing
11. Ingles Markets, Inc	Retail Trade
12. United Parcel Service Inc	Transportation and Warehousing
13. Charter Communications Inc	Information

Name	Industry
14. Wakemed Health and Hospitals	Health Care and Social Assistance
15. Wake Forest University Baptist Medical Center	Health Care and Social Assistance
16. Compass Group USA Inc	Accommodation and Food Service
17. Memorial Mission Hospital Inc	Health Care and Social Assistance
18. Cone Health	Health Care and Social Assistance
19. Target Corporation	Retail Trade
20. Laboratory Corporation of America	Health Care and Social Assistance
21. Belk Inc	Retail Trade
22. AT&T Services Inc	Information
23. International Business Machines Corp	Manufacturing
24. Lowes Foods LLC	Retail Trade
25. Home Depot USA Inc	Retail Trade

3.4.3.2 Locations

Most of the top employers in the State are located in multiple places of business across the State. For example, Wal Marts, Food Lions and many of the banks listed above can be found in most urban area and even in some more rural locations. Therefore, it is difficult to get a clear picture on the number of these specific locations that are vulnerable to hazards.

3.4.3.3 Type of Employers

The major types of employers in North Carolina fall into one of the following categories:

- Retail Trade (9)
- Health Care and Social Assistance (5)
- Finance and Insurance (3)
- Transportation and Warehousing (2)
- Manufacturing (2)
- Information (2)
- Accommodation and Food Service (1)
- Educational Services (1)

The number listed in parenthesis by the employment sector represents the number of Top 25 businesses in North Carolina that are in that sector.

3.4.3.4 Development

Since 2007, the North Carolina Department of Commerce has used a three-level system for designating development tiers and determining county economic distress rankings. These state-mandated designations help determine state funding opportunities to aid economic development and assigns each county a designation of Tier One (most distressed), Tier Two, or Tier Three (least distressed). To determine a county’s ranking, four factors are assessed:

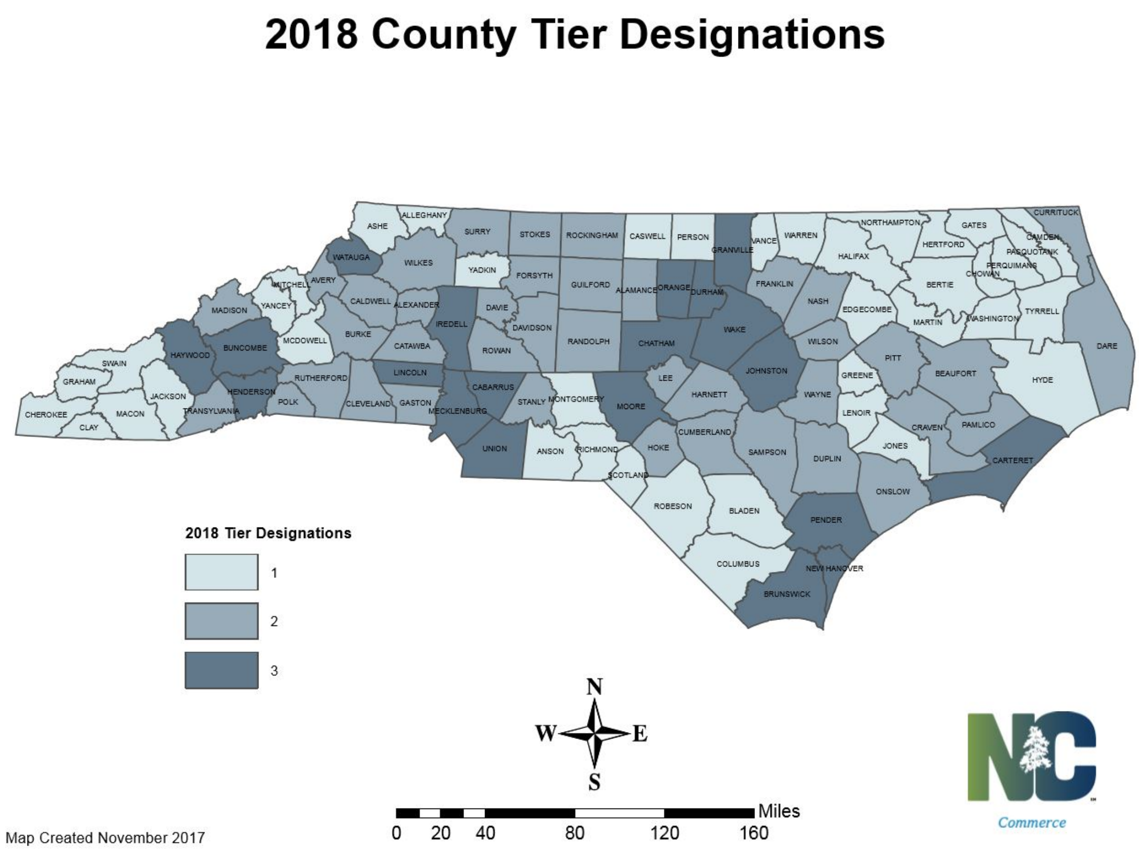
- Average unemployment rate for the most recent twelve months
- Median household income for the most recent twelve months
- Percentage growth in population for the most recent 36 months
- Adjusted property tax base per capita for the most recent taxable year

Each county is ranked from 1 (most distressed) to 100 (least distressed) based on the above variable assessments. Tier 1 consists of the lowest ranking 40 counties, Tier 2 contains the middle 40 counties, and Tier 3 is designated to the remaining 20 counties. A county may be automatically qualified as Tier 1 if the county:

- Is a Tier 1 county for at least 2 consecutive years
- Has a population of less than 12,000 people
- Has a population of less than 50,000 and a poverty rate of 19% or higher.

Figure 3-60 below displays county tier designations for 2018.

Figure 3-66 2018 County Tier Designations



Source: NC Department of Commerce

Table 3-28 displays a list of each county's economic distress ranking and tier designations.

Table 3-28 2018 County Development Tier Rankings

County	**Economic Distress Rank** (#1 = most distressed)	2018 Tiers
Alamance	64	2
Alexander	60	2
Alleghany	47	1
Anson	11	1
Ashe	56	1
Avery	68	2
Beaufort	43	2
Bertie	4	1
Bladen	11	1

County	**Economic Distress Rank** (#1 = most distressed)	2018 Tiers
Brunswick	80	3
Buncombe	90	3
Burke	52	2
Cabarrus	94	3
Caldwell	41	2
Camden	77	1
Carteret	78	3
Caswell	22	1
Catawba	62	2
Chatham	100	3
Cherokee	54	1
Chowan	27	1
Clay	66	1
Cleveland	38	2
Columbus	10	1
Craven	49	2
Cumberland	20	2
Currituck	98	2
Dare	76	2
Davidson	68	2
Davie	79	2
Duplin	23	2
Durham	92	3
Edgecombe	1	1
Forsyth	72	2
Franklin	70	2
Gaston	58	2
Gates	42	1
Graham	25	1
Granville	74	3
Greene	15	1
Guilford	70	2
Halifax	2	1
Harnett	50	2
Haywood	81	3
Henderson	91	3
Hertford	9	1
Hoke	34	2
Hyde	21	1
Iredell	95	3
Jackson	75	1
Johnston	86	3
Jones	31	1
Lee	44	2
Lenoir	14	1
Lincoln	85	3
Macon	73	1
Madison	61	2
Martin	15	1
McDowell	51	1
Mecklenburg	92	3
Mitchell	32	1

County	Economic Distress Rank (#1 = most distressed)	2018 Tiers
Montgomery	46	1
Moore	87	3
Nash	30	2
New Hanover	96	3
Northampton	11	1
Onslow	36	2
Orange	89	3
Pamlico	63	2
Pasquotank	37	1
Pender	83	3
Perquimans	38	1
Person	64	1
Pitt	33	2
Polk	82	2
Randolph	53	2
Richmond	6	1
Robeson	3	1
Rockingham	27	2
Rowan	59	2
Rutherford	25	2
Sampson	17	2
Scotland	5	1
Stanly	67	2
Stokes	54	2
Surry	34	2
Swain	40	1
Transylvania	84	2
Tyrrell	24	1
Union	97	3
Vance	7	1
Wake	99	3
Warren	19	1
Washington	8	1
Watauga	88	3
Wayne	18	2
Wilkes	47	2
Wilson	29	2
Yadkin	45	1
Yancey	57	1

Six counties will change tiers in 2018. Beaufort County, Caldwell County, and Granville County will move to a less distressed tier designation. Forsyth County, Lenoir County, and Perquimans County will move to a more distressed tier designation.

3.4.3.5 Agricultural Industry

An integral part of the North Carolina economy is ag-based industry. There were 2,067 farms in operation according to 2015 data obtained from the North Carolina Department of Agriculture and 912,000 acres in farming. Natural hazards can have a tremendous impact on the agricultural industry. Droughts, floods, severe storms, winter weather and wildfires can be devastating to farmers and crops.

3.4.4 Environmental Vulnerability

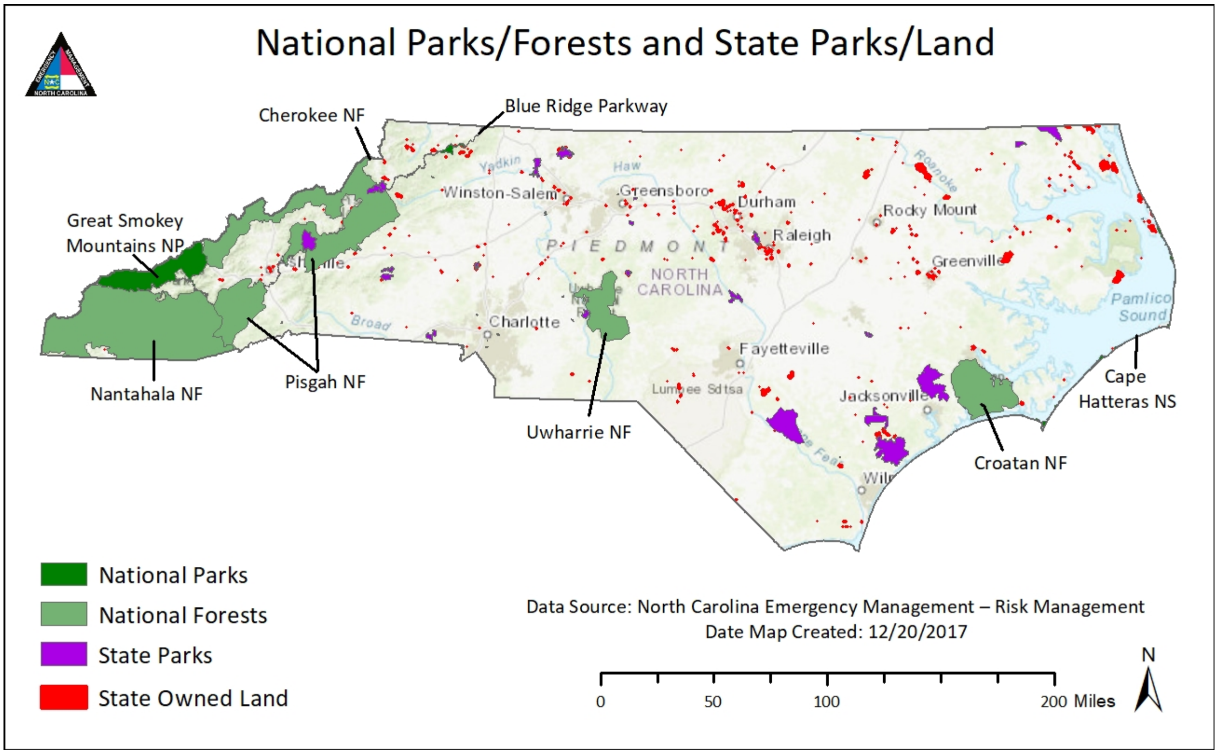
Although North Carolina's environment is adaptable to natural hazards, the state's natural resources, environmental diversity, and protected lands are still vulnerable to unpredictable disasters. Mitigation strategies are put in place to offset unavoidable environmental damage; however, it is important to assess varying vulnerability across the state. Environmental vulnerability takes various factors into consideration, including land uses, protected areas, population densities, land resiliency, and impacts on tourism and the economy.

According to the North Carolina Forest Service, forestland covers 18.6 million acres, or 60% of the state's land area. There are four national forests within state borders: Croatan, Nantahala, Pisgah, and Uwharrie. North Carolina is also home to multiple state parks, which cover over 225,000 acres. Protected forests and parks are an asset to the state, and they are also areas of high vulnerability. Table 3-29 below lists all of North Carolina's state parks, and a graphic representation follows in Figure 3-61.

Table 3-29 North Carolina State Parks

NC State Park	Region
Boone's Cave State Park	Piedmont
Carolina Beach State Park	Coastal Plain
Cliffs of the Neuse State Park	Coastal Plain
Crowders Mountain State Park	Piedmont
Duke Power State Park	Piedmont
Eno River State Park	Piedmont
Fort Macon State Park	Coastal Plain
Goose Creek State Park	Coastal Plain
Hammocks Beach State Park	Coastal Plain
Hanging Rock State Park	Piedmont
Jockey's Ridge State Park	Coastal Plain
Jones Lake State Park	Coastal Plain
Lack Waccamaw State Park	Coastal Plain
Lake James State Park	Western Mountains
Medoc Mountain State Park	Coastal Plain
Morrow Mountain State Park	Piedmont
Merchants Millpond State Park	Coastal Plain
Mt. Jefferson State Park	Western Mountains
Mt. Mitchell State Park	Western Mountains
New River State Park	Western Mountains
Pilot Mountain State Park	Piedmont
Pettigrew State Park	Coastal Plain
Raven Rock State Park	Piedmont
Singletary Lake State Park	Coastal Plain
South Mountains State Park	Western Mountains
Stone Mountain State Park	Piedmont
Wayneborough State Park	Coastal Plain
William B Umstead State Park	Piedmont

Figure 3-67 State and Federal Protected Lands in North Carolina



3.4.5 Vulnerability to Natural Hazards

The vulnerability assessments for both the County-level summaries were conducted using the following methodologies:

General Vulnerability

- Methodology 1 – Vulnerability Estimates from Local Mitigation Plans: All of the existing local hazard mitigation plans were reviewed to determine which plans had calculated annualized losses for the hazards identified in this plan. One of the challenges with this methodology is that annualized losses are not calculated in the same manner across all plans so results will not be developed using the same techniques.

Flood Vulnerability

- Methodology 1 – GIS Analysis of NC Flood Risk Data: This methodology represents a geospatial approach using multiple GIS datasets and intersecting building data with flood hazard data. Building footprints are intersected with the flood hazard areas most likely to be impacted in North Carolina. Based on the hazard, a damage curve is applied to each structure to calculate damages. A cost based on the estimated structure value multiplied by the damage percentage illustrates the expected cost of damages. This approach for calculating vulnerability differs from previous versions of the plan.
- Methodology 2 – Analysis of NFIP Claims Data and Repetitive Loss Claims Data: This methodology does not account for flood losses that occur to uninsured properties

which are most often those properties located outside of the special flood hazard area.

Other Hazards Vulnerability

- Methodology 1 – GIS Analysis of NC Risk Data: This methodology was used for the hurricane, earthquake, and tornado hazards and represents a geospatial approach using multiple GIS datasets and intersecting building data with hazard data. Building footprints are intersected with the hazard areas most likely to be impacted in North Carolina. Based on the hazard, a damage curve is applied to each structure to calculate damages. A cost based on the estimated structure value multiplied by the damage percentage illustrates the expected cost of damages. This approach for calculating vulnerability differs from previous versions of the plan.
- Methodology 2 – GIS Hazard Area Overlay Analysis of NCEM-RM Building Data to Determine Exposure: This methodology was used for the coastal surge (as part of hurricanes), wildfire and geological hazards (landslide, sinkhole and coastal erosion).
- Methodology 3 – Analysis of NCEI Data: This methodology was used for the severe winter weather, drought, tornado/severe thunderstorm hazards. Previous occurrence records from the NCEI database were evaluated and any reported dollar losses were inflated to 2017 dollars and calculations were made to determine how much damage (dollar losses) could be expected to occur during any given year.

3.4.5.1 General Vulnerability

The table on the following page provides annualized loss data as calculated and presented in the local hazard mitigation plans.

Summary of Annualized Losses from Local Plans

County	Flooding	Hurricanes	Severe Winter Weather	Earthquakes	Wildfires	Dam Failures	Drought	Tornado	Thunderstorms	Landslides	Infectious Disease	Extreme Heat
Alamance	$100,000.00	$158,078,947.00	Negligible	N/A	N/A	N/A	Negligible	$15,846.00	$12,708.00	N/A	N/A	Negligible
Alexander	$5,000.00	Negligible	$50,000.00	Negligible	Negligible	Negligible	Negligible	$76,250.00	$67,150.00	Negligible	N/A	Negligible
Alleghany	$34,386.00	$11,720.00	$58,439.00	$23,000.00	Negligible	Negligible	Negligible	$40,101.00	$1,734.00	Negligible	N/A	N/A
Anson	$466.00	$314,760.00	$28,308.00	$26,600.00	Negligible	Negligible	Negligible	$126,292.00	$1,622.00	Negligible	Not Calculated	Not Calculated
Ashe	$71,496.00	$19,840.00	$40,153.00	$11,200.00	Negligible	Negligible	Negligible	N/A	$1,577.00	Negligible	N/A	N/A
Avery	$3,897,000.00	$16,292.00	Negligible	$55,000.00	Negligible	Negligible	Negligible	$4,834.00	$533.00	$1,090.00	N/A	N/A
Beaufort	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bertie	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bladen	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Brunswick	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Buncombe	$5,379,863.00	$237,000.00	$323,542.00	$129,000.00	Negligible	Negligible	Negligible	$108,278.00	$78,391.00	$2,906,534.00	N/A	Negligible
Burke	$450,315.00	Negligible	$100.00	Negligible	Negligible	Negligible	Negligible	$706,250.00	$64,900.00	Negligible	N/A	Negligible
Cabarrus	$903,229.00	$807,000.00	$1,135,909.00	$54,000.00	Negligible	Negligible	Negligible	$1,659,332.00	$36,038.00	Negligible	N/A	Negligible
Caldwell	$138,000.00	Negligible	$0.00	Negligible	Negligible	Negligible	Negligible	$85,000.00	$13,000.00	Negligible	N/A	Negligible
Camden	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Carteret	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Caswell	$21,561.00	$72,000.00	$43,047.00	$9,000.00	Negligible	Negligible	Negligible	$102,346.00	$41,711.00	Negligible	N/A	Negligible
Catawba	$165,050.00	Negligible	$50,100.00	Negligible	Negligible	Negligible	Negligible	$1,636,950.00	$537,400.00	Negligible	N/A	Negligible
Chatham	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cherokee	$112,207.00	$16,900.00	$28,327.00	$139,000.00	Negligible	Negligible	Negligible	$4,163,189.00	$90,077.00	Negligible	N/A	N/A
Chowan	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Clay	$77,134.00	$9,000.00	Neg	$40,000.00	Negligible	Negligible	Negligible	$10,785.00	$22,670.00	Negligible	N/A	Negligible
Cleveland	$3,774.00	$339,000.00	$1,130,502.00	$40,000.00	Negligible	Negligible	Negligible	$1,394,197.00	$73,813.00	Negligible	N/A	Negligible
Columbus	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Craven	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cumberland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Currituck	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dare	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Davidson	$46,533.00	$790,000.00	$344,444.00	$165,000.00	$116,000.00	Negligible	Negligible	$501,190.00	$162,030.00	Negligible	N/A	Negligible
Davie	$63,463.00	$110,000.00	$885,738.00	$10,000.00	Negligible	Negligible	Negligible	$11,712.00	$4,903.00	Negligible	N/A	Negligible
Duplin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Durham	$8,421.00	$10,789.00	Negligible	N/A	N/A	Negligible	Negligible	$436,538.00	$6,892.00	N/A	N/A	Negligible
Edgecombe	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Forsyth	$9,673.00	$1,374,000.00	$43,111.00	$87,000.00	Negligible	Negligible	Negligible	$11,712.00	$12,929.00	Negligible	N/A	Negligible
Franklin	$3,252.00	$890,000.00	$27,221.00	$3,000.00	Negligible	Negligible	Negligible	$862,405.00	$145,089.00	Not Calculated	Not Calculated	Negligible

County	Flooding	Hurricanes	Severe Winter Weather	Earthquakes	Wildfires	Dam Failures	Drought	Tornado	Thunderstorms	Landslides	Infectious Disease	Extreme Heat
Gaston	$161,132.00	$805,000.00	$1,141,609.00	$79,000.00	Negligible	$197.00	Negligible	$1,442,814.00	$35,104.00	Negligible	N/A	Negligible
Gates	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Graham	$320,524.00	$5,500.00	$33,150.00	$47,300.00	Negligible	Negligible	Negligible	$1,243,824.00	$95,638.00	Negligible	N/A	N/A
Granville	$4,207.00	$517,000.00	$41,868.00	$3,000.00	Negligible	Negligible	Negligible	$130,271.00	$12,129.00	Not Calculated	Not Calculated	Negligible
Greene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Guilford	$147,647.00	$2,278,000.00	$454,297.00	$121,000.00	Negligible	Negligible	Negligible	$2,871,725.00	$267,321.00	N/A	Negligible	Negligible
Halifax	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Harnett	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Haywood	$464,639.00	$50,000.00	$206,620.00	$284,500.00	Negligible	Negligible	Negligible	$1,078,897.00	$109,822.00	Negligible	N/A	N/A
Henderson	$428,371.00	$151,000.00	$60,481.00	$51,000.00	Negligible	Negligible	Negligible	$1,308.00	$59,712.00	$178,243.00	N/A	Negligible
Hertford	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hoke	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hyde	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iredell	$367,126.00	$522,000.00	$964,143.00	$47,000.00	Negligible	Negligible	Negligible	$367,126.00	$51,348.00	Negligible	N/A	Negligible
Jackson	$70,878.00	$26,300.00	$666,710.00	$189,800.00	Negligible	Negligible	Negligible	$1,078,897.00	$107,691.00	Negligible	N/A	N/A
Johnston	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jones	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lee	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lenoir	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lincoln	$46,246.00	$233,000.00	$796,460.00	$25,000.00	Negligible	Negligible	Negligible	$1,216,069.00	$23,393.00	Negligible	N/A	Negligible
Macon	$290,279.00	$40,000.00	Neg	$177,000.00	Negligible	Negligible	Negligible	$27,797.00	$49,911.00	$202,636.00	N/A	Negligible
Madison	$1,160,697.00	$13,000.00	$319,567.00	$10,000.00	Negligible	Negligible	Negligible	$60,793.00	$51,740.00	Negligible	N/A	Negligible
Martin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
McDowell	$6,882,000.00	$42,728.00	Negligible	$105,000.00	Negligible	Negligible	Negligible	$7,953.00	$12,131.00	$5,856.00	N/A	N/A
Mecklenburg	$4,864,000.00	$6,921,500.00	$1,178,000.00	$1,235,000.00	$168,000.00	Negligible	$792,000.00	$170,000.00	$286,000.00	Negligible	N/A	N/A
Mitchell	$3,992,000.00	$13,491.00	Negligible	$46,000.00	Negligible	Negligible	Negligible	Negligible	$66.00	$1,209.00	N/A	N/A
Montgomery	Not Calculated	$378,300.00	Not Calculated	$24,800.00	Negligible	Negligible	Negligible	$207,046.00	$6,693.00	Negligible	Not Calculated	Not Calculated
Moore	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nash	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New Hanover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Northampton	Not Calculated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Onslow	$485,000.00	$51,000,000.00	$8,529.00	Negligible	Negligible	Negligible	Negligible	$249,939.00	$4,645.00	Negligible	Not Calculated	Negligible
Orange	$561,053.00	Negligible	Negligible	N/A	N/A	N/A	Negligible	Negligible	$37,931.00	N/A	N/A	N/A
Pamlico	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pasquotank	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pender	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

County	Flooding	Hurricanes	Severe Winter Weather	Earthquakes	Wildfires	Dam Failures	Drought	Tornado	Thunderstorms	Landslides	Infectious Disease	Extreme Heat
Perquimans	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Person	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pitt	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Polk	$171,333.00	$36,000.00	$799,446.00	$9,000.00	Negligible	Negligible	Negligible	$5,930.00	$7,474.00	Negligible	N/A	Negligible
Randolph	Negligible	$880,000.00	$191,139.00	$15,000.00	Negligible	Negligible	Negligible	$189,670.00	$36,169.00	Negligible	Negligible	Negligible
Richmond	$9,498.00	$905,970.00	Not Calculated	$54,400.00	Negligible	Negligible	Negligible	$34,507.00	$35,007.00	Negligible	Not Calculated	Not Calculated
Robeson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rockingham	$203,871.00	$276,000.00	$43,047.00	$17,000.00	Negligible	Negligible	Negligible	$3,286,824.00	$66,069.00	Negligible	N/A	Negligible
Rowan	$39,918.00	$575,000.00	$956,585.00	$41,000.00	Negligible	Negligible	Negligible	$355,639.00	$112,365.00	Negligible	N/A	Negligible
Rutherford	$605,552.00	$108,725.00	$799,446.00	$30,000.00	Negligible	Negligible	Negligible	$25,239.00	$108,725.00	Negligible	N/A	Negligible
Sampson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scotland	$9,964.00	$2,770,290.00	$28,301.00	$47,800.00	Negligible	Negligible	Negligible	$589,870.00	$57,008.00	Negligible	Not Calculated	Not Calculated
Stanly	$20,994.00	$438,000.00	$43,762.00	$24,000.00	Negligible	Negligible	Negligible	$540,263.00	$8,426.00	Negligible	N/A	Negligible
Stokes	$6,753.00	$108,000.00	$46,202.00	$9,000.00	Negligible	Negligible	Negligible	$268,223.00	$23,997.00	Negligible	N/A	Negligible
Surry	$107,078.00	$118,000.00	$195,731.00	$18,000.00	Negligible	Negligible	Negligible	$84,978.00	$101,385.00	Negligible	N/A	Negligible
Swain	$96,804.00	$8,000.00	$206,840.00	$97,500.00	Negligible	Negligible	Negligible	$1,093,823.00	$96,746.00	Negligible	N/A	N/A
Transylvania	$925,884.00	$43,000.00	$1,034,026.00	$18,000.00	Negligible	Negligible	Negligible	$21,873.00	$56,483.00	$176,175.00	N/A	Negligible
Tyrrell	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Union	$29,397.00	$1,105,000.00	$1,135,909.00	$67,000.00	Negligible	Negligible	Negligible	$1,023,582.00	$109,582.00	Negligible	N/A	Negligible
Vance	$9,230.00	$341,000.00	$41,346.00	$2,000.00	Negligible	Negligible	Negligible	$792,592.00	$10,013.00	Not Calculated	Not Calculated	Negligible
Wake	$590,938.00	$9,936,000.00	$47,408.00	$119,000.00	Negligible	Negligible	Negligible	$11,553,089.00	$686,730.00	Negligible	N/A	Negligible
Warren	$17,637.00	$1,937,000.00	$150,574.00	$1,000.00	Negligible	Negligible	Negligible	$70,835.00	$12,423.00	Not Calculated	Not Calculated	Negligible
Washington	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Watauga	$597,880.00	$39,500.00	$58,411.00	$30,600.00	Negligible	Negligible	Negligible	$10,819.00	$17,839.00	Negligible	N/A	N/A
Wayne	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wilkes	$225,784.00	$81,290.00	$72,156.00	$7,800.00	Negligible	Negligible	Negligible	$87,089.00	$20,766.00	Negligible	N/A	N/A
Wilson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yadkin	$902.00	$76,000.00	$62,780.00	$9,000.00	Negligible	Negligible	Negligible	$20,826.00	$38,934.00	Negligible	N/A	Negligible
Yancey	$4,254,000.00	$14,989.00	Negligible	$47,000.00	Negligible	Negligible	Negligible	$3,846.00	$770.00	$16,903.00	N/A	N/A
North Carolina	$39,660,039.00	$245,891,831.00	$15,973,484.00	$3,901,300.00	$284,000.00	$197.00	$792,000.00	$42,167,183.00	$4,193,353.00	$3,488,646.00	$0.00	$0.00

N/A indicates that the County did not consider the hazard or there wasn't enough data to compute an annualized loss.
Not calculated indicated that the hazard was included in the Risk Assessment but an annualized loss was simply not calculated.

3.4.5.2 Vulnerability for State-Owned Facilities

According to the North Carolina Department of Insurance, Office of State Fire Marshall's Office, the North Carolina State-Owned Properties insures the State's universities and colleges, government business services – transportation, parks, legislative, offices, etc., correctional facilities, ports authority, medical facilities, stadiums and arenas and college housing. The account has 14,310 locations with Total Insurable Values (TIV) of $38,038,303,059 as of 2017. The coastal, Tier 1 county value exposure is $2,464,303,095 or 6.48% of the TIV."

The North Carolina Department of Insurance reports that, according to two modeling programs (2016 AIR Worldwide Touchstone v3.1 and RMS's RiskBrowser v15.0 models) State-Owned Property Losses based on worst case scenarios modeling, for 1,000-year hurricane event the cost would be $783,623,225; for a 20-year hurricane event the property loss would be $88,752,422; and annual average loss (AAL) is $16,910,600. These figures are based on total insured value of about $40 billion. UNC Campuses, Universities, UNC Hospitals represent about 73 % of the overall values or about $28 billion.

The modeling programs used to determine those losses are proprietary and therefore, the details of the methodology used to develop those estimates cannot be provided in this document. Other vulnerability analyses were conducted by NCEM-RM and their contractors to determine vulnerability for state-owned facilities. Those methodologies are described in the hazard-specific vulnerability discussions found below.

3.4.5.3 Flood Hazard Vulnerability

The State of North Carolina has developed advanced technology and continues to acquire tremendous amounts of data for the purposes of determining flood hazard vulnerability. This includes creating building footprints for every building in the State (for buildings greater than 500 square feet) and collecting first floor elevations for every building in the State. Having this data, and combining it with the digital flood data that has been developed, allows NCEM-RM to conduct detailed flood risk assessments that take into account the first-floor elevation of structures and associated depth of flooding (and associated damages).

The 2018 plan update represents the first attempt at beginning to integrate the findings from that technology and data to determine county-level summaries of vulnerability. At this time, this plan will include county level vulnerability as calculated by annualized loss. Future updates of the plan will attempt to expand on this analysis by incorporating results from other return period flood events.

Table 3-30 Annualized Flood Hazard Losses by County

County	Annualized Losses
Alamance	$ 190,069.75
Alexander	$ 1,452.16
Alleghany	$ 15,898.44
Anson	$ 53,805.49
Ashe	$ 118,948.98
Avery	$ 30,225.90
Beaufort	$ 510,486.01
Bertie	$ 9,602.90
Bladen	$ 36,564.31
Brunswick	$ 791,848.17
Buncombe	$ 14,314,247.24
Burke	$ 41,225.67
Cabarrus	$ 240,305.29
Caldwell	$ 260,033.69
Camden	$ 21,493.67
Carteret	$ 779,712.65
Caswell	$ 40,681.10
Catawba	$ 97,335.77
Chatham	$ 182,933.96
Cherokee	$ 73,128.33
Chowan	$ 9,437.50
Clay	$ 8,650.81
Cleveland	$ 51,089.09
Columbus	$ 8,080.53
Craven	$ 160,761.35
Cumberland	$ 43,975.62
Currituck	$ 174,498.83
Dare	$ 775,745.20
Davidson	$ 15,297.30
Davie	$ 147,302.50
Duplin	$ 308,315.50
Durham	$ 1,973,614.48
Edgecombe	$ 704,827.40
Forsyth	$ 121,112.73
Franklin	$ 35,580.87
Gaston	$ 58,104.97
Gates	$ 2,974,202.51
Graham	$ 23,605.85
Granville	$ 1,661.63

County	Annualized Losses
Greene	$ 13,285.60
Guilford	$ 318,727.68
Halifax	$ 394,506.10
Harnett	$ 12,967.05
Haywood	$ 338,641.30
Henderson	$ 364,351.16
Hertford	$ 5,205,709.45
Hoke	$ 1,062.99
Hyde	$ 313,676.88
Iredell	$ 315,169.10
Jackson	$ 9,025,286.05
Johnston	$ 572,641.62
Jones	$ 5,649.21
Lee	$ 6,877.03
Lenoir	$ 5,110,209.97
Lincoln	$ 201,014.35
Macon	$ 94,363.73
Madison	$ 160,959.58
Martin	$ 79,310.15
McDowell	$ 32,418.29
Mecklenburg	$ 785,367.29
Mitchell	$ 34,616.02
Montgomery	$ 58,263.75
Moore	$ 6,443.29
Nash	$ 7,217,910.34
New Hanover	$ 2,319,798.50
Northampton	$ 2,814,138.18
Onslow	$ 216,407.43
Orange	$ 180,524.71
Pamlico	$ 127,493.08
Pasquotank	$ 41,971.87
Pender	$ 233,188.63
Perquimans	$ 9,696.20
Person	$ 442,478.00
Pitt	$ 2,344,846.28
Polk	$ 42,361.15
Randolph	$ 41,905.24
Richmond	$ 544,766.03
Robeson	$ 31,452,319.00
Rockingham	$ 306,191.37
Rowan	$ 259,074.76

County	Annualized Losses
Rutherford	$ 176,093.67
Sampson	$ 226,564.56
Scotland	$ 131,796.69
Stanly	$ 88,864.85
Stokes	$ 999.47
Surry	$ 385,351.30
Swain	$ 18,272,384.76
Transylvania	
Tyrrell	$ 37,649.69
Union	$ 16,835.26
Vance	$ 5,576.70
Wake	$ 921,373.19
Warren	$ 770.91
Washington	$ 5,580.94
Watauga	$ 158,827.40
Wayne	$ 676,092.57
Wilkes	$ 511,849.81
Wilson	$ 1,478,961.63
Yadkin	$ 3,244.77
Yancey	$ 67,057.72
North Carolina	$ 120,618,328.43

Source: NCEM-RM

National Flood Insurance Program (NFIP) and Repetitive Loss Data

According to FEMA records compiled as of September 30, 2017, there are 130,282 flood insurance policies in force in the state of North Carolina, with more than $32 billion in coverage and almost $ 108 million of annual premiums in force. There have been 83,390 claims under the NFIP totaling over $1.2 billion. 27,461 of those claims were closed without payment. Table 3-31 provides a summary of the NFIP policies and claims that have been made in North Carolina.

Table 3-31 North Carolina NFIP Policy and Claims Data

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Alamance	Alamance County	50	$15,377,900.00	35	$824,801.65
	Burlington	147	$31,209,900.00	44	$378,054.58
	Elon	23	$5,880,100.00	2	$12,790.23
	Gibsonville	29	$6,756,100.00	2	$0.00
	Graham	45	$9,683,100.00	10	$63,752.71
	Haw River	6	$899,200.00	1	$60,000.00
	Mebane	41	$9,975,600.00	2	$4,622.05

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Summerfield	15	$4,200,000.00		
	Swepsonville	3	$574,400.00		
Alexander	Alexander County	29	$7,657,000.00	4	$4,910.85
	Taylorsville	3	$1,150,000.00		
Alleghany	Alleghany County	17	$4,016,300.00	2	$51,459.92
	Sparta	3	$350,000.00	2	$34,861.10
Anson	Anson County	3	$980,000.00	1	$11,012.97
	Wadesboro	4	$1,105,000.00	1	$6,579.63
Ashe	Ashe County	155	$37,123,900.00	77	$527,780.02
	Jefferson	5	$2,146,500.00	4	$8,618.01
	Lansing	4	$332,800.00	1	$24,194.26
	West Jefferson	7	$1,580,800.00	15	$206,917.50
Avery	Avery County	148	$34,637,800.00	116	$2,049,238.12
	Banner Elk	31	$8,044,100.00	9	$85,396.72
	Beech Mountain	22	$7,028,000.00	1	
	Crossnore	5	$792,600.00	4	$34,480.71
	Elk Park	5	$575,400.00	2	$2,487.44
	Grandfather Village	10	$3,450,000.00		
	Newland	9	$2,780,600.00	11	$592,999.77
	Seven Devils	2	$310,000.00		
	Sugar Mountain	9	$2,870,000.00		
Beaufort	Aurora	35	$25,640.00	34	$796,499.27
	Bath	83	$45,619.00	33	$315,813.17
	Beaufort County	2255	$1,733,818.00	4663	$69,518,711.65
	Belhaven	450	$397,254.00	1847	$19,285,695.35
	Chocowinity	2	$1,277.00	6	$99,791.53
	Pantego	14	$18,666.00	9	$71,415.62
	Washington Park	134	$183,710.00	308	$3,636,964.54
	Washington (City)	1204	$1,124,419.00	1262	$13,335,556.99
Bertie	Aulander	10	$1,044,000.00	7	$51,959.11
	Bertie County	91	$16,732,600.00	101	$2,567,926.78
	Colerain	2	$630,000.00		
	Kelford	1	$70,000.00		
	Roxobel	1	$140,000.00		
	Windsor	119	$19,346,700.00	305	$10,542,964.32
Bladen	Bladen County	105	$18,384,200.00	45	$2,574,621.78
	Bladenboro	19	$2,601,900.00	16	$605,898.99
	Clarkton	3	$533,000.00		$52,606.93
	Elizabethtown	16	$4,135,600.00	3	

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	White Lake	9	$2,415,000.00	6	$117,495.94
Brunswick	Bald Head Island	1080	$335,082,300.00	335	$2,216,068.00
	Belville	49	$13,931,300.00		
	Boiling Spring Lakes	124	$30,314,600.00	28	$155,567.00
	Bolivia	3	$428,000.00		
	Brunswick County	3324	$932,369,100.00	436	$4,525,946.14
	Calabash	65	$18,995,300.00	5	$75,749.15
	Carolina Shores	376	$110,570,600.00	24	$1,108,427.29
	Caswell Beach	644	$140,053,900.00	136	$678,855.77
	Holden Beach	1860	$503,506,200.00	2123	$12,550,556.12
	Leland	389	$113,704,300.00	3	$4,901.42
	Long Beach	3	$760,800.00	1914	$17,682,275.85
	Navassa	7	$1,665,000.00	1	$15,809.49
	Northwest	6	$1,568,000.00		
	Oak Island	3281	$833,249,600.00	267	$1,566,191.40
	Ocean Isle Beach	2433	$612,517,200.00	1799	$8,309,236.19
	Shallotte	151	$46,806,800.00	11	$645,201.10
	Southport	379	$112,369,400.00	61	$459,034.93
	St James	940	$296,049,500.00	1	
	Sunset Beach	1696	$444,502,900.00	238	$472,501.47
	Yaupon Beach			85	$749,362.08
	Varnamtown	15	$4,487,900.00		
Buncombe	Asheville	510	$156,429,800.00	317	$14,527,234.00
	Biltmore Forest	11	$4,232,700.00		
	Black Mountain	61	$14,347,800.00	18	$35,989.00
	Buncombe County	382	$99,665,600.00	211	$3,586,462.00
	Montreat	11	$3,850,000.00		
	Weaverville	28	$7,982,800.00		
	Woodfin	26	$10,332,800.00	5	$41,307.00
Burke	Burke County	66	$15,242,400.00	23	$743,362.00
	Connelly Springs	1	$250,000.00		
	Drexel	3	$593,000.00	1	
	Glen Alpine	1	$210,000.00		
	Hickory	84	$22,139,100.00	23	$200,273.00
	Hildebran	1	$70,000.00		
	Long View	6	$1,853,900.00		
	Morganton	50	$14,585,500.00	22	$1,202,461.00
	Rhodhiss	5	$1,312,400.00	2	$12,587.00
	Valdese	1	$552,500.00		

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Cabarrus	Cabarrus County	143	$40,424,900.00	100	$1,855,575.00
	Concord	157	$46,068,800.00	20	$131,442.00
	Harrisburg	82	$20,590,500.00	44	$660,642.00
	Kannapolis	81	$19,792,800.00	15	$1,203,576.00
	Locust	2	$700,000.00		
	Midland	4	$533,100.00		
	Mount Pleasant	1	$350,000.00		
Caldwell	Caldwell County	75	$15,331,800.00	18	$233,720.00
	Gamewell	2	$208,500.00		
	Granite Falls	7	$1,504,200.00	1	
	Hudson	6	$2,819,000.00		
	Lenoir	97	$22,766,900.00	31	$185,873.00
Camden	Camden County	884	$204,465,700.00	263	$3,171,892.00
	Elizabeth City	1435	$273,274,300.00	274	$4,541,606.00
Carteret	Atlantic Beach	2972	$513,327,400.00	837	$6,135,084.00
	Beaufort	786	$208,184,900.00	112	$787,982.00
	Bogue	30	$8,707,100.00		
	Cape Carteret	163	$45,894,800.00	99	$937,442.00
	Carteret County	3776	$872,431,000.00	3216	$41,067,494.00
	Cedar Point	314	$64,724,000.00	63	$529,249.00
	Emerald Isle	2721	$686,414,100.00	1406	$7,929,318.00
	Indian Beach	469	$106,266,700.00	29	$140,992.00
	Morehead City	1475	$406,422,600.00	259	$1,588,929.00
	Newport	105	$25,208,100.00	25	$165,150.00
	Peletier	10	$2,547,500.00		
	Pine Knoll Shores	1340	$319,433,100.00	254	$1,218,180.00
Caswell	Caswell County	2	$378,000.00		
Catawba	Brookford	1	$108,000.00		
	Catawba County	101	$24,993,600.00	89	$1,102,685.00
	Catawba (Town of)	1	$350,000.00	1	
	Claremont	5	$922,700.00		
	Conover	17	$3,615,800.00	6	$21,468.00
	Maiden	10	$4,022,600.00	1	$2,378.00
	Newton	19	$4,056,600.00	3	$50,078.00
Chatham	Cary	684	$203,497,800.00	156	$2,424,510.00
	Chatham County	120	$35,251,100.00	1	$1,893.00
	Pittsboro	20	$4,777,200.00	2	
	Siler City	16	$2,848,000.00	5	$149,039.00
Cherokee	Andrews	6	$1,948,600.00	5	$192,489.00

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Cherokee County	136	$31,289,500.00	36	$299,041.00
	Eastern Band of Cherokee Indians	45	$10,363,500.00	5	$244,607.00
	Murphy	5	$1,826,000.00	4	$24,946.00
Chowan	Chowan County	269	$71,099,300.00	106	$1,455,527.00
	Edenton	187	$50,376,800.00	161	$4,408,215.00
Clay	Clay County	115	$30,428,500.00	21	$92,312.00
	Hayesville	10	$1,888,500.00		
Cleveland	Cleveland County	10	$2,432,000.00	7	$29,293.00
	Kings Mountain	12	$2,683,000.00	3	$11,804.00
	Shelby	36	$9,472,200.00	28	$403,317.00
Columbus	Brunswick	1	$140,000.00		
	Cerro Gordo	1	$100,000.00		
	Chadbourn	7	$1,785,000.00	6	$67,050.00
	Columbus County	246	$45,550,900.00	146	$3,218,436.00
	Fair Bluff	63	$7,437,800.00	16	$977,984.00
	Lake Waccamaw	48	$11,105,400.00	39	$468,238.00
	Tabor City	16	$1,813,000.00	7	$97,055.00
	Whiteville	66	$11,396,000.00	66	$1,399,858.00
Craven	Bridgeton	73	$14,692,500.00	54	$483,526.00
	Cove City	1	$210,000.00		
	Craven County	2193	$539,109,900.00	1649	$19,721,973.00
	Havelock	164	$40,386,800.00	84	$1,587,850.00
	New Bern	1358	$301,747,600.00	986	$9,464,390.00
	River Bend	448	$102,742,200.00	430	$4,203,994.00
	Trent Woods	254	$73,371,000.00	114	$1,018,378.00
	Vanceboro	6	$1,338,600.00	3	$15,959.00
Cumberland	Cumberland County	598	$153,128,300.00	158	$6,921,869.00
	Falcon	1	$140,000.00		
	Fayetteville	1149	$277,074,300.00	351	$11,869,865.00
	Fletcher	45	$12,009,200.00	2	$16,687.00
	Hope Mills	4	$1,092,000.00	5	$45,448.00
	Spring Lake	18	$3,644,800.00	3	$13,671.00
	Stedman	7	$1,960,000.00	1	$6,355.00
	Wade	2	$280,000.00		
Currituck	Currituck County	5101	$1,444,536,300.00	1744	$18,605,190.00
Dare	Dare County	8768	$2,176,023,900.00	9958	$125,254,303.00
	Duck	972	$306,321,100.00	72	$619,399.00
	Kill Devil Hills	4277	$1,007,862,000.00	1920	$17,754,192.00
	Kitty Hawk	1554	$405,919,800.00	1750	$18,272,825.00

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Manteo	899	$208,738,900.00	226	$3,602,714.00
	Nags Head	3477	$958,194,600.00	3120	$33,012,207.00
	Southern Shores	1147	$339,838,700.00	320	$1,650,037.00
Davidson	Davidson County	180	$42,019,100.00	32	$229,407.00
	Denton	1	$280,000.00		
	High Point	265	$58,312,300.00	92	$288,904.00
	Lexington	27	$7,801,900.00	11	$25,648.00
	Thomasville	57	$16,011,400.00	12	$108,134.00
	Wallburg	2	$630,000.00		
Davie	Bermuda Run	30	$8,662,600.00	1	$84,532.00
	Cooleemee	1	$350,000.00		
	Davie County	37	$10,277,600.00	6	$27,596.00
	Matthews	75	$22,053,000.00	10	$126,312.00
	Mocksville	3	$760,000.00		
Duplin	Beulaville	3	$595,000.00	1	$14,554.00
	Calypso	3	$595,000.00	1	$12,858.00
	Duplin County	325	$90,793,000.00	160	$4,051,519.00
	Faison	2	$350,000.00	1	
	Greenevers	1	$350,000.00		
	Kenansville	3	$1,410,000.00		
	Magnolia	2	$490,000.00		
	Mount Olive	13	$2,918,000.00	20	$257,180.00
	Rose Hill	1	$70,000.00		
	Wallace	20	$5,035,000.00	25	$462,176.00
	Warsaw	9	$2,345,000.00	1	$10,148.00
Durham	Butner	6	$1,372,000.00	1	
	Chapel Hill	669	$131,158,400.00	263	$10,242,770.00
	Durham County	207	$54,268,900.00	68	$583,957.00
	Durham (City of)	1141	$282,912,200.00	199	$2,555,190.00
Edgecombe	Conetoe	9	$1,804,700.00	2	$99,803.00
	Edgecombe County	131	$25,598,300.00	104	$3,152,177.00
	Leggett	6	$458,800.00	1	$518.00
	Pinetops	41	$2,640,100.00	25	$889,299.00
	Princeville	158	$34,253,200.00	124	$7,694,597.00
	Rocky Mount	917	$214,698,400.00	889	$38,985,164.00
	Sharpsburg	20	$4,223,000.00	12	$169,452.00
	Speed	15	$2,388,100.00	9	$83,695.00
	Tarboro	253	$52,307,200.00	104	$2,669,231.00
	Whitakers	3	$509,800.00		

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Forsyth	Clemmons	35	$8,611,600.00	2	$40,653.00
	Forsyth County	120	$32,189,700.00	79	$612,113.00
	Kernersville	28	$8,417,200.00	4	$88,856.00
	King	6	$1,731,900.00	1	
	Lewisville	13	$3,848,000.00	1	$351.00
	Rural Hall	2	$455,000.00		
	Walkertown	3	$742,000.00		
	Winston-Salem	481	$121,781,900.00	263	$2,340,264.00
Franklin	Franklin County	63	$15,039,600.00	4	$13,729.00
	Franklinton	2	$490,000.00		
	Louisburg	12	$2,520,200.00	15	$119,853.00
Gaston	Belmont	27	$7,256,700.00	5	$8,066.00
	Bressemer	2	$226,200.00		
	Cherryville	2	$420,000.00		
	Cramerton	22	$5,103,700.00	4	$27,215.00
	Dallas	10	$1,575,700.00	2	$12,878.00
	Gaston County	50	$12,555,300.00	10	$36,872.00
	Gastonia	157	$34,606,200.00	31	$85,232.00
	Lowell	5	$1,402,000.00		
	McAdenville	7	$3,207,800.00		
	Middlesex	1	$350,000.00		
	Mount Holly	53	$12,883,100.00	5	$12,745.00
	Pleasant Garden	3	$980,000.00		
	Ranlo	3	$739,900.00		
	Stanley	2	$499,300.00		
Gates	Gates County	74	$17,876,800.00	23	$256,704.00
	Gatesville	3	$1,370,000.00	3	$159,447.00
Graham	Graham County	46	$8,367,300.00	4	$10,846.00
	Robbinsville	2	$245,600.00		
Granville	Creedmoor	2	$322,000.00	6	$854,590.00
	Granville County	29	$7,851,400.00	3	$93,168.00
	Oxford	4	$760,600.00	2	$2,433.00
Greene	Greene County	88	$16,514,500.00	49	$1,706,043.00
	Hookerton			1	$52,610.00
	Snow Hill	24	$5,781,700.00	22	$785,018.00
Guilford	Archdale	26	$3,937,700.00	11	$35,156.00
	Greensboro	627	$157,568,000.00	342	$4,252,959.00
	Guilford County	100	$26,075.00	49	$484,132.00
	Jamestown	10	$2,788,300.00		

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Oak Ridge	2	$378,000.00	1	$17,950.00
	Sedalia	1	$280,000.00		
	Stokesdale	2	$443,200.00		
Halifax	Enfield	4	$1,480,000.00	4	$139,888.00
	Halifax County	35	$8,186,600.00	3	$3,753.00
	Hobgood	3	$658,000.00	1	$2,349.00
	Littleton	1	$105,000.00		
	Roanoke Rapids	76	$18,786,100.00	34	$451,605.00
	Scotland Neck	3	$770,000.00	1	$85,318.00
	Weldon	9	$2,674,900.00	2	$70,364.00
Harnett	Angier	8	$2,463,000.00	1	
	Broadway	3	$770,000.00	1	$20,239.00
	Dunn	61	$10,330,200.00	13	$178,579.00
	Erwin	12	$2,834,700.00	2	$202,472.00
	Harnett County	302	$74,468,400.00	39	$649,378.00
	Lillington	6	$1,410,300.00		
Haywood	Canton	39	$10,205,700.00	59	$3,045,873.00
	Clyde	61	$10,586,600.00	148	$3,874,582.00
	Haywood County	231	$50,360,900.00	65	$991,475.00
	Maggie Valley	44	$14,354,100.00	6	$23,642.00
	Waynesville	305	$52,150,700.00	31	$117,734.00
Henderson	Flat Rock	28	$7,146,400.00		
	Henderson County	196	$52,395,200.00	18	$292,472.00
	Hendersonville	130	$35,320,600.00	141	$1,479,665.00
	Laurel Park	7	$1,918,000.00	1	$2,979.00
	Saluda	1	$280,000.00		
Hertford	Ahoskie	21	$6,160,100.00	67	$1,444,592.00
	Cofield	1	$175,000.00		
	Hertford County	68	$14,319,900.00	70	$1,459,247.00
	Murfreesboro	2	$560,000.00	3	
	Winton	3	$875,000.00	3	$31,122.00
Hoke	Hoke County	132	$31,725,500.00	18	$333,089.00
	Raeford	7	$1,995,000.00	2	
Hyde	Hyde County	1268	$244,255,200.00	1172	$15,809,967.00
Iredell	Davidson	47	$15,139,500.00	1	
	Iredell County	84	$25,364,200.00	12	$71,478.00
	Mooresville	29	$7,353,700.00		
	Statesville	35	$9,368,900.00	19	$880,368.00
	Troutman	1	$1,000,000.00		

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Jackson	Dillsboro	7	$2,321,600.00	6	$307,078.00
	Forest Hills	2	$308,500.00		
	Highlands	24	$7,010,900.00		
	Jackson County	236	$56,591,500.00	29	$274,697.00
	Sylva	35	$9,572,700.00	8	$121,212.00
	Webster	6	$976,000.00	1	
Johnston	Benson	10	$2,380,000.00	1	$68,721.00
	Clayton	52	$16,341,600.00	5	$7,831.00
	Four Oaks	9	$2,150,700.00	2	$56,264.00
	Johnston County	287	$67,024,900.00	98	$3,287,100.00
	Kenly	5	$1,640,000.00	2	$77,454.00
	Micro	1	$80,000.00		
	Pine Level	2	$630,000.00		
	Princeton	6	$985,000.00		
	Selma	10	$2,800,000.00		
	Smithfield	126	$30,489,900.00	126	$6,070,550.00
Jones	Jones County	11	$29,519,300.00	66	$2,384,083.00
	Maysville	5	$963,000.00	1	$33,809.00
	Pollocksville	13	$3,423,800.00	17	$560,778.00
	Trenton	10	$1,817,800.00	18	$185,912.00
Lee	Lee County	63	$16,280.00	17	$181,592.00
	Sanford	53	$14,057.00	12	$95,509.00
Lenoir	Grifton	82	$15,831,500.00	58	$2,556,609.00
	Kinston	345	$77,204,100.00	480	$28,498,419.00
	La Grange	9	$1,983,000.00	1	$13,422.00
	Lenoir County	188	$32,837,200.00	161	$5,739,675.00
Lincoln	Lincoln County	92	$26,152,500.00	7	$130,380.00
	Lincolnton	13	$1,769,700.00	1	$3,933.00
Macon	Macon County	156	$40,005,100.00	48	$1,011,968.00
Madison	Hot Springs	4	$888,000.00	1	$2,361.00
	Madison County	51	$13,130,000.00	20	$416,269.00
	Mars Hill	6	$1,149,500.00	1	
	Marshall	28	$6,967,700.00	46	$517,815.00
Martin	Hamilton			1	$26,019.00
	Martin County	38	$7,445,900.00	22	$282,478.00
	Robersonville	4	$1,190,000.00	5	$39,838.00
	Williamston	45	$8,832,300.00	13	$216,949.00
McDowell	Marion	12	$15,910.00	3	$56,414.00
	McDowell County	70	$51,693.00	48	$673,511.00

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Old Fort	10	$9,014.00	2	$2,941.00
Mecklenburg	Charlotte	2810	$700,798,700.00	2173	$38,085,752.00
	Cornelius	131	$38,658,000.00	7	$81,233.00
	Huntersville	126	$38,066,100.00		
	Mecklenburg	262	$67,569,400.00	188	$2,823,433.00
	Mint Hill	47	$12,850,400.00	2	$18,104.00
	Pineville	58	$18,781,300.00	3	$18,000.00
Mitchell	Bakersville	11	$3,421,700.00	12	$196,023.00
	Mitchell County	18	$4,126,000.00	13	$316,563.00
	Spruceville			9	$291,600.00
Montgomery	Montgomery County	21	$5,128,800.00	4	$44,138.00
	Troy	2	$630,000.00		
Moore	Aberdeen	23	$6,088,500.00	2	$912.00
	Foxfire	1	$350,000.00		
	Moore County	273	$65,970,200.00	57	$826,940.00
	Pinebluff	1	$300,000.00		
	Pinehurst	109	$26,647,400.00	12	$261,118.00
	Southern Pines	64	$17,679,000.00	7	$41,724.00
	Whispering Pines	38	$10,235,600.00	3	$590.00
Nash	Dortches	2	$700,000.00		
	Nash County	107	$28,138,500.00	65	$2,661,903.00
	Nashville	40	$9,446,700.00	38	$1,594,830.00
	Red Oak	14	$4,602,600.00	2	$3,693.00
	Spring Hope	1	$100,000.00		
New Hanover	Carolina Beach	3576	$703,841,400.00	2554	$31,536,729.00
	Kure Beach	954	$256,636,000.00	504	$161,197,465.00
	New Hanover County	4606	$1,361,888,400.00	2498	$37,881,368.00
	Wilmington	2601	$729,840,700.00	288	$3,429,962.00
	Wrightsville	2685	$671,964,900.00	3134	$45,554,787.00
Northampton	Conway	1	$350,000.00		
	Garysburg	3	$980,000.00	1	$13,363.00
	Jackson	4	$294,600.00	2	$76,282.00
	Northampton County	45	$7,835,600.00	16	$93,953.00
	Seven	5	$733,300.00	6	$44,261.00
	Woodland	3	$575,000.00	2	$11,588.00
Onslow	Holly Ridge	30	$7,760,200.00	1	$7,231.00
	Jacksonville	602	$167,993,000.00	153	$2,004,182.00
	North Topsail Beach	1310	$259,314,100.00	1265	$15,300,722.00
	Onslow County	1743	$459,311,900.00	1819	$22,403,567.00

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Richlands	18	$5,560,400.00	1	$6,685.00
	Surf City	2196	$528,118,500.00	1779	$15,528,657.00
	Swansboro	163	$42,155,800.00	103	$2,206,725.00
Orange	Carrboro	91	$24,603,800.00	10	$94,288.00
	Hillsborough	14	$4,894,500.00	6	$9,032.00
	Orange County	91	$27,899,300.00	13	$185,944.00
Pamlico	Alliance	8	$1,318,200.00	3	$15,591.00
	Bayboro	40	$8,371,600.00	46	$882,957.00
	Mesic	36	$4,865,900.00	11	$452,884.00
	Minnessott Beach	18	$5,653,800.00	8	$51,733.00
	Oriental	696	$179,293,800.00	963	$18,493,074.00
	Pamlico County	1138	$264,819,300.00	1833	$39,216,340.00
	Stonewall	21	$3,720,300.00	21	$382,493.00
	Vandemere	61	$11,965,100.00	149	$4,692,028.00
Pasquotank	Pasquotank County	1229	$281,755,400.00	208	$1,346,462.00
Pender	Atkinson	2	$385,000.00		
	Burgaw	61	$13,471,600.00	18	$189,761.00
	Pender County	1615	$421,380,700.00	789	$15,800,634.00
	Saint Helena	2	$460,000.00		
	Topsail Beach	1101	$290,618,200.00	2174	$21,663,527.00
	Watha	2	$233,400.00		
Perquimans	Hertford	43	$11,616,300.00	27	$315,015.00
	Perquimans County	668	$165,235,000.00	125	$567,547.00
	Winfall	19	$4,657,300.00	2	$55,030.00
Person	Person County	17	$3,874,400.00	1	
	Roxboro	10	$3,412,700.00	2	$24,521.00
Pitt	Ayden	24	$5,010,100.00	17	$266,042.00
	Bethel	1	$105,000.00	4	$12,469.00
	Falkland	2	$512,500.00	1	$21,317.00
	Farmville	80	$22,017,800.00	29	$179,622.00
	Greenville	1144	$258,679,500.00	571	$21,324,523.00
	Grimesland	4	$1,330,000.00	1	$40,880.00
	Pitt County	402	$88,005,500.00	395	$10,437,400.00
	Simpson	7	$2,100,000.00		
	Winterville	102	$28,016,900.00	37	$250,257.00
Polk	Columbus	1	$350,000.00		
	Polk County	50	$13,215,700.00	16	$190,534.00
	Tryon	18	$3,997,500.00	1	$20,405.00
Randolph	Asheboro	52	$8,990,300.00	14	$59,055.00

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Liberty	3	$910,000.00		
	Ramseur	2	$310,000.00	1	$5,527.00
	Randleman	6	$660,000.00		
	Randolph County	29	$6,865,100.00	8	$67,132.00
	Trinity	8	$2,029,400.00	1	
Richmond	Hamlet	3	$643,900.00	2	$34,995.00
	Richmond County	38	$3,680,000.00	5	$79,559.00
	Rockingham	25	$4,790,300.00	9	$132,054.00
Robeson	Rennert	3	$266,600.00		
	Fairmont	15	$2,009,300.00	2	$4,842.00
	Lumberton	738	$131,516,700.00	370	$16,549,203.00
	Orrum			1	$252.00
	Parkton	1	$210,000.00		
	Pembroke	6	$882,200.00		
	Proctorville	1	$42,000.00		
	Red Springs	9	$2,100,000.00	1	$44,432.00
	Robeson County	484	$55,949,900.00	203	$4,736,758.00
	Saint Pauls	5	$1,120,000.00		
Rockingham	Eden	28	$4,011,400.00	50	$311,614.00
	Madison County	8	$2,715,800.00	18	$104,050.00
	Mayodan	3	$961,100.00	12	$295,062.00
	Reidsville	28	$5,071,500.00	6	$10,804.00
	Rockingham County	17	$4,474,100.00	12	$73,433.00
Rowan	Faith	1	$108,000.00		
	Granite Quarry	17	$3,770,800.00	5	$63,935.00
	Landis	1	$67,900.00		
	Rockwell	7	$1,471,300.00	1	$700.00
	Rowan County	79	$20,509,500.00	11	$184,795.00
	Salisbury	102	$27,463,200.00	20	$130,091.00
	Spencer	4	$690,400.00	1	
Rutherford	Bostic	1	$350,000.00		
	Chimney Rock	18	$4,741,700.00		
	Forest City	5	$1,056,100.00		
	Lake Lure	50	$12,690,100.00		
	Rutherford County	43	$11,436,100.00	45	$817,814.00
	Rutherfordton	6	$1,357,600.00	1	$780.00
	Spindale	2	$3,400.00		
Sampson	Autryville			1	$7,236.00
	Clinton	25	$6,937,000.00	23	$250,741.00

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Newton Grove	3	$735,000.00	2	$197,215.00
	Sampson County	83	$18,159,700.00	69	$1,855,101.00
	Turkey	1	$210,000.00		
Scotland	East Laurinburg	1	$28,000.00		
	Laurinburg	26	$6,977,500.00	2	$32,326.00
	Scotland County	12	$2,539,800.00		
Stanly	Albemarle	32	$7,197,200.00	30	$351,635.00
	Badin	1	$210,000.00	1	
	Misenheimer	2	$377,600.00	1	$6,706.00
	Norwood	4	$1,181,000.00	1	$10,622.00
	Stanly County	18	$5,246,100.00	4	$29,767.00
Stokes	Danbury			1	$3,828.00
	Stokes County	21	$10,649.00	10	$185,099.00
	Walnut Cove	1	$1,127.00	1	$6,669.00
Surry	Elkin	3	$415,000.00	1	$3,582.00
	Mount Airy	36	$10,910,500.00	42	$1,047,033.00
	Surry County	8	$3,840,800.00	21	$355,747.00
Swain	Bryson City	31	$7,561,000.00	15	$405,822.00
	Swain County	67	$14,509,300.00	10	$26,351.00
Transylvania	Brevard	96	$27,878,200.00	15	$151,991.00
	Rosman	9	$1,728,900.00	29	$93,223.00
	Transylvania County	150	$39,027,400.00	37	$305,983.00
Tyrell	Columbia	143	$24,784,100.00	156	$3,388,631.00
	Tyrell County	415	$64,665,200.00	357	$4,482,041.00
Union	Fairview	7	$1,505,700.00		
	Hemby Bridge	4	$1,410,000.00		
	Indian Trail	92	$267,558,900.00	10	$49,878.00
	Lake Park	1	$210,000.00		
	Marshville	5	$1,300,900.00		
	Marvin	19	$6,550,000.00		
	Mineral Springs	2	$700,000.00		
	Monroe	33	$9,236,500.00	3	$15,578.00
	Stallings	47	$12,928,700.00	3	$91,652.00
	Union County	172	$49,668,600.00	29	$375,602.00
	Unionville	7	$1,980,000.00		
	Waxhaw	30	$8,848,000.00		
	Weddington	25	$7,703,300.00		
	Wesley Chapel	12	$3,990,000.00	2	$40,660.00
	Wingate	4	$906,400.00		

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Vance	Henderson	12	$2,935,100.00	6	$72,940.00
	Vance County	16	$4,244,000.00	3	$102,268.00
Wake	Apex	102	$30,549,400.00	1	$1,299.00
	Fuquay-Varina	91	$23,813,100.00	5	$107,051.00
	Garner	118	$90,125,400.00	32	$1,677,144.00
	Holly Springs	70	$21,925,300.00	12	$187,594.00
	Knightdale	34	$9,824,300.00	3	$31,363.00
	Morrisville	80	$24,338,800.00	6	$92,752.00
	Raleigh	1795	$503,161,000.00	1075	$23,441,316.00
	Rolesville	11	$3,227,000.00		
	Wake County	370	$100,032,400.00	95	$996,017.00
	Wake Forest	117	$33,584,700.00	5	
	Wendell	21	$5,363,000.00	9	$144,907.00
	Zebulon	21	$3,368,000.00	11	$187,065.00
Warren	Warren County	31	$9,373,000.00	4	
Washington	Creswell	9	$1,359,700.00	6	$25,575.00
	Plymouth	75	$19,526,400.00	42	$1,189,169.00
	Roper	11	$2,068,500.00	5	$100,477.00
	Washington County	161	$33,463,100.00	95	$1,306,085.00
Watauga	Blowing Rock	28	$9,377,600.00	9	$79,459.00
	Boone	249	$52,559,400.00	69	$940,935.00
	Watauga County	287	$74,604,800.00	148	$1,325,825.00
Wayne	Fremont	3	$595,000.00		
	Goldsboro	735	$144,234,600.00	642	$24,392,926.00
	Pikeville	8	$1,287,300.00	3	$57,621.00
	Seven Springs	12	$1,031,400.00	34	$2,316,346.00
	Walnut Creek	34	$9,934,800.00	18	$1,046,316.00
	Wayne County	351	$72,287,200.00	274	$12,884,552.00
Wilkes	North Wilkesboro	16	$32,796.00		
	Ronda	1	$1,609.00		
	Wilkes County	31	$16,385.00	3	$4,188.00
	Wilkesboro	21	$31,500.00	14	$452,467.00
Wilson	Black Creek	3	$1,636.00		
	Elm City	5	$3,483.00		
	Lucama	5	$2,360.00	1	$20,038.00
	Stantonsburg	2	$693.00	1	$35,444.00
	Wilson County	71	$40,827.00	79	$2,477,553.00
	Wilson	476	$417,567.00	359	$7,626,273.00
Yadkin	Jonesville	3	$916,000.00		

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Yadkin County	6	$1,435,000.00	2	$2,109.00
	Yadkinville	1	$50,000.00		
Yancey	Burnsville	8	$1,524,300.00	4	$70,736.00
	Yancey County	110	$25,652,500.00	49	$592,653.00
Total	North Carolina	130,282	$32,218,224,800.00	83,390	$1,231,655,253.00

Source: FEMA

Many of North Carolina's insured losses have involved repetitive loss properties. The Federal definition of a repetitive loss property is "any insured structure with at least two paid flood insurance losses of more than $1,000 each in any rolling 10-year period since 1978" (FEMA). Table 3-32 lists North Carolina repetitive loss data by community, according to FEMA records compiled in the Fall of 2017.

A few summary statistics regarding repetitive loss and severe repetitive loss properties in North Carolina:

- 13 counties have no repetitive loss properties.
- 65 of the State's 100 counties experienced an increase in the number of repetitive loss properties from 2013 to 2017.
- Only one county (Pender) had a decrease in the number of repetitive loss properties in the county from 2013 to 2017 and that was only a decrease of 2 properties.
- There are 13 counties with over 100 repetitive loss properties. Of those 13, 11 of them are coastal counties. The other two represent the largest metropolitan areas in the state (Mecklenburg and Wake Counties).
- Beaufort, Dare and New Hanover Counties have over 1,000 repetitive lose properties each and represent 42% of all repetitive loss properties in the State.

Table 3-32 Repetitive Loss Property Counts by County, 2017

County	Residential Repetitive Loss Count	Commercial Repetitive Loss County	Total Repetitive Loss County	RL Property Increase from 2012-2017	Number of Validated Severe Repetitive Loss Properties
Alamance	9	1	10	1	1
Alexander	0	0	0	0	
Alleghany	1	0	1	0	
Anson	0	0	0	0	
Ashe	2	5	7	1	
Avery	11	2	13	1	
Beaufort	1257	98	1,355	126	232
Bertie	64	34	98	91	6
Bladen	2	2	4	0	1
Brunswick	662	17	679	14	45
Buncombe	11	23	34	1	3

County	Residential Repetitive Loss Count	Commercial Repetitive Loss County	Total Repetitive Loss County	RL Property Increase from 2012-2017	Number of Validated Severe Repetitive Loss Properties
Burke	1	1	2	0	
Cabarrus	20	1	21	5	2
Caldwell	5	2	7	2	
Camden	43	11	54	9	1
Carteret	764	32	796	171	49
Caswell	0	0	0	0	
Catawba	11	0	11	6	
Chatham	18	1	19	7	
Cherokee	7	2	9	3	1
Chowan	34	2	36	24	1
Clay	1	0	1	1	
Cleveland	3	0	3	2	
Columbus	17	8	25	13	1
Craven	382	6	388	115	37
Cumberland	30	1	31	23	3
Currituck	159	2	161	87	10
Dare	1,197	109	1,306	403	152
Davidson	8	3	11	0	
Davie	1	0	1	1	
Duplin	14	5	19	4	1
Durham	41	6	47	5	8
Edgecombe	41	10	51	8	1
Forsyth	30	5	35	2	13
Franklin	5	0	5	0	
Gaston	2	0	2	2	
Gates	3	0	3	2	
Graham	0	0	0	0	
Granville	1	0	1	0	
Greene	5	0	5	4	
Guilford	44	6	50	4	11
Halifax	1	1	2	0	
Harnett	2	0	2	1	
Haywood	14	3	17	1	
Henderson	4	12	16	2	
Hertford	16	6	22	5	2
Hoke	0	0	0	0	
Hyde	104	27	131	35	8
Iredell	1	0	1	0	

County	Residential Repetitive Loss Count	Commercial Repetitive Loss County	Total Repetitive Loss County	RL Property Increase from 2012-2017	Number of Validated Severe Repetitive Loss Properties
Jackson	2	1	3	1	
Johnston	18	3	21	6	
Jones	7	0	7	2	1
Lee	3	0	3	3	
Lenoir	35	7	42	5	1
Lincoln	0	0	0	0	
Macon	4	0	4	2	
Madison	0	4	4	0	
Martin	4	2	6	4	
McDowell	1	3	4	2	1
Mecklenburg	315	19	334	27	43
Mitchell	3	4	7	1	
Montgomery	0	0	0	0	
Moore	1	1	2	2	
Nash	6	1	7	0	
New Hanover	1323	76	1,399	6	44
Northampton	1	0	1	1	
Onslow	687	31	718	24	38
Orange	2	0	2	1	
Pamlico	637	27	664	369	12
Pasquotank	21	0	21	3	1
Pender	418	17	435	-2	36
Perquimans	6	0	6	2	
Person	0	0	0	0	
Pitt	49	3	52	27	6
Polk	2	0	2	1	
Randolph	1	0	1	0	
Richmond	1	2	3	0	1
Robeson	13	1	14	2	
Rockingham	10	2	12	0	1
Rowan	4	0	4	0	
Rutherford	5	1	6	0	
Sampson	5	0	5	0	1
Scotland	0	0	0	0	
Stanly	0	3	3	0	
Stokes	0	0	0	0	
Surry	1	6	7	0	
Swain	0	2	2	1	1

County	Residential Repetitive Loss Count	Commercial Repetitive Loss County	Total Repetitive Loss County	RL Property Increase from 2012-2017	Number of Validated Severe Repetitive Loss Properties
Transylvania	5	0	5	0	
Tyrrell	75	4	79	64	1
Union	4	0	4	1	
Vance	1	0	1	0	
Wake	100	35	135	15	23
Warren	0	0	0	0	
Washington	7	1	8	7	
Watauga	10	7	17	5	
Wayne	44	7	51	4	1
Wilkes	0	1	1	0	1
Wilson	29	5	34	19	1
Yadkin	0	0	0	0	
Yancey	2	0	2	0	
Totals	8,943 (1,650 increase)	723 (138 increase)	9,666	1,787	803

Source: FEMA

Figure 3-68 Summary of North Carolina Repetitive Loss Properties by County

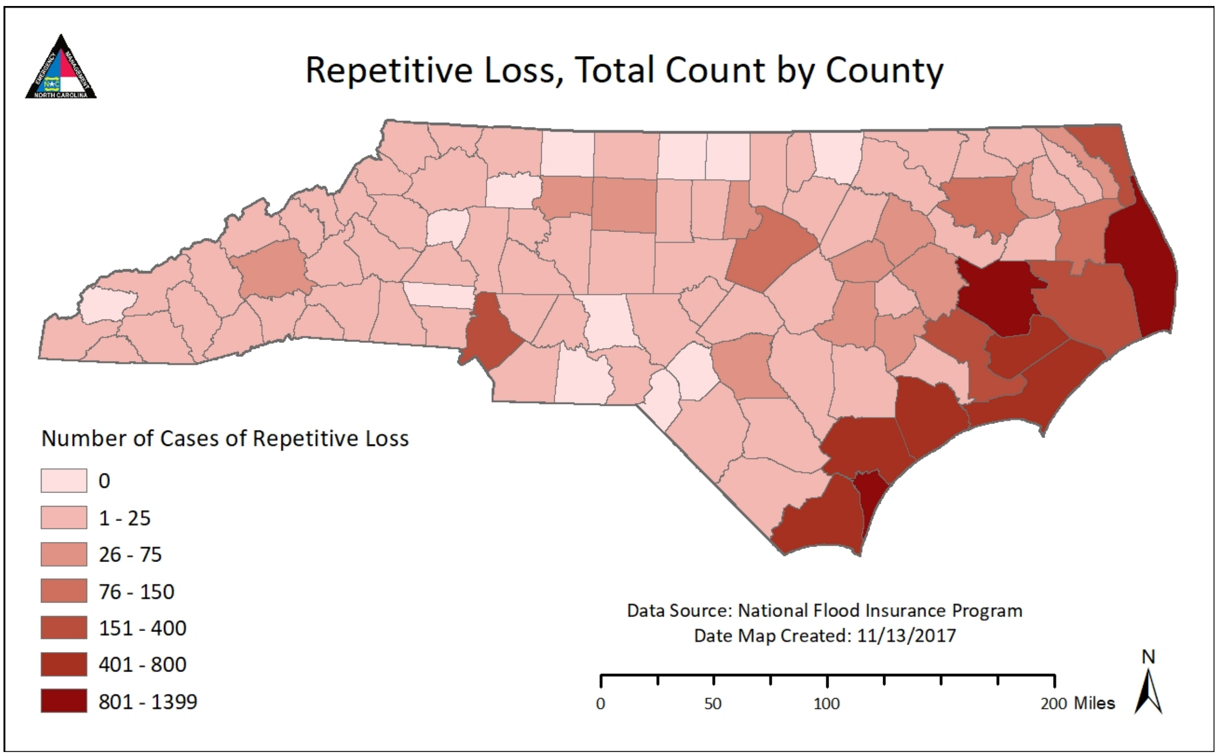
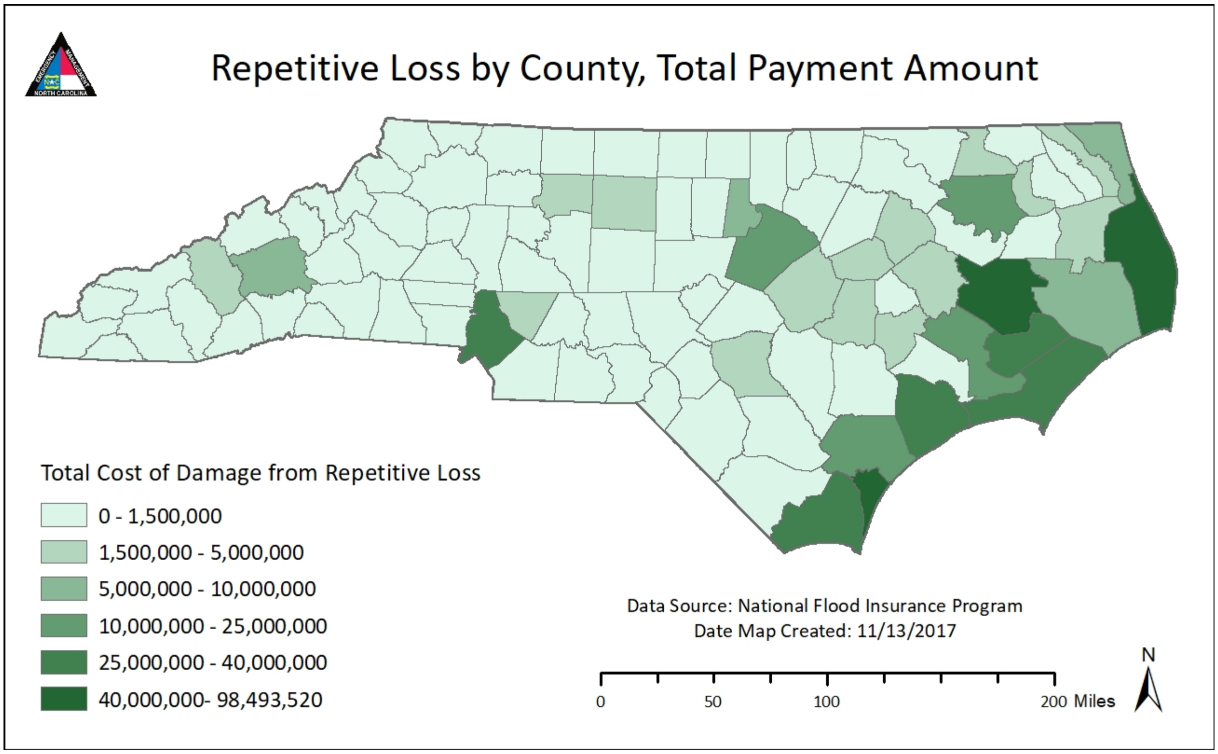


Figure 3-69 NC Repetitive Loss by County and Total Payment Amounts



Severe Repetitive Loss Properties in North Carolina

There are 803 validated severe repetitive loss properties in the North Carolina. There are an additional 179 severe repetitive loss properties that are pending validation. Beaufort and Dare counties make up 47% of the validated severe repetitive loss properties in the State.

Flood Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	During flood events, people are often stranded and have to be rescued by first responders. Often lives are lost or people are injured. Even when injuries and fatalities are avoided, the impact on the public can be great as many people will be forced into shelters or will need to find temporary lodging as they wait for flooding to recede. They may be unable to return to their homes if the damage is great and may find their homes uninhabitable if personal property has become waterlogged and is unusable. Another major impact on the public can be the deteriorating health conditions that result from flooding. After floodwaters recede, homes and personal property that were covered in water may begin to become infested with mold which can create serious health risks. Additionally, waterborne diseases can be pervasive in areas impacted by flooded sewer and water systems. Mosquitoes and other carriers of illnesses often thrive in post-flood conditions, increasing the chances of transmitting vector-borne diseases.

Category	Impact Rating	Description of Impacts
		Public confidence is often impacted by flood events, especially when impacted people do not have flood insurance and are not covered by their home insurance policy. This can create public relations issues for the government and a loss of public confidence.
Responders	High	Responders are often affected by flooding because floods can trap people in their homes or in other locations, forcing responders to put their lives at risk to return members of the public to safety. Often responders in flood situations face blocked roads and have difficulty safely protecting citizens. Water rescues can be some of the most dangerous as rapidly moving flood waters are difficult to navigate. Rescuers are typically at high risk to loss of life or personal injury during flood events, especially compared to other types of natural hazards.
Operations/Continuity of Operations	High	Flooding can impact continuity of operations by knocking out power sources and preventing emergency management personnel from being able to do their jobs properly. Floods typically have some impact on continuity of operations as they can cause severe disruption to normal operations and have done so in the past in North Carolina in nearly every county. Operations would be most impacted at a localized level as areas that are flooded would experience the most disruption to normal operations.
Built Environment (Property, Facilities, Infrastructure)	High	Many buildings and structures could be impacted by a flood event, but critical infrastructure and key resources (CIKR) within the state are especially important to identify. When these facilities are located in flood-prone areas, there is a substantial risk to important functions of government such as law enforcement and medical care. This also includes any assets, systems, and networks that are vital to the continued operation of government services such as power generation facilities, transmission infrastructure, and road networks, among others. The incapacitation or destruction of these resources would have a debilitating and costly effect on many aspects of the state's normal functionality. Often, in the case of flooding, water and wastewater infrastructure are some of the most prominently impacted. Since these types of infrastructure deal directly with water, often they are located in the most flood prone areas and are severely impacted during flood events. When these facilities or infrastructure are flooded, it complicates recovery and impacts people who are unable to utilize normal water sources for drinking, sanitation, and other everyday uses. In addition, personal property such as homes and businesses have been impacted to a large degree by past flooding events and are a major concern in future flooding events. Although a great deal of effort has been undertaken to reduce the number of properties at risk through the use of progressively improved risk assessment and mitigation techniques, there are still a significant number of structures throughout the state that are located in flood zones or which have not been properly mitigated to reduce risk. These properties may sustain billions of dollars of damage during future flood events and are often a major focus of post-disaster recovery efforts.
Economy	High	There are a variety of economic impacts that could result from a large-scale flood event. One major impact is on soil that is covered by flood waters,

Category	Impact Rating	Description of Impacts
		causing the rapid depletion of oxygen, which is essential for plant growth and development. This can hurt agricultural production in areas of the state were that is a key economic driver. Secondly, flooding often causes the shutdown of businesses, many of which never re-open after a flood event. Indeed, FEMA reports that almost 40 percent of small businesses never reopen their doors after a disaster because only small amounts of flood waters can cause thousands of dollars of damage.[37] The shutdown of these small businesses in many communities can be devastating as many small, rural communities in the state rely heavily on these small businesses as economic drivers and the base of the local economy. After Hurricane Floyd, which was primarily considered to be a flood event, the North Carolina Floodplain Mapping Program reported the following statistics which serve as a sort of benchmark for potential future flooding events:
Environment	Low	The fluctuation of water levels in a wetland, especially flood waters, supports the biological diversity of low-lying areas by releasing nutrients into the soil and germinating wetland flora. Flooding also offers some control of invasive water weeds. Most features of the environment have come to adapt to the effects of a flood event and respond quickly, although it is possible that some species may not be resilient enough to survive and will experience population loss. However, areas that have been modified by human activity tend to suffer more negative consequences from flooding which can result from modifying stream banks or removing vegetation from riverside. When these modifications are present, flooding can cause unnatural erosion of sediment into the waterway and create an imbalance of nutrients in the water which may harm ecosystems and have a negative impact on downstream water quality.[39]

Hurricane Floyd Impacts (1999)[38]	
Businesses Affected	60,000
Estimated Jobs Lost	31,000
Physical Damage to Businesses	$1,000,000,000
Business Revenue Lost	$4,000,000,000

Flood Hazard Vulnerability for State-Owned Facilities

NCEM-RM has calculated the number of state-owned facilities in the special flood hazard areas. Table 3-33 below provides a summary of those findings.

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[37] *FEMA. (2017). Protecting Your Businesses. Retrieved August 21, 2017, from https://www.fema.gov/protecting-your-businesses*

[38] *North Carolina Floodplain Mapping Program. Retrieved August 21, 2017, from: http://www.ncfloodmaps.com/flood_data.htm*

[39] *Office of the Queensland Australia Chief Scientist (2017). What are the consequences of floods? Retrieved August 21, 2017, from: http://www.chiefscientist.qld.gov.au/publications/understanding-floods/flood-consequences*

Table 3-33 State-Owned Facilities and Flood Risk

Zone	Value	Number
A	$3,151,621	4
AE	$151,516,415	315
VE	$2,345,774	14
X500	$61,266,875	176

Source: NCEM-RM

3.4.5.4 Hurricane/Coastal Hazards Vulnerability

Table 3-34 provides a summary of the expected annualized losses to hurricanes by county based on NCEM-RM risk data analysis.

Table 3-34 Annualized Hurricane Hazard Losses by County

County	Annualized Losses
Alamance	$ 13,051,977.32
Alexander	$ 3,464,491.45
Alleghany	$ 2,765,951.13
Anson	$ 2,578,273.93
Ashe	$ 4,317,541.97
Avery	$ 1,103,784.03
Beaufort	$ 28,496,957.31
Bertie	$ 2,791,021.67
Bladen	$ 13,311,343.42
Brunswick	$ 53,436,605.42
Buncombe	$ 8,087,910.58
Burke	$ 4,244,313.41
Cabarrus	$ 22,080,792.80
Caldwell	$ 6,589,596.12
Camden	$ 3,316,297.60
Carteret	$ 53,890,219.27
Caswell	$ 4,339,280.00
Catawba	$ 10,806,009.36
Chatham	$ 15,408,174.29
Cherokee	$ 1,997,263.05
Chowan	$ 5,204,494.69
Clay	$ 571,224.76
Cleveland	$ 10,334,511.01
Columbus	$ 34,665,840.73
Craven	$ 44,811,960.36
Cumberland	$ 34,969,108.22
Currituck	$ 33,232,796.73
Dare	$ 70,807,891.07
Davidson	$ 24,291,358.87
Davie	$ 8,572,098.18
Duplin	$ 48,986,272.39
Durham	$ 18,889,639.06
Edgecombe	$ 7,867,137.59
Forsyth	$ 27,798,992.20

County	Annualized Losses
Franklin	$ 5,645,638.85
Gaston	$ 7,455,572.40
Gates	$ 5,487,742.44
Graham	$ 612,033.90
Granville	$ 3,767,592.52
Greene	$ 5,775,677.30
Guilford	$ 36,997,531.96
Halifax	$ 16,331,005.37
Harnett	$ 12,731,765.74
Haywood	$ 3,351,227.57
Henderson	$ 5,579,274.81
Hertford	$ 5,039,509.65
Hoke	$ 7,189,893.60
Hyde	$ 3,939,637.57
Iredell	$ 10,056,703.45
Jackson	$ 1,461,167.64
Johnston	$ 25,285,893.51
Jones	$ 4,565,754.76
Lee	$ 6,442,896.04
Lenoir	$ 17,155,818.53
Lincoln	$ 6,426,516.38
Macon	$ 1,435,935.43
Madison	$ 1,432,114.55
Martin	$ 15,709,847.42
McDowell	$ 1,692,227.20
Mecklenburg	$ 60,486,369.27
Mitchell	$ 1,125,175.60
Montgomery	$ 3,187,295.34
Moore	$ 12,955,854.18
Nash	$ 12,935,995.57
New Hanover	$ 167,594,284.67
Northampton	$ 5,697,304.28
Onslow	$ 90,454,924.79
Orange	$ 14,461,907.79
Pamlico	$ 5,619,501.20
Pasquotank	$ 19,096,536.58
Pender	$ 19,447,689.32
Perquimans	$ 9,069,429.58
Person	$ 5,275,846.59
Pitt	$ 31,099,665.75
Polk	$ 1,438,203.83
Randolph	$ 19,508,757.63
Richmond	$ 7,884,699.69
Robeson	$ 55,448,728.09
Rockingham	$ 17,624,340.56
Rowan	$ 22,167,408.18
Rutherford	$ 5,446,860.73
Sampson	$ 46,194,954.62
Scotland	$ 8,670,720.49
Stanly	$ 9,303,827.27

County	Annualized Losses
Stokes	$ 4,502,289.72
Surry	$ 10,036,912.68
Swain	$ 485,437.94
Transylvania	
Tyrrell	$ 2,245,937.25
Union	$ 16,476,134.79
Vance	$ 4,391,168.88
Wake	$ 92,211,100.39
Warren	$ 1,958,030.95
Washington	$ 2,288,212.67
Watauga	$ 2,463,287.89
Wayne	$ 55,908,582.46
Wilkes	$ 7,130,676.41
Wilson	$ 10,066,122.12
Yadkin	$ 4,409,787.60
Yancey	$ 1,217,908.77
North Carolina	$ 1,706,637,980.70

Source: NCEM-RM

Hurricane/Coastal Hazards Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	During previous hurricane events in North Carolina, there have been significant losses of life and injuries to citizens. A number of people are expected to be displaced from their homes and will require accommodations in temporary public shelters due to a hurricane. Many people may also be permanently displaced and require longer term housing after a major event. In addition, many of the same health and property damage effects listed under the flood hazard would also likely occur as a result of a hurricane. A major difference is that hurricanes can also bring negative effects from high winds and storm surge (especially in coastal areas). High winds can shatter glass and cause personal injury and storm surge and rip tides prior to and during the event can cause loss of life if members of the public are not cautious and continue normal activities in the ocean prior to a hurricane event. Hurricane Matthew, which was perhaps the most impactful hurricane the state has experienced since the 1990s, had major implications for the people of North Carolina. The table below outlines some of the impacts and gives at least some idea of the potential consequences of future hurricane events. This information was updated on September 29, 2017 through the state's "Rebuild NC" website (rebuild.nc.gov).

Hurricane Matthew Impacts (2016)	
Families registered for assistance	81,498
Total Dollars Distributed through Individual and Households Program	$98,193,197
Flood Claims	5,868

Category	Impact Rating	Description of Impacts
		Total Dollars Distributed Through National Flood Insurance Program: $195,493,901 This hazard could potentially have a large negative effect on public confidence due to the possibility of a high magnitude event and the difficulties that might arise for local governments in terms of response and recovery. As has been the case with several previous events, members of the public who are displaced or whose homes/property are damaged may be frustrated causing a failure of confidence in the government's ability to respond to disasters.
Responders	High	The impacts on responders from this type of storm could potentially be very high as responders may be physically injured or killed during a storm event by flooding or high winds. In addition, their homes and personal effects could also be impacted, which would limit their response capability. In terms of their actual response capacity, downed trees in the wake of a hurricane often block roads and make ingress and egress difficult, thereby causing issues with response time. This is also often true of the resulting floodwaters. Moreover, due to the large-scale spatial impact of hurricanes and the number of citizens affected by the storm, response time will be reduced because of the number of incidents that require emergency responders.
Operations/Continuity of Operations	High	Continuity of operations in a hurricane event can be severely affected if power is lost or if critical facilities or infrastructure are damaged during an event. Although North Carolina has a plan in place to maintain continuity of operations in the event of a storm, a hurricane with a high magnitude would likely disrupt operations to some degree due to the impacts it would have on personnel. Some may experience damage from the storm themselves and be unable to work putting a strain on staff who are working as they will be forced to take on additional responsibilities during and after an event. In major events, all staff will likely be called on to work additional hours to maintain continuity of operations, which may result in fatigue and a reduced capability of employees in the long run.
Built Environment (Property, Facilities, Infrastructure)	High	Many buildings and structures could be impacted by a hurricane or tropical storm event including many local and state critical facilities such as police stations, fire stations, medical facilities, and other key buildings. There are also a number of important historic locations located along the coast such as Large-scale damage to infrastructure such as bridges and roads could occur from flood waters and storm surge especially in coastal areas such as the Outer Banks where roadways such as Highway 12 have been damaged severely during past events. Stormwater infrastructure such as culverts could also be damaged if they are clogged with debris from the storm or their design capacity is overrun. Many utilities including water/wastewater may be affected as a result of their location near rivers and other water sources. Power lines may be downed by falling trees or limbs and, due to high demand across the state, utility companies may face challenges in restoring power in a timely manner.

<table>
<tr><th>Category</th><th>Impact Rating</th><th>Description of Impacts</th></tr>
<tr><td></td><td></td><td>Hurricane Matthew also offers some insight on impacts to public infrastructure based on funding distributed through FEMA's Public Assistance (PA) program, though these numbers fall far below total damage to the built environment. According to Rebuild NC, as of September 29, 2017:
<table>
<tr><th colspan="2">Hurricane Matthew Impacts (2016)</th></tr>
<tr><td>Public Assistance (PA) Projects Submitted</td><td>81,498</td></tr>
<tr><td>Total Federal Dollars Distributed through PA Program</td><td>$62,663,672</td></tr>
</table></td></tr>
<tr><td>Economy</td><td>High</td><td>In general, the economy would be severely impacted by a hurricane or tropical storm event. Due to the massive scale of these events and multiple types of impacts from flooding and high winds, commerce would definitively slow down as efforts to rebuild are undertaken. Businesses may be shut down for long periods as owners try to rebuild after damage from flood waters, downed trees, or wind. Even business owners without direct physical damage to their workplaces may be shut down temporarily by loss of power or because employees are unable to come in to work as a result of roads that are shut down or personal property damage. As mentioned in the flooding analysis, many businesses that shut down after a major disaster never re-open their doors, which can have a major negative impact on local economies, especially in smaller communities.

Some data on impacted businesses during Hurricane Matthew is available via loans distributed through the Small Business Administration (SBA). This certainly does not encompass all the businesses impacted by the storm, but provides an estimate that can be used as a floor. This information was also retrieved from rebuild.nc.gov and is updated through September 29, 2017.
<table>
<tr><th colspan="2">Hurricane Matthew Impacts (2016)</th></tr>
<tr><td>SBA Loans Approved</td><td>81,498</td></tr>
<tr><td>Total Dollars Distributed through SBA Program</td><td>$102,424,200</td></tr>
</table></td></tr>
<tr><td>Environment</td><td>Moderate</td><td>Flooding and wind damage are the main impacts that would be felt by a hurricane in North Carolina. Hurricane winds can down trees and cause disruptions to local ecosystems, particularly if damage is heavy in areas where endangered or protected species are present. As mentioned in the flood analysis, flood waters may cause some losses in species population. In coastal areas, sensitive habitats could be drastically impacted by hurricane events if the storm damages dune systems via storm surge. This may also cause local communities to become more vulnerable to future events as dunes provide a natural barrier against storm surge. Additionally, estuarine habitats may be impacted if floodwaters inundate these complex ecosystems with additional freshwater or saltwater, thereby causing an abnormality in a system that relies on a particular balance of salinity. Hurricane events can also sometimes cause spills of hazardous materials which would have damaging effects on the environment (as detailed further in the hazardous substances analysis below).</td></tr>
</table>

Hurricane/Coastal Hazards Vulnerability for State-Owned Facilities

Table 3-35 provides a summary of the number and value of state-owned facilities in storm surge zones.

Table 3-35 State-Owned Facilities and Storm Surge Zones

Storm Surge Zone	Number of State-Owned Facilities in Zone	Value of State-Owned Facilities in Zone
Category 1	37	$15,924,163
Category 2	181	$125,205,270
Category 3	274	$306,009,149
Category 4	321	$356,303,291
Category 5	391	$380,878,794

Source: NOAA, NCEM-RM

3.4.5.5 Severe Winter Weather Hazard Vulnerability

Because winter weather is an atmospheric hazard and can occur anywhere throughout the state, all populations, buildings and infrastructure are vulnerable. NCEI data indicates that occurrences of severe winter weather are more frequent in the mountains of North Carolina, thereby increasing the risk to the hazard in those counties. However, vulnerability to winter weather is difficult to qualify and quantify because of the unique impacts the hazard has on people, structures and infrastructure. Snow alone does not pose a significant threat to structures unless it falls in extremely heavy amounts. Ice events occur less frequently, but can have significant impacts on people and particularly on infrastructure.

Table 3-36 provides a summary of the expected annualized losses by county based on NCEI data.

Table 3-36 Annualized Losses for Severe Winter Weather

County	**Total Damages for All Recorded Events** (2017 Dollars)	Annualized Losses
Alamance	$544,484.00	$25,927.81
Alexander	$12,197,820.00	$580,848.57
Alleghany	$187,278.00	$8,918.00
Anson	$0.00	$0.00
Ashe	$358,685.00	$17,080.24
Avery	$79,878,496.00	$3,803,737.90
Beaufort	$70,789.00	$3,370.90
Bertie	$35,833.00	$1,706.33
Bladen	$4,604,380.00	$219,256.19
Brunswick	$201,211.00	$9,581.48
Buncombe	$11,999,065.00	$571,384.05
Burke	$169,609,440.00	$8,076,640.00
Cabarrus	$17,719,471.00	$843,784.33

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Caldwell	$141,852,230.00	$6,754,868.10
Camden	$0.00	$0.00
Carteret	$334,011.00	$15,905.29
Caswell	$341,681.00	$16,270.52
Catawba	$13,605,347.00	$647,873.67
Chatham	$544,484.00	$25,927.81
Cherokee	$1,573.00	$74.90
Chowan	$0.00	$0.00
Clay	$0.00	$0.00
Cleveland	$14,858,933.00	$707,568.24
Columbus	$7,845,330.00	$373,587.14
Craven	$0.00	$0.00
Cumberland	$10,283.00	$489.67
Currituck	$0.00	$0.00
Dare	$34,070,106.00	$1,622,386.00
Davidson	$6,464,068.00	$307,812.76
Davie	$12,379,403.00	$589,495.38
Duplin	$0.00	$0.00
Durham	$1,494,102.00	$71,147.71
Edgecombe	$23,807.00	$1,133.67
Forsyth	$497,438.00	$23,687.52
Franklin	$538,532.00	$25,644.38
Gaston	$246,815,866.00	$11,753,136.48
Gates	$0.00	$0.00
Graham	$1,190,395.00	$56,685.48
Granville	$827,329.00	$39,396.62
Greene	$31,461.00	$1,498.14
Guilford	$9,046,072.00	$430,765.33
Halifax	$657,674.00	$31,317.81
Harnett	$28,138.00	$1,339.90
Haywood	$2,380,791.00	$113,371.00
Henderson	$13,639,279.00	$649,489.48
Hertford	$0.00	$0.00
Hoke	$0.00	$0.00
Hyde	$538,234.00	$25,630.19
Iredell	$14,949,651.00	$711,888.14
Jackson	$77,058,460.00	$3,669,450.48
Johnston	$600,763.00	$28,607.76
Jones	$0.00	$0.00
Lee	$0.00	$0.00
Lenoir	$62,923.00	$2,996.33
Lincoln	$13,604,006.00	$647,809.81
Macon	$2,380,791.00	$113,371.00
Madison	$3,751,186.00	$178,627.90
Martin	$62,923.00	$2,996.33
McDowell	$80,012,554.00	$3,810,121.62
Mecklenburg	$59,462,458.00	$2,831,545.62
Mitchell	$1,223,351.00	$58,254.81
Montgomery	$0.00	$0.00

County	**Total Damages for All Recorded Events** (2017 Dollars)	Annualized Losses
Moore	$0.00	$0.00
Nash	$554,767.00	$26,417.48
New Hanover	$0.00	$0.00
Northampton	$2,222,259.00	$105,821.86
Onslow	$222,211.00	$10,581.48
Orange	$3,892,063.00	$185,336.33
Pamlico	$23,596.00	$1,123.62
Pasquotank	$0.00	$0.00
Pender	$2,001,571.00	$95,312.90
Perquimans	$0.00	$0.00
Person	$1,095,275.00	$52,155.95
Pitt	$117,982.00	$5,618.19
Polk	$29,333,674.00	$1,396,841.62
Randolph	$3,770,566.00	$179,550.76
Richmond	$0.00	$0.00
Robeson	$5,947,616.00	$283,219.81
Rockingham	$572,356.00	$27,255.05
Rowan	$14,948,331.00	$711,825.29
Rutherford	$14,856,015.00	$707,429.29
Sampson	$0.00	$0.00
Scotland	$0.00	$0.00
Stanly	$0.00	$0.00
Stokes	$354,471.00	$16,879.57
Surry	$1,450,735.00	$69,082.62
Swain	$1,190,395.00	$56,685.48
Transylvania	$13,404,061.00	$638,288.62
Tyrrell	$0.00	$0.00
Union	$16,340,269.00	$778,108.05
Vance	$817,035.00	$38,906.43
Wake	$1,087,349.00	$51,778.52
Warren	$793,227.00	$37,772.71
Washington	$23,596.00	$1,123.62
Watauga	$616,110.00	$29,338.57
Wayne	$10,283.00	$489.67
Wilkes	$3,046,982.00	$145,094.38
Wilson	$554,767.00	$26,417.48
Yadkin	$884,380.00	$42,113.33
Yancey	$1,223,621.00	$58,267.67
North Carolina	**$1,181,948,148.00**	**$56,283,245.14**

Source: NCEI

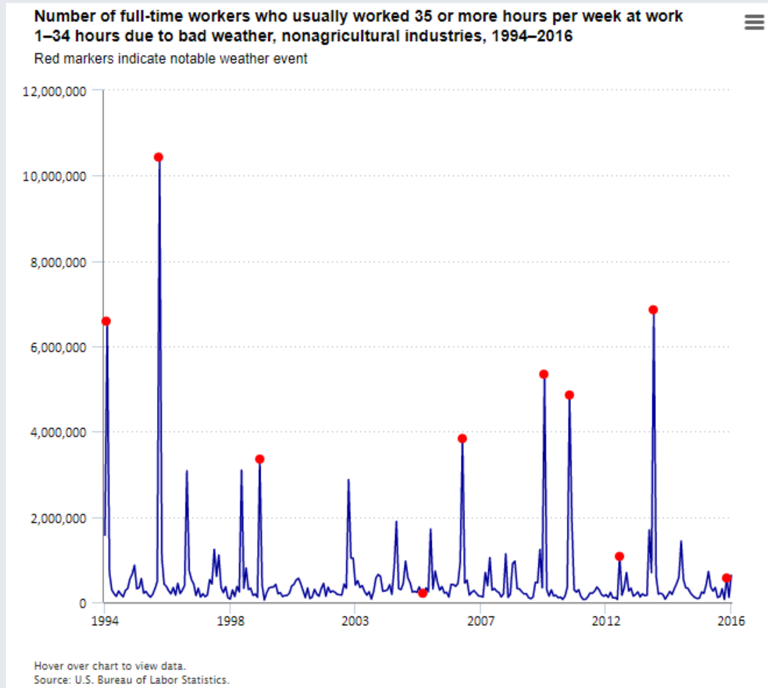
Severe Winter Weather Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Winter weather most often impacts people indirectly and has differing impacts in different areas of the state. Mountainous areas in the western part of the state are much more accustomed to winter weather and therefore, are often more prepared to deal with it. However, these areas are also much more likely to experience larger accumulations of precipitation and colder temperatures than areas further east.

Category	Impact Rating	Description of Impacts
		Across the state, winter weather can create dangerous driving conditions by limiting visibility for drivers or creating slick conditions that make maneuverability difficult. Loss of power can create very cold conditions for residents, making it difficult to stay warm. Residents may try to heat their home using alternative means, which runs the risk of carbon monoxide poisoning caused by improperly ventilated heating sources. In addition, dangerously cold temperatures increase the risk of wind chill, frostbite, and hypothermia. Another indirect impact of winter weather on the public is its potential to impact public and private school schedules through closings and delays. Poor driving conditions, lack of power and heat, and mechanical problems with school buses and equipment due to cold weather conditions are potential concerns. School closures and delays can lead to logistical problems for teachers and school administrators, especially in the event of end-of-term exams and standardized testing schedules. It can also result in logistical problems for making up school days. Winter storms generally do not have a large impact on public confidence, but it could be somewhat impacted if road clearing or response operations are slow.
Responders	Moderate	Responders in severe winter weather events face a variety of hazards, including slick or icy roads that could cause accidents if they are attempting to quickly respond to an emergency as is often the case. The chances of crashed emergency vehicles and injuries to responders are always a possibility, but increase during a winter storm event due to difficult driving conditions. Winter weather can also make it difficult to access more rural areas if roads are snowed/iced over and emergency vehicles cannot pass through.
Operations/Continuity of Operations	Moderate	Generally, continuity of operations can be maintained during a winter weather event in North Carolina. However, winter weather does have the potential to affect power transmission as the weight of ice and snow can cause trees and limbs to fall and damage transmission lines. Winter precipitation can also freeze to roadways or create slick conditions that make it difficult for emergency management employees to get to work. As a result, there will likely be some disruption of operations during a winter weather event.
Built Environment (Property, Facilities, Infrastructure)	Moderate	One of the primary identified impacts of winter weather in North Carolina is the disruption of utilities. Utilities that are at risk of being affected include telephone, internet, cable, and water. Newspaper reports typically cite trees falling on electrical wires—as well as trees that have already been damaged from previous incidents that fall during a winter storm—or the stress caused by ice accumulation as main causes for power outages. Damage to this infrastructure is one of the major consequences of a winter weather event in the state and can lead to life-threatening situations if the public is unable to utilize central heating systems to keep warm during the concurrent cold weather that often accompanies winter weather. Winter weather also has the potential to create hazardous driving conditions leading to accidents on roadways. The North Carolina Climate Office reports

Category	Impact Rating	Description of Impacts
		that 70 percent of winter-weather–related injuries are a result of accidents on the road.40 The North Carolina Highway Patrol call volume can double during a winter storm compared to a typical 24-hour period. This creates significant problems for emergency workers. Accidents can cause highways to become "large parking lots" as well as cause motorists to strand their vehicles, making it difficult for emergency workers to reach those who need assistance. In general, major and local roadways become severely impacted when temperatures drop, making pre-treatment solutions ineffective. Transportation impacts can be minimized during early- and late-season events when paved surfaces are able to warm sufficiently to prevent winter precipitation accumulation. Winter weather can also cause delays and cancellations of flights at airports in the state due to slick conditions on runways. There is also the potential of a loss of power that can close the airport. The North Carolina Department of Transportation (NCDOT), which maintains the second largest state network in the country, is primarily responsible for maintaining the state's transportation infrastructure during severe winter weather events. As of the end of 2016, NCDOT has the following capabilities in terms of storm preparation: **NCDOT Winter Weather Capabilities**[41] Plows/Salt and Sand Spreaders: 1,739 Front-End Loaders and Backhoes: 495 Motor Graders: 332 Storage Space for Salt/Sand: 170,000 tons Storage Space for Brine: 1,520,000 gallons Annual Budget for Storm Preparation: $70,000,000
Economy	Moderate	In the event of winter weather, there is a high potential of business and office closures, modified business and office hours, and cancellation or postponement of sporting and other planned events in the state. This can be attributed to poor road conditions (including icy and slick conditions) that result in fewer people using the roads to get to their destination or a loss of power and heat that result in a loss of operations at specific facilities. In general, absenteeism is higher during winter weather events as many employers rightly encourage employees to stay home and avoid potential injury in unsafe driving conditions. As can be seen in the chart below, the Bureau of Labor Statistics[42] notes that although any major weather event can cause absences at work, workers are more likely to be absent because of bad weather during winter months because winter weather tends to impact much larger areas and makes travel difficult throughout much more

[40] *State Climate Office of North Carolina. Winter weather—impacts. Retrieved August 21, 2017, from http://www.nc-climate.ncsu.edu/climate/winter_wx/Impacts.php*
[41] *North Carolina Department of Transportation. Severe Weather- Winter Storms. Retrieved August 21, 2017, from https://www.ncdot.gov/travel/severeweather/winter.html*
[42] *United States Bureau of Labor Statistics. Work Absences Due to Bad Weather from 1994 to 2016. Retrieved August 21, 2017, from https://www.bls.gov/opub/ted/2017/work-absences-due-to-bad-weather-from-1994-to-2016.htm*

Category	Impact Rating	Description of Impacts
		of the transportation network. 
Environment	Low	Winter weather has an impact on the environment through the clearing of roadways. Snow on the roads can pick up contaminants from chemicals and oil products in traffic as well as the salt mixture that is used to de-ice the roads. These contaminants can be carried to nearby waterways, which contaminates water sources and is absorbed by groundwater. In addition, vegetation can be damaged by these storm types, which harms habitats and may threaten wildlife.

Severe Winter Weather Hazard Vulnerability for State-Owned Facilities

All state-owned facilities are vulnerable to severe winter weather. NCEI data indicates that occurrences of severe winter weather are more frequent in the mountains of North Carolina, thereby increasing the risk to the state-owned facilities in that region of the State. However, structural damages to severe winter weather are not common and losses are more confined to loss of productivity of workers and loss of wages which are not calculated in this assessment.

3.4.5.6 Excessive Heat Vulnerability

All buildings in the state should be considered vulnerable to excessive heat, but excessive heat does not cause significant structural or monetary damage. The most significant impacts from excessive heat are loss of life.

Excessive Heat Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Extreme heat can affect many people and to varying degrees. Often the elderly and very young are susceptible to the most detrimental impacts, but heat stroke and exhaustion can plague anyone. People who are overweight, who overexert during work or exercise, and who are ill or are on certain medications are also at greater risk of suffering from heat-related illness. Risks from exposure to extreme heat include heat cramps, heat exhaustion, heat stroke, and death. Many of the impacts of extreme heat on people are the result of heat exhaustion or improperly functioning air conditioning units. A heat wave or extreme heat event would have minimal effects on public confidence as these events are frequent and the public likely understands the potential impacts. However, if an extreme heat event results in a large number of illnesses and fatalities, government organizations may be accused of failing to properly prepare for or respond to the threat, and public confidence could suffer.
Responders	Moderate	Extreme heat can also affect responders who are often more susceptible to heat stroke and exhaustion due to the nature of their work. This work forces police and emergency medical providers to be exposed to the elements, physically exert themselves, or wear heavy personal protective equipment. In these cases, responders could be negatively impacted by extreme heat and will need to protect themselves and prepare accordingly.
Operations/Continuity of Operations	Low	Extreme heat would likely have few impacts on continuity of operations as the warning time for these events is usually long and direct impacts to large numbers of personnel or other resources necessary to maintain operations are unlikely. If air conditioning systems in operations centers break down due to overuse, operations could be interrupted or forced to move to secondary facilities.
Built Environment (Property, Facilities, Infrastructure)	Low	Extreme heat would likely have a minor effect on the built environment, although high temperatures could potentially put a strain on infrastructure such as power generation and water systems due to higher demand. During times of extreme heat, air conditioning units work harder and require more electricity, making brownouts and blackouts possible if electricity demands exceed generation. Extreme heat can also cause transportation infrastructure such as roads, bridges, railways, and runways to buckle, crack, or shatter.
Economy	Low	An extreme heat event could potentially have a negative impact on the economy in the short term as the public may be advised to stay indoors, causing them to reduce overall spending and negatively impact businesses in the community. Additionally, extreme heat events can also result in decreased worker productivity as high temperatures can result in decreased energy, loss of concentration, and heat-related illness in workers. This can cause disruptions to the regular working of

Category	Impact Rating	Description of Impacts
		the local economy. Extended periods of extreme heat may also disrupt the local economy if agricultural, dairy, and livestock production declines, resulting in income loss for farmers and other related industries as well as increased prices for consumers.
Environment	Moderate	The environment would be impacted by extreme heat as many plants and animals that are not able to withstand the heat may die off and crops and livestock may be impacted by unusually high temperatures, resulting in death or illness. Heat waves can also contribute to higher levels of air pollution since air becomes stagnant and traps emitted pollutants, often causing increased levels of surface ozone.

Excessive Heat Hazard Vulnerability for State-Owned Facilities

All state-owned facilities buildings in the state should be considered vulnerable to excessive heat, but excessive heat does not cause significant structural or monetary damage. The most significant impacts from excessive heat are loss of life.

3.4.5.7 Earthquake Hazard Vulnerability

Table 3-37 provides a summary of the expected annualized losses to earthquakes by county based on NCEM-RM risk data analysis.

Table 3-37 Annualized Earthquake Hazard Losses by County

County	Annual Losses
Alamance	$ 319,787.66
Alexander	$ 167,955.41
Alleghany	$ 97,486.32
Anson	$ 168,253.58
Ashe	$ 279,673.60
Avery	$ 146,001.01
Beaufort	$ 42,392.29
Bertie	$ 9,697.89
Bladen	$ 178,791.51
Brunswick	$ 409,577.54
Buncombe	$ 1,264,155.87
Burke	$ 461,660.02
Cabarrus	$ 1,097,106.10
Caldwell	$ 543,123.67
Camden	$ 1,825.24
Carteret	$ 70,583.50
Caswell	$ 66,240.07
Catawba	$ 806,784.96
Chatham	$ 288,272.15

County	Annual Losses
Cherokee	$ 503,852.64
Chowan	$ 7,997.75
Clay	$ 108,904.37
Cleveland	$ 763,509.54
Columbus	$ 411,352.64
Craven	$ 93,614.62
Cumberland	$ 1,409,514.67
Currituck	$ 7,820.52
Dare	$ 9,689.50
Davidson	$ 552,246.82
Davie	$ 225,696.42
Duplin	$ 257,214.17
Durham	$ 480,734.82
Edgecombe	$ 61,166.18
Forsyth	$ 832,815.82
Franklin	$ 82,439.88
Gaston	$ 800,913.37
Gates	$ 9,094.92
Graham	$ 178,421.07
Granville	$ 83,008.14
Greene	$ 25,811.29
Guilford	$ 1,234,939.99
Halifax	$ 145,739.17
Harnett	$ 187,749.30
Haywood	$ 620,125.86
Henderson	$ 764,597.22
Hertford	$ 22,727.45
Hoke	$ 134,708.26
Hyde	$ 2,394.19
Iredell	$ 632,179.02
Jackson	$ 324,709.03
Johnston	$ 310,796.50
Jones	$ 12,803.18
Lee	$ 189,627.29
Lenoir	$ 108,764.40
Lincoln	$ 442,674.21
Macon	$ 379,476.30
Madison	$ 249,098.27
Martin	$ 44,071.90
McDowell	$ 241,940.43

County	Annual Losses
Mecklenburg	$ 4,748,906.80
Mitchell	$ 164,451.75
Montgomery	$ 179,616.22
Moore	$ 445,012.07
Nash	$ 143,063.61
New Hanover	$ 831,870.81
Northampton	$ 25,023.10
Onslow	$ 231,483.91
Orange	$ 300,455.11
Pamlico	$ 8,172.45
Pasquotank	$ 13,936.49
Pender	$ 98,801.65
Perquimans	$ 6,234.17
Person	$ 99,583.00
Pitt	$ 145,331.97
Polk	$ 213,557.91
Randolph	$ 550,488.75
Richmond	$ 458,407.83
Robeson	$ 1,153,622.09
Rockingham	$ 357,653.24
Rowan	$ 773,176.03
Rutherford	$ 665,773.15
Sampson	$ 358,501.91
Scotland	$ 295,102.94
Stanly	$ 389,664.75
Stokes	$ 114,985.98
Surry	$ 318,876.46
Swain	$ 148,718.86
Transylvania	
Tyrrell	$ 1,521.62
Union	$ 855,554.82
Vance	$ 74,313.71
Wake	$ 1,612,877.44
Warren	$ 20,544.78
Washington	$ 4,098.27
Watauga	$ 255,762.35
Wayne	$ 374,681.96
Wilkes	$ 387,461.95
Wilson	$ 100,334.65
Yadkin	$ 111,729.84

County	Annual Losses
Yancey	$ 179,694.68
North Carolina	$ 36,593,358.59

Source: NCEM-RM

Earthquake Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Low	Earthquakes in North Carolina generally are not high impact events that cause injury or death as most are moderate in terms of impacts. The public typically experiences some shaking in these events and the greatest threat to health and well-being is often from objects falling, from shelves or off walls. The western and southeastern parts of the state are where people are most likely to be impacted by an earthquake, but even in these cases, a major disaster would be unlikely. Therefore, public confidence would likely not be affected in the event of an earthquake.
Responders	Low	There would be little impact on responders in the event of an earthquake, because North Carolina is only likely to experience a moderate earthquake magnitude. Since there would be minimal damage to structures and infrastructure, responders would likely not be impacted in their ability to respond to an earthquake. If there were any major collapses of buildings or infrastructure however, responders will need to take care when accessing these structures in case they have become structurally unstable and unsafe. It should also be noted that because earthquakes can knock items such as candles off shelves or damage gas lines, fires are possible directly after an event. This may cause additional emergency calls for responders and create a burden on response operations.
Operations/Continuity of Operations	Low	During and after an earthquake, continuity of operations could relatively easily be maintained and there would likely be little disruption to services or operations during an event, especially at the state level. The most likely impact may be downed communication networks which could cause interruptions to normal operations.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Ground shaking is the primary cause of damage to the built environment during an earthquake. There are three important variables that determine the amount of damage: the intensity of the earthquake, local soil characteristics, and the quality of the impacted structures. The amount of damage caused by an earthquake is strongly influenced by soil characteristics. The velocity at which the rock or soil transmits shear waves is the main contributor to ground shaking. Shaking is increased by soft, thick, or wet soil types. Certain building types are particularly vulnerable to earthquake

Category	Impact Rating	Description of Impacts
		damage: wood-frame multi-unit buildings, single-family homes, mobile homes, and unreinforced masonry buildings.43 The most susceptible structures are wood-frame, multi-story, mixed-use buildings that have large openings on the first floor for garages or commercial space and housing on the upper floors. During an earthquake, these types of structures could sway or even collapse. Single-family homes built prior to the 1970s are often not bolted to their foundations, and walls surrounding crawl spaces are not braced (i.e., cripple walls). Typical earthquake damage to these structures include cracked foundations, chimneys breaking at the roof line, wood frames coming off their foundations, and racking of cripple walls. Mobile homes that are built of light-weight metal or a combination of steel frame and wood are easily damaged by a quake. Mobile homes installed prior to 1995 were often not attached to their foundations and could shift off their supports. The last type of susceptible building material is unreinforced masonry—masonry walls that have not been reinforced with steel. These buildings were often built before 1960 in an era when reinforcing was not generally used, anchorage to floors and roofs was missing, and use of low-strength lime mortar was common. Earthquake damage to these buildings can be severe. A lack of reinforcement and tie-downs can result in substantial damage in the form of cracked or leaning walls. Damage may also occur between the walls, and separation between the framing and walls could lead to full collapse due to a lack of vertical support. Critical Infrastructure There are a handful of key resource categories that could be impacted by an earthquake including transportation systems, communication systems, and utility systems. Historically, the state has not been impacted by an earthquake with more than a moderate intensity so damage to these resources would be very minor; however, an inspection of certain features after a strongly felt earthquake may be necessary.
Economy	Low	There are several sources of economic loss typically associated with an earthquake including property damage and business interruption costs; cost to repair public transportation, communication, or utility systems; and debris removal costs. Historically, there have been relatively minor economic losses from earthquakes in the state that have not already been described under the impacts to the built environment above.
Environment	Low	There would be very minor impacts to the environment following a significant earthquake that is felt in North Carolina with a moderate intensity. Secondary effects from the damage of key resources mentioned above (e.g. utility systems) could impact the environment,

[43] *Association of Bay Area Governments. (2017). Guide to housing vulnerable resources. Retrieved August 21, 2017, from http://quake.abag.ca.gov/housing/*

Category	Impact Rating	Description of Impacts
		but the probability of this type of situation is very small. For instance, a ruptured pipeline could release dangerous materials that could damage the surrounding environment, but the likelihood of an earthquake causing this in North Carolina is relatively low.

Earthquake Hazard Vulnerability for State-Owned Facilities

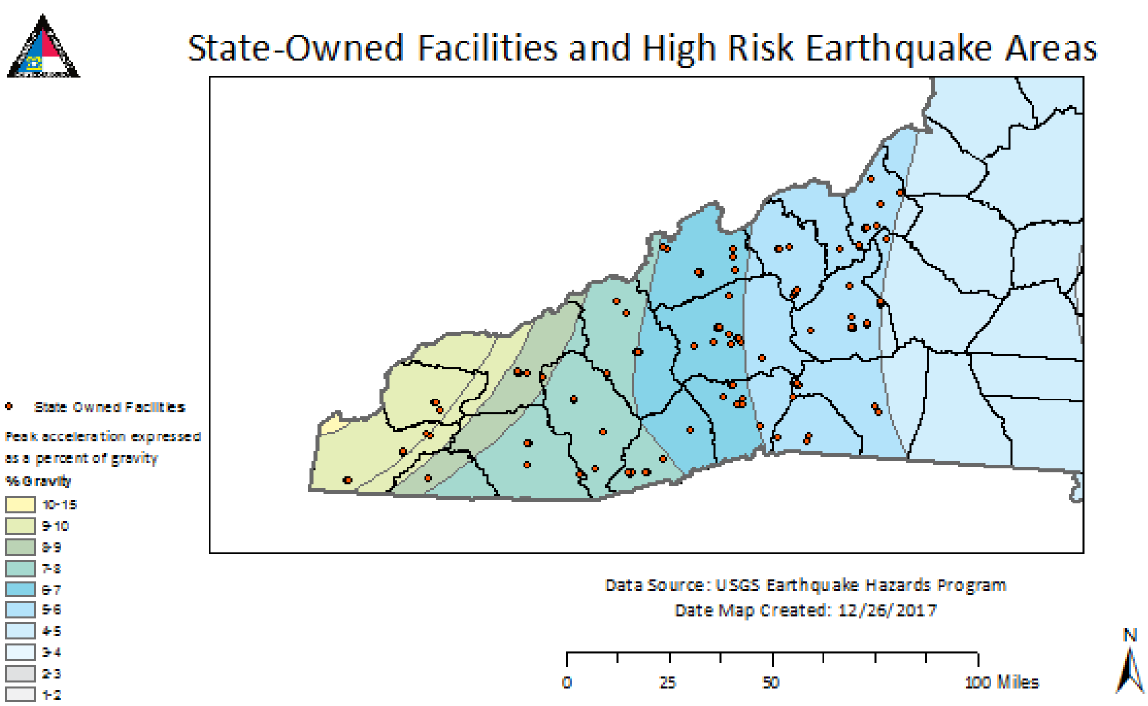
Table 3-38 provides a summary of vulnerability to earthquakes for state-owned facilities. Figure 3-64 State-Owned Facilities and Earthquake Risk provides a graphical representation of those facilities in the higher hazard risk areas.

Table 3-38 State-Owned Facilities and Earthquake Risk

Earthquake Hazard Zone	USGS Hazard Zone Indicator	Number of State-Owned Facilities in Hazard Zone	Value of State-Owned Facilities in Hazard Zone
8-15%g	Higher Hazard	48	$6,960,247
5-8%g		174	$41,067,139
3-5%g		791	$922,319,869
1-3%g	Lower Hazard	3678	$10,880,615,474

Source: USGS and NCEM-RM

Figure 3-70 State-Owned Facilities and Earthquake Risk



3.4.5.8 Wildfire Hazard Vulnerability

To determine vulnerability to the wildfire hazard, a GIS analysis was run to determine, by County, the number and value of structures in high risk wildland urban interface areas (areas 7 through 9 as depicted on Figure 3-65 below). Results of the analysis can be found in Table 3-39.

Figure 3-71 Value of Buildings in High WUI Risk Areas

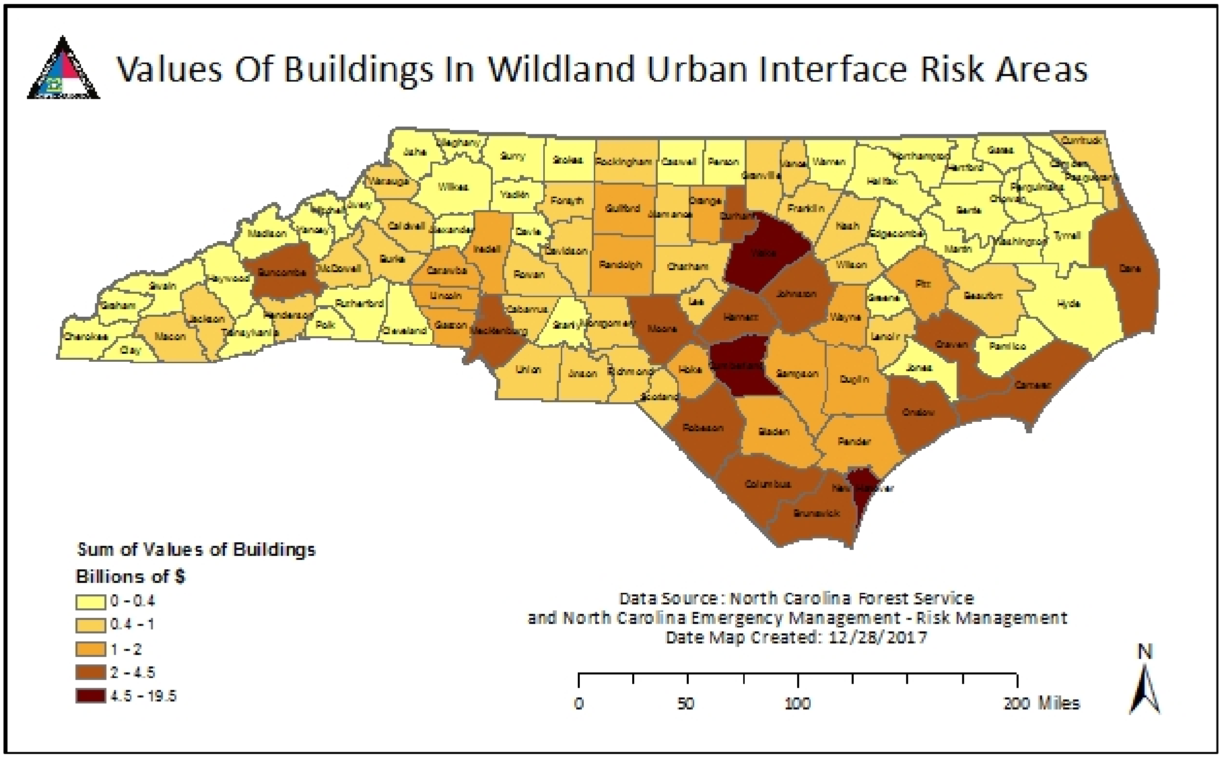


Table 3-39 Wildfire Vulnerability

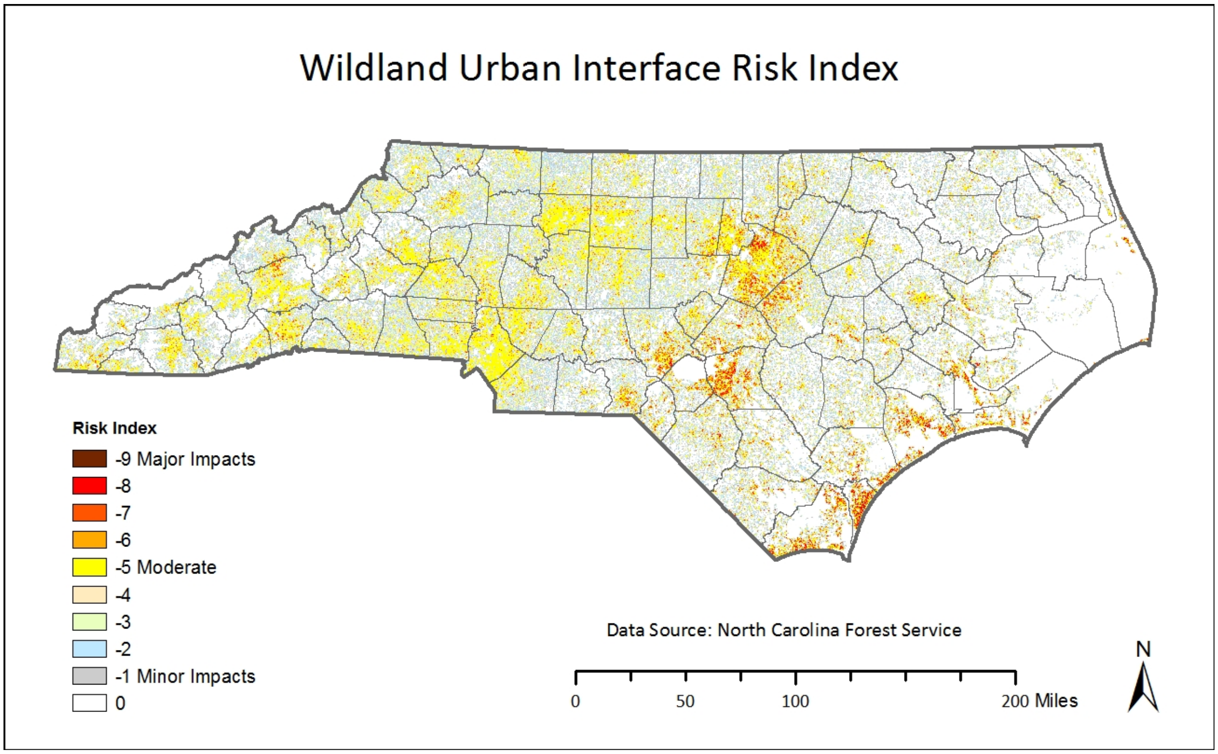
County Name	Number of Buildings in High WUI Zones (7-9)	Value of Buildings in High WUI Zones (7-9)
Alamance	5125	$828,881,703
Alexander	2636	$370,810,950
Alleghany	923	$67,989,360
Anson	2044	$400,362,936
Ashe	1124	$133,559,919
Avery	815	$141,538,464
Beaufort	6521	$548,034,579
Bertie	1598	$92,062,199
Bladen	7220	$1,303,157,726
Brunswick	31976	$3,400,679,826
Buncombe	9442	$2,507,948,026
Burke	4382	$454,043,702
Cabarrus	7531	$824,656,472
Caldwell	4488	$436,118,688
Camden	670	$76,459,248

County Name	Number of Buildings in High WUI Zones (7-9)	Value of Buildings in High WUI Zones (7-9)
Carteret	16919	$2,866,583,615
Caswell	1568	$279,676,048
Catawba	7816	$1,176,028,120
Chatham	5462	$821,806,651
Cherokee	2842	$255,238,779
Chowan	977	$135,943,385
Clay	915	$120,149,911
Cleveland	1822	$166,621,272
Columbus	10178	$2,062,535,094
Craven	16831	$2,539,656,405
Cumberland	57192	$19,454,822,783
Currituck	4202	$428,248,828
Dare	13700	$2,097,457,863
Davidson	9363	$643,768,397
Davie	3747	$287,424,220
Duplin	7480	$1,576,175,800
Durham	13714	$2,753,384,570
Edgecombe	2669	$197,745,090
Forsyth	8148	$799,302,920
Franklin	7625	$657,573,045
Gaston	7128	$1,382,695,656
Gates	759	$78,754,425
Graham	731	$69,336,152
Granville	5014	$707,315,769
Greene	992	$269,484,085
Guilford	13919	$1,087,388,399
Halifax	1366	$87,081,841
Harnett	24103	$3,409,621,627
Haywood	596	$73,890,054
Henderson	6130	$885,943,198
Hertford	2124	$364,432,873
Hoke	11262	$1,401,152,264
Hyde	1354	$107,471,606
Iredell	9642	$1,690,638,393
Jackson	2160	$476,419,053
Johnston	25764	$2,480,733,502
Jones	1730	$236,250,347
Lee	6762	$575,123,751
Lenoir	7395	$878,364,850
Lincoln	5569	$1,295,380,561
Macon	3581	$628,642,823
Madison	1069	$94,231,437
Martin	2316	$234,765,295
McDowell	3659	$409,449,787
Mecklenburg	12819	$3,894,047,853
Mitchell	729	$80,477,714
Montgomery	3253	$408,016,986
Moore	25353	$3,152,153,776
Nash	4337	$430,688,907

County Name	Number of Buildings in High WUI Zones (7-9)	Value of Buildings in High WUI Zones (7-9)
New Hanover	39753	$10,932,110,627
Northampton	1142	$76,311,872
Onslow	49257	$4,308,735,426
Orange	7741	$1,640,198,144
Pamlico	4875	$296,238,128
Pasquotank	1911	$232,529,353
Pender	18206	$1,518,931,797
Perquimans	763	$100,467,043
Person	1458	$131,419,296
Pitt	9823	$1,474,760,752
Polk	801	$91,978,016
Randolph	7703	$1,171,374,384
Richmond	9404	$747,923,034
Robeson	15309	$2,979,703,865
Rockingham	6605	$422,490,729
Rowan	6660	$572,070,885
Rutherford	2355	$157,765,893
Sampson	7140	$1,516,131,494
Scotland	5753	$583,320,582
Stanly	2795	$232,029,786
Stokes	2092	$342,976,689
Surry	2255	$197,817,212
Swain	884	$198,948,435
Transylvania	1985	$276,248,397
Tyrrell	504	$40,521,492
Union	4335	$706,977,231
Vance	4189	$730,332,267
Wake	73548	$16,897,720,972
Warren	2159	$127,792,355
Washington	1897	$106,034,879
Watauga	1571	$502,014,482
Wayne	17893	$1,442,527,986
Wilkes	4251	$319,668,666
Wilson	2407	$525,633,432
Yadkin	789	$59,713,189
Yancey	727	$63,600,478
North Carolina	**792,221**	**$129,521,418,846**

Source: NC Forest Service and NCEM-RM

Figure 3-72 Wildland Urban Interface Risk Index



Wildfire Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	There are a number of potential losses from a wildland fire in North Carolina including loss of life and injury due to severe burns. Health hazards from smoke caused by wildland fires can include breathing difficulties and worsening of chronic breathing and/or cardiovascular disease. Smoke and air pollution pose a risk for children, the elderly, and those with respiratory and cardiovascular problems. Wildfire tends to create some issues with public confidence because of the very visible impacts that the fire has on the community.
Responders	High	Responders are often at great risk when responding to wildfire, especially firefighters who are responsible for putting out the blaze. All response personnel are potentially at risk when dealing with a wildfire, as changing winds and a number of other factors can often cause a fire to spread rapidly. Although many areas of the state are urbanized and are not at a high risk to wildfire, moderately-developed rural areas that are located in the wildland urban interface may require response personnel to be ready to act. Like the general public, first responders are also at risk for exposure to dangers from the initial incident and after-effects such as smoke inhalation and/or heat stroke. However, their risk is often more prominent as they are often in the middle of an incident through their responsibilities as a responder.

Category	Impact Rating	Description of Impacts
Operations/Continuity of Operations	Moderate	Since wildfire often moves quickly and can affect infrastructure that is important to maintaining continuity of operations, there is some level of concern for maintaining continuity. However, operations at the state level, which are generally run from urbanized areas, will probably not be impacted in a major way. Local continuity of operations in rural areas is much more susceptible to the impacts of a wildfire.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Wildland fires have the potential to substantially burn forested areas as well as private residences. Damage and destruction to state, county, private, and municipal structures and facilities are major losses that are attributed to wildland fires. Private residences and communities that are located within the Wildland Urban Interface (WUI) are particularly susceptible to the threat. Population increases in North Carolina's WUI areas, for example, can create significant challenges for firefighters and residents. This is especially notable considering a study in 2000 showed that North Carolina ranked number one in terms of the amount of land area located within the WUI zones and fifth in number of homes located within the WUI.44 Many new homes are constructed without considering community wildland fire planning. This creates neighborhoods with limited accessibility, flammable building construction, and landscaping. A lack of firewise planning can also greatly increase the probability of a wildland fire occurrence with more homes and emergency personnel being threatened. All types of private property may suffer losses from wildfires. This includes business properties, homes, vehicles, and livestock. Damage to capital goods and equipment as well as evacuation expenses and other losses are directly related to fire and smoke damage. Additional potential losses include building and landscape maintenance expenses, firefighting equipment purchases, and fire-related business closures. Additional post-fire losses include cleanup, rehabilitation and repair expenses, equipment and capital goods replacement, drinking water pollution, smoke damage, deflated real estate values, and an increase in fire insurance premiums.
Economy	Moderate	Given the fact that a number of homes, businesses, and infrastructure are located in areas that could be impacted by wildfire, there could be some significant economic impacts of a wildfire in the state. If homes or businesses are burned, the cost of rebuilding could be substantial. Impacts to agricultural crops are another economic loss that the state could face in the event of a wildland fire. Wildfires can be particularly damaging to the lumber and Christmas tree farming industries which are important to the

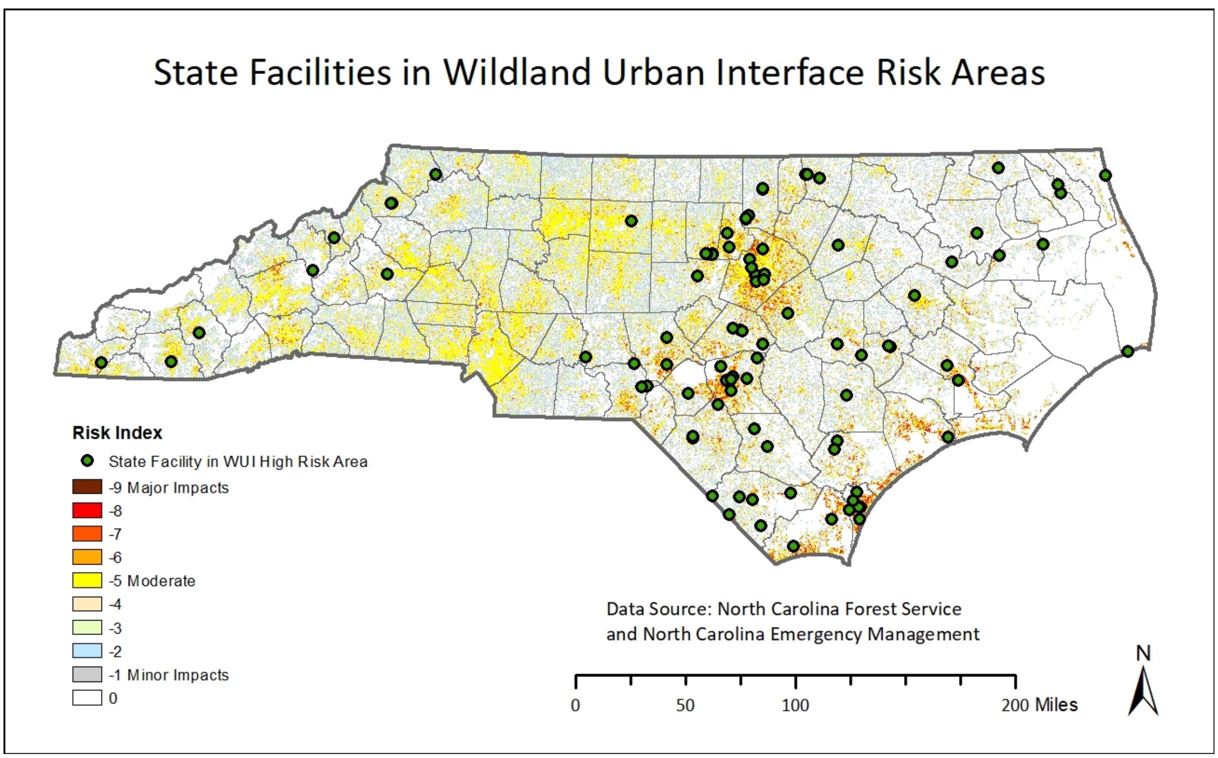
[44] *North Carolina Firewise (2000). North Carolina Firewise. Retrieved August 21, 2017, from http://www.ncfirewise.org/index.htm*

Category	Impact Rating	Description of Impacts
		state.
Environment	Low	Wildland fires have the potential to damage or destroy forage on grazing lands, secondary forest products destruction, and/or degradation and loss of wildlife habitat on public lands. On private lands, vegetation losses could include agricultural crops that are either burned or impacted by wildland fire smoke. Indirect losses could include loss of growing stock as well as irrigation systems. Another potential loss includes damage and destruction to a wide variety of common or protected habitats in the state. Finally, the release of smoke from wildfires can pollute the air and reduce air quality. It should also be noted, however, that wildfires are a naturally occurring element of the environment and have played an important part in the development of many ecosystems in that they are regenerative and provide vital nutrients for the soil which can help sustain a forest habitat and all of the organisms living within it. Therefore, although there are some negative impacts of wildfire, there are also some positive impacts on the environment.

Wildfire Hazard Vulnerability for State-Owned Facilities

There are 566 State-owned facilities with a value of $1,133,718,049 located in high risk WUI areas (WUI categories 7, 8, 9). Figure 3-67 provides a graphical representation of where those facilities are located.

Figure 3-73 State Facilities in Wildland Urban Interface Risk Areas



3.4.5.9 Dam Failure Hazard Vulnerability

Inventories of statewide dam inundation data is an area that NCEM-RM is currently working hard to improve. At this time, there is geospatial data in final quality control review for 19 dams in North Carolina and that number is expected to increase significantly over the next several years. Additionally, NCEM is currently working with the USACE to acquire inundation data for 9 dams under the Corps' control. As this data becomes available, detailed assessments can be run to better determine statewide vulnerability to dam failures. The 2023 update of the NCEHMP will include a much more robust analysis of statewide dam failure vulnerability at the County level and for State-owned facilities.

Dam Failure Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)		Many of the impacts associated with a dam/levee failure are the same as those that would be associated with a flood event. However, the primary difference for members of the public in the case of a dam/levee failure is that often citizens who might be impacted by a dam/levee failure may believe themselves to be protected from flood events as a result of the dam/levee and therefore, may not be anticipating the event. This may have a severe impact on public confidence in the long run as citizens may view this as a failure of government institutions to properly regulate and control the dam/levee. That is to say, they may ultimately view the incident as preventable, unlike a flood that occurs purely from natural causes.
Responders		Similar to the issues associated with the flood hazard, responders would be impacted by a dam/levee failure as they may be forced to attempt to assist citizens who have become trapped in their homes or in flood waters. Responders may have difficulty accessing homes or other structures where they need to provide support and their lives and well-being will likely be put at risk if they are forced to assist in a flooded area.
Operations/Continuity of Operations		A dam/levee failure would be unlikely to impact continuity of operations as the event would likely be confined to a specific area directly surrounding the dam/levee and most operations-related facilities in the state are not at risk of being impacted by a dam/levee failure.
Built Environment (Property, Facilities, Infrastructure)		A dam/levee failure may impact any properties located downstream of a dam/levee, especially any that are within identified inundation zones. The effects of a dam/levee failure on property, facilities, and infrastructure would be similar to those that have been outlined in the flood analysis although it is possible that the damage may be more severe, as high volumes of water are released all at once rather than over time. For example, during Hurricane Matthew a number of homes were damaged by dam breaks that were caused by massive rainfall in the state. Many of these dam breaks were at private dams and were the result of uncoordinated releases among operators along the river systems. In this scenario, when one dam failed, it caused a rush of water that impacted the downstream dams and resulted in similar

Category	Impact Rating	Description of Impacts
		failures and flooding of buildings.
Economy		The economic costs of a dam/levee failure could be significant as there will likely be a high economic cost for the owner of the structure (whether it be a privately or publicly-owned) to rebuild or reconstruct the dam/levee. If a dam/levee fails, the owner may also need to rebuild the new structure to a higher standard to prevent future failures. If the dam was involved in electricity production as is the case for many dams in the state (Lake Jocassee Dam, Fontana Dam, High Rock Lake Dam), the failure will result in a loss of revenue for the owner, which could impact local utilities and may also result in temporary power outages (although most communities do not rely solely on hydroelectric power, so this is less likely). Many of these dams/levees are also used to create recreational lakes (Kerr Lake, Lake Gaston, Lake Norman) and when this type of dam fails, that recreational resource will be lost, which in turn may reduce tourism and visitors to the area and reduce property values in and around the lake.
Environment		The impacts on the environment from a dam/levee failure might be that ecosystems and habitats that existed while a dam was in place on a stream/river could be destroyed as floodwaters destabilize areas by inundating places that had not previously been under water or causing higher flow rates downstream. Similar to flood events, if a facility that houses hazardous materials is impacted by flooding from a dam/levee failure, there may be contamination of the stream/river and ultimately the water supply. Although the dam failure itself would likely disrupt habitats in the short term, in some sense, a dam failure may restore the environment to a more natural state by allowing the river to return to its natural course and flow. That is to say, the absence of a dam/levee may be a long-term boon to the local environment.

Dam Failure Hazard Vulnerability for State-Owned Facilities

There is currently inadequate data available to conduct analysis to determine vulnerability of State-owned facilities to the dam failure hazard. This analysis will be updated as more data becomes available.

3.4.5.10 Drought Hazard Vulnerability

Table 3-40 provides a summary of the expected annualized losses for the drought hazard by county based on NCEI data.

Table 3-40 Annualized Losses for Drought

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Alamance	$0.00	$0.00
Alexander	$0.00	$0.00
Alleghany	$12,271,076.00	$584,336.95
Anson	$0.00	$0.00
Ashe	$12,293,923.00	$585,424.90
Avery	$0.00	$0.00

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Beaufort	$0.00	$0.00
Bertie	$0.00	$0.00
Bladen	$0.00	$0.00
Brunswick	$0.00	$0.00
Buncombe	$0.00	$0.00
Burke	$0.00	$0.00
Cabarrus	$0.00	$0.00
Caldwell	$0.00	$0.00
Camden	$0.00	$0.00
Carteret	$0.00	$0.00
Caswell	$15,995,005.00	$761,666.90
Catawba	$0.00	$0.00
Chatham	$0.00	$0.00
Cherokee	$0.00	$0.00
Chowan	$0.00	$0.00
Clay	$0.00	$0.00
Cleveland	$0.00	$0.00
Columbus	$0.00	$0.00
Craven	$0.00	$0.00
Cumberland	$0.00	$0.00
Currituck	$0.00	$0.00
Dare	$0.00	$0.00
Davidson	$0.00	$0.00
Davie	$0.00	$0.00
Duplin	$0.00	$0.00
Durham	$0.00	$0.00
Edgecombe	$0.00	$0.00
Forsyth	$0.00	$0.00
Franklin	$0.00	$0.00
Gaston	$0.00	$0.00
Gates	$0.00	$0.00
Graham	$0.00	$0.00
Granville	$0.00	$0.00
Greene	$0.00	$0.00
Guilford	$0.00	$0.00
Halifax	$0.00	$0.00
Harnett	$0.00	$0.00
Haywood	$0.00	$0.00
Henderson	$0.00	$0.00
Hertford	$0.00	$0.00
Hoke	$0.00	$0.00
Hyde	$0.00	$0.00
Iredell	$0.00	$0.00
Jackson	$0.00	$0.00
Johnston	$0.00	$0.00
Jones	$0.00	$0.00
Lee	$0.00	$0.00
Lenoir	$0.00	$0.00
Lincoln	$0.00	$0.00
Macon	$0.00	$0.00
Madison	$0.00	$0.00
Martin	$0.00	$0.00
McDowell	$0.00	$0.00
Mecklenburg	$0.00	$0.00
Mitchell	$0.00	$0.00
Montgomery	$0.00	$0.00
Moore	$0.00	$0.00

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Nash	$0.00	$0.00
New Hanover	$0.00	$0.00
Northampton	$0.00	$0.00
Onslow	$0.00	$0.00
Orange	$0.00	$0.00
Pamlico	$0.00	$0.00
Pasquotank	$0.00	$0.00
Pender	$0.00	$0.00
Perquimans	$0.00	$0.00
Person	$0.00	$0.00
Pitt	$0.00	$0.00
Polk	$0.00	$0.00
Randolph	$0.00	$0.00
Richmond	$0.00	$0.00
Robeson	$0.00	$0.00
Rockingham	$13,157,091.00	$626,528.14
Rowan	$0.00	$0.00
Rutherford	$0.00	$0.00
Sampson	$0.00	$0.00
Scotland	$0.00	$0.00
Stanly	$0.00	$0.00
Stokes	$12,395,810.00	$590,276.67
Surry	$12,388,243.00	$589,916.33
Swain	$0.00	$0.00
Transylvania	$0.00	$0.00
Tyrrell	$0.00	$0.00
Union	$0.00	$0.00
Vance	$0.00	$0.00
Wake	$0.00	$0.00
Warren	$0.00	$0.00
Washington	$0.00	$0.00
Watauga	$12,713,868.00	$605,422.29
Wayne	$0.00	$0.00
Wilkes	$10,021,767.00	$477,227.00
Wilson	$0.00	$0.00
Yadkin	$10,001,391.00	$476,256.71
Yancey	$0.00	$0.00
North Carolina	$111,238,174.00	$5,297,055.90

Source: NCEI

Drought Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Drought can have a detrimental effect on the livelihood of farmers and agricultural producers in North Carolina. Efforts to mitigate against drought, such as using irrigation equipment, have a high initial cost, including the need for an increase in management requirements, cost of operation and maintenance, and the lack of good quality water resources—which during times of drought would be severely affected. Although the general public may be subject to water restrictions during extreme drought events, it is unlikely that public confidence in the state's governance would be impacted severely as a result of a drought.
Responders	Low	Although drought would have many of the same impacts on responders as it would on the public, the overall effects would be

Category	Impact Rating	Description of Impacts
		relatively limited when compared to the impacts other hazards could potentially have on responders. Since a drought is typically a slowly developing event, the risk and exposure that responders would face is minimal.
Operations/Continuity of Operations	Low	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. Normal operations would very likely be able to continue throughout the event and there would likely be little change to the program's management overall.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Water Use Drought has the potential to affect North Carolina's water supply for residential, commercial, institutional, industrial, and government-owned areas. Drought can reduce water supply in wells and reservoirs. When drought conditions persist with no relief, local or state governments often institute water restrictions which may have an impact on personal property to some degree, though generally these restrictions are meant to protect life safety by ensuring adequate supplies of drinking water for consumption and other critical purposes. Irrigation Drought would affect irrigation and outdoor landscaping efforts around residential, commercial, institutional, industrial, and government-owned land. Water conservation strategies can limit the amount of water used to maintain the aesthetic environment around buildings, businesses, and areas such as golf courses. This would include automatic and non-automatic spray irrigation systems, hose-end sprinklers, handheld hoses, bucket watering, drip irrigation, athletic field irrigation, swimming pools, car washing, pressure washing, and reuse water.
Economy	High	Drought can have a detrimental effect on agricultural and agribusiness industry sectors which account for one-sixth of North Carolina's income and employees.45 Extreme drought also has the potential to depress local businesses and industries such as landscaping, recreation and tourism, and public utilities. Nursery and landscape businesses can also face significant losses from a drought. Losses include reduction of output and sales of crops, reduction in plant sales, and an increase in watering costs. This can lead to the closing of many business locations, laying-off employees, and increases in bankruptcy filing. Agriculture The agriculture sector of North Carolina is particularly susceptible to drought damage. The table below shows there are more than 50,000 farms in North Carolina, with over ¼ of the land area of the state

[45] *Walden, Mike. North Carolina State University College of Agriculture and Life Sciences. (2017). Agriculture and agribusiness: North Carolina's Number One Industry. Retrieved August 21, 2017, from https://cals.ncsu.edu/intranet/news/agriculture-and-agribusiness*

Category	Impact Rating	Description of Impacts
		being farmland.46 Agricultural drought has the potential to directly affect much of the land in North Carolina. Agricultural areas at particular risk are cropland and pastures.

Census of Agriculture (2012)	
Total Acres in State	31,115,462
Number of Farms	50,218
Total Land in Farms, Acres	8,414,756
Average Farm Size, Acres	168

Crops

Prolonged periods of dry weather are the most difficult and damaging problem faced by crop growers and agricultural suppliers. North Carolina has 4,378,097 acres of harvested cropland, which is 14.1 percent of total land area of state.

Short- or long-term moisture deficits—even with the use of irrigation methods—during critical stages of crop development can severely reduce yields, with the amount of yield lost depending on when the drought occurs (see table below for a list of North Carolina crop specific information), the growth stage of the crop, the severity of dry conditions, and the amount of available water that the soil can hold.

Crops	Value of Sales	U.S. Rank[47]
Tobacco	$732,772,000	1
Cut Christmas trees and short rotation woody crops	$67,097,000	2
Cotton and cottonseed	$403,366,00	5
Nursery, greenhouse, floriculture, and sod	$580,230,000	7
Vegetables, melons, potatoes, and sweet potatoes	$434,974,000	10

Livestock

Table 5.1 shows the type of livestock in North Carolina, including the quantity of livestock and the state's rank compared to other states in the United States. These are at risk for being affected by drought conditions in the state.

Livestock losses from drought will most likely be confined to forage-based production systems. Losses in beef and dairy systems will

[46] *North Carolina: Census of agriculture—2012. Retrieved August 21, 2017, from https://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/North_Carolina/index.asp*
[47] *Rank in production among all states*

Category	Impact Rating	Description of Impacts
		potentially be of a single-season or multiyear variety. Single-season losses will include lost forage production (on both hay and grazing land), reduced weaning weights, reduced milk production, and increased mortality. Multiyear losses could include the cost of reestablishing pastures and reduced meat or milk production in subsequent years due to forced sales in the drought year. In addition, drought conditions could result in poor pasture conditions, reduced drinking water supplies, and a critical hay shortage that directly affects livestock and poultry health.
Environment	Moderate	Drought may also lead to pollution of water sources as a result of lack of rainwater to dilute industrial and agricultural chemical runoff. This poses a risk to plants and animals and makes it difficult to maintain a clean drinking water supply. Lack of water reaching the soil may also cause the ground to become dry and unstable. Erosion can increase and loss of topsoil can be severe if a high-intensity rain falls on ground lacking a ground cover of plants. As a result of these environmental impacts, habitats may be degraded through a loss of wetlands, lake capacity, and vegetation.

Livestock	Number	U.S. Rank[48]
Turkeys	17,1919,277	2
Hogs and pigs	8,901,434	2
Broilers and other meat-type chickens	148,251,469	4
Layers	13,091,384	8
Pullets for laying flock replacement	6,239,251	8

Drought Hazard Vulnerability for State-Owned Facilities

All state-owned facilities should be considered vulnerable to drought, but drought does not cause significant structural or monetary damage. The most significant damages would be to water supplies so any state-owned facilities that has more dependency on water would be considered more vulnerable; however, at this time, there is no method for determining what those state-owned facilities might be.

[48] *Rank in production among all states*

3.4.5.11 Tornado/Thunderstorm Hazard Vulnerability

Tornado Vulnerability

Table 3-42 provides a summary of the expected annualized losses to tornadoes by county based on NCEM-RM risk data analysis.

Table 3-41 Annualized Tornado Hazard Losses by County

County	Annualized Losses
Alamance	$ 1,526,398.39
Alexander	$ 234,081.44
Alleghany	$ 245,273.52
Anson	$ 300,275.33
Ashe	$ 649,499.14
Avery	$ 345,134.64
Beaufort	$ 488,760.10
Bertie	$ 188,365.66
Bladen	$ 559,007.20
Brunswick	$ 1,284,176.77
Buncombe	$ 796,429.41
Burke	$ 509,154.85
Cabarrus	$ 3,606,215.43
Caldwell	$ 1,465,994.70
Camden	$ 70,836.13
Carteret	$ 312,434.53
Caswell	$ 413,301.33
Catawba	$ 508,537.15
Chatham	$ 1,763,435.77
Cherokee	$ 1,755,646.83
Chowan	$ 217,690.11
Clay	$ 252,264.26
Cleveland	$ 2,293,834.24
Columbus	$ 703,981.66
Craven	$ 443,300.82
Cumberland	$ 740,509.70
Currituck	$ 177,329.23
Dare	$ 144,271.17
Davidson	$ 691,547.87
Davie	$ 839,925.73
Duplin	$ 1,419,944.84
Durham	No results
Edgecombe	$ 259,607.55

County	Annualized Losses
Forsyth	$ 578,327.30
Franklin	$ 382,957.27
Gaston	$ 344,320.30
Gates	$ 179,796.42
Graham	$ 595,608.32
Granville	$ 351,346.14
Greene	$ 156,256.78
Guilford	$ 960,238.92
Halifax	$ 1,353,010.07
Harnett	$ 659,461.81
Haywood	$ 1,693,481.79
Henderson	$ 2,286,765.74
Hertford	$ 322,033.62
Hoke	$ 220,290.25
Hyde	$ 31,969.82
Iredell	$ 713,927.01
Jackson	$ 1,022,316.14
Johnston	$ 2,132,896.82
Jones	$ 124,223.22
Lee	$ 400,360.58
Lenoir	$ 329,120.11
Lincoln	$ 430,001.28
Macon	$ 1,713,629.36
Madison	$ 582,168.19
Martin	$ 556,018.27
McDowell	$ 365,848.63
Mecklenburg	$ 13,611,075.94
Mitchell	$ 367,382.64
Montgomery	$ 371,863.38
Moore	$ 980,996.59
Nash	$ 460,175.46
New Hanover	No results
Northampton	$ 366,777.74
Onslow	$ 488,536.63
Orange	$ 2,012,151.22
Pamlico	$ 162,049.43
Pasquotank	$ 148,158.75
Pender	$ 416,457.44
Perquimans	$ 195,775.72
Person	$ 659,560.18

County	Annualized Losses
Pitt	$ 514,399.60
Polk	$ 675,018.90
Randolph	$ 584,500.80
Richmond	$ 279,723.21
Robeson	$ 2,586,565.19
Rockingham	$ 1,401,713.34
Rowan	$ 2,833,174.08
Rutherford	$ 2,006,982.85
Sampson	$ 1,808,690.71
Scotland	$ 247,605.43
Stanly	$ 1,233,213.18
Stokes	$ 268,306.63
Surry	$ 236,649.67
Swain	$ 262,544.16
Transylvania	No results
Tyrrell	$ 47,186.50
Union	$ 988,998.82
Vance	$ 178,736.29
Wake	$ 1,647,745.36
Warren	$ 274,551.90
Washington	$ 72,987.99
Watauga	$ 474,907.42
Wayne	$ 2,459,157.14
Wilkes	$ 438,655.21
Wilson	$ 69,538.97
Yadkin	$ 215,333.21
Yancey	$ 441,323.04
North Carolina	**$ 86,182,710.38**

Source: USGS and NCEM-RM

Thunderstorm Vulnerability

Table 3-42 provides a summary of the expected annualized losses to thunderstorms by county based on NCEI data.

Table 3-42 Annualized Losses for Thunderstorms

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Alamance	$1,270,796.00	$60,514.10
Alexander	$1,338,000.00	$63,714.29
Alleghany	$145,274.00	$6,917.81
Anson	$228,566.00	$10,884.10
Ashe	$267,872.00	$12,755.81
Avery	$22,759.00	$1,083.76
Beaufort	$357,617.00	$17,029.38
Bertie	$428,462.00	$20,402.95
Bladen	$2,684,680.00	$127,841.90
Brunswick	$809,879.00	$38,565.67
Buncombe	$553,040.00	$26,335.24
Burke	$675,404.00	$32,162.10
Cabarrus	$792,885.00	$37,756.43
Caldwell	$505,293.00	$24,061.57
Camden	$75,958.00	$3,617.05
Carteret	$2,141,410.00	$101,971.90
Caswell	$1,664,330.00	$79,253.81
Catawba	$2,967,167.00	$141,293.67
Chatham	$680,888.00	$32,423.24
Cherokee	$1,131,580.00	$53,884.76
Chowan	$755,931.00	$35,996.71
Clay	$605,292.00	$28,823.43
Cleveland	$924,063.00	$44,003.00
Columbus	$9,609,388.00	$457,589.90
Craven	$367,027.00	$17,477.48
Cumberland	$1,749,515.00	$83,310.24
Currituck	$117,530.00	$5,596.67
Dare	$1,008,964.00	$48,045.90
Davidson	$1,960,533.00	$93,358.71
Davie	$207,019.00	$9,858.05
Duplin	$1,449,497.00	$69,023.67
Durham	$1,103,896.00	$52,566.48
Edgecombe	$1,494,863.00	$71,183.95
Forsyth	$994,835.00	$47,373.10
Franklin	$6,408,388.00	$305,161.33
Gaston	$773,856.00	$36,850.29
Gates	$108,792.00	$5,180.57
Graham	$55,752.00	$2,654.86
Granville	$306,017.00	$14,572.24
Greene	$382,703.00	$18,223.95
Guilford	$1,205,135.00	$57,387.38
Halifax	$712,246.00	$33,916.48
Harnett	$1,327,558.00	$63,217.05

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Haywood	$205,551.00	$9,788.14
Henderson	$234,456.00	$11,164.57
Hertford	$214,938.00	$10,235.14
Hoke	$504,494.00	$24,023.52
Hyde	$95,459.00	$4,545.67
Iredell	$1,073,976.00	$51,141.71
Jackson	$662,214.00	$31,534.00
Johnston	$1,180,931.00	$56,234.81
Jones	$145,531.00	$6,930.05
Lee	$425,038.00	$20,239.90
Lenoir	$905,826.00	$43,134.57
Lincoln	$551,959.00	$26,283.76
Macon	$539,158.00	$25,674.19
Madison	$52,800.00	$2,514.29
Martin	$521,848.00	$24,849.90
McDowell	$795,800.00	$37,895.24
Mecklenburg	$1,950,903.00	$92,900.14
Mitchell	$2,682.00	$127.71
Montgomery	$2,475,520.00	$117,881.90
Moore	$1,494,262.00	$71,155.33
Nash	$832,087.00	$39,623.19
New Hanover	$2,430,684.00	$115,746.86
Northampton	$614,478.00	$29,260.86
Onslow	$398,613.00	$18,981.57
Orange	$339,536.00	$16,168.38
Pamlico	$95,863.00	$4,564.90
Pasquotank	$790,776.00	$37,656.00
Pender	$3,584,115.00	$170,672.14
Perquimans	$171,881.00	$8,184.81
Person	$316,636.00	$15,077.90
Pitt	$1,106,637.00	$52,697.00
Polk	$40,168.00	$1,912.76
Randolph	$785,578.00	$37,408.48
Richmond	$688,071.00	$32,765.29
Robeson	$5,483,568.00	$261,122.29
Rockingham	$3,576,485.00	$170,308.81
Rowan	$2,075,756.00	$98,845.52
Rutherford	$1,577,437.00	$75,116.05
Sampson	$4,274,034.00	$203,525.43
Scotland	$851,930.00	$40,568.10
Stanly	$2,848,029.00	$135,620.43
Stokes	$1,178,810.00	$56,133.81
Surry	$2,879,310.00	$137,110.00
Swain	$69,630.00	$3,315.71
Transylvania	$121,119.00	$5,767.57
Tyrrell	$108,953.00	$5,188.24
Union	$1,813,030.00	$86,334.76
Vance	$255,699.00	$12,176.14
Wake	$3,813,352.00	$181,588.19

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Warren	$399,560.00	$19,026.67
Washington	$125,764.00	$5,988.76
Watauga	$246,555.00	$11,740.71
Wayne	$5,187,599.00	$247,028.52
Wilkes	$1,418,572.00	$67,551.05
Wilson	$265,439.00	$12,639.95
Yadkin	$1,709,075.00	$81,384.52
Yancey	$96,993.00	$4,618.71
North Carolina	$118,975,828.00	$5,665,515.62

Source: NCEI

Tornado/Thunderstorm Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	The entire State of North Carolina's population is vulnerable to the impacts of a tornado regardless of the measured magnitude. Because it cannot be predicted where a tornado will touch down, it cannot be said which areas of the population within the state are most vulnerable. However, injuries and deaths resulting from tornadoes are the most significant impacts and are most likely to occur to those living in mobile homes or older homes that have not been built to current design standards. Tornadoes often have a high likelihood of affecting public confidence due to their destructive and highly visible impacts. Thunderstorms are generally associated with several other hazards such as high wind and flooding, the latter of which is caused by torrential rain. As such, the public could be impacted in a number of ways by a thunderstorm event. High wind can cause trees to fall and potentially result in injuries or death and rising floodwaters can lead to drowning or other serious injury. Although often not as severe as tornadoes, the impacts on the public from thunderstorms can be significant, especially in the long run. However, the public confidence is usually not affected to a large degree as a result of thunderstorms.
Responders	High	Responders could be critically affected by tornado events as the onset is often very rapid and unpredictable, thereby putting response personnel potentially in harm's way. Many responders may be out in the open while on duty when a tornado forms and they may be caught in a dangerous position as a result. Due to the unpredictability of such events, response may also be hindered post-event as responders may be unable to access those that have been affected if storm conditions persist and they are unable to safely enter affected areas. Responders are not generally affected to any great degree by thunderstorm events, although it should be noted that they could be impacted in many of the same ways as the public. Otherwise, responders could be affected by road blockages caused by downed trees or floodwaters, which would ultimately reduce their response time.

Category	Impact Rating	Description of Impacts
Operations/Continuity of Operations	Moderate	Continuity of operations could be greatly impacted by a tornado as personnel may be harmed and critical resources damaged or destroyed during a tornado. In many ways, since the impacts of a tornado are unpredictable, it is also difficult to predict and plan for the appropriate ways to ensure continuity of operations. Although North Carolina is prepared for such an event, disruption of operations will likely take place to some degree if the event is large enough and spurs multiple tornadoes across the state, as has happened frequently in the past. In general, continuity of operations during a thunderstorm event can be maintained as these events are common in all parts of the state. Thunderstorm events often affect power in much the same way as tornadoes and hurricanes, which ultimately may impact operations. However, thunderstorm events are typically not large enough to severely affect normal operations and their impacts are not wide enough to disrupt continuity of operations at the state level.
Built Environment (Property, Facilities, Infrastructure)	High	*Building Inventory* According to the National Climatic Data Center, North Carolina has been impacted by tornadoes ranging in intensity from F0/EF0 to F4/EF4 based on the Fujita scale. An F5/EF5 has never been experienced, but it is certainly possible. Because it cannot be predicted where a tornado may touch down, all buildings, facilities, and infrastructure within the state are considered exposed to the hazard and at risk for being impacted. Older buildings that are constructed with less-advanced building techniques are at higher risk as are mobile homes. Building materials play a role in how well a structure can withstand tornado force winds. Buildings that use structural steel, reinforced concrete, or load-bearing masonry have the best change of withstanding a tornado event in the state. Homes constructed of wood or manufactured material are most at risk. Non-engineered structures in the state are far more vulnerable than engineered buildings to damage from tornado winds. It is also notable that materials that are well-tied to all other building components are also more likely to survive extreme wind events.[49]The magnitude of the tornado will determine the extent of damage and impacts that are felt throughout the county. These impacts can include structural failure, debris damage, and loss of facility functionality. *Critical Infrastructure* The state's infrastructure system is also vulnerable to the impacts of a tornado. This includes critical infrastructure such as roads,

[49] *Federal Emergency Management Agency. Tornado Protection: Selecting Refuge Areas in Buildings. FEMA P-431, Second Edition, October 2009. Retrieved August 21, 2017 from: https://www.fema.gov/media-library-data/20130726-1456-20490-4099/fema_p_431.pdf*

Category	Impact Rating	Description of Impacts
		railroads, bridges, utilities (power and gas), and pipelines. Any number of these infrastructure systems could be damaged in the event of a tornado, although often power lines are the most common assets that are affected during a tornado. Impacts could include structural damage, impassable or blocked roadways, failed utility lines, railway failure, and impassable bridges. Thunderstorms often have their greatest impact on the built environment as they can cause damage to homes via strong winds or flooding and will often impact facilities and infrastructure in the same way. Power losses often occur due to damage to power lines and roads can flood and cause damage as well. In fact, thunderstorms are often considered one of the greater hazards of concern for local communities, even though any given event will cause relatively little damage, because damaging events occur so frequently.
Economy	High	A tornado can impact any area of North Carolina at any time and bring with it significant property damage costs to individual citizens and the disrupt the regular functioning of the local economy. After past events, there has been a substantial halt to many economic activities and losses to businesses have often been high. The loss of power can also interrupt local economies and have a strong negative impact on daily functioning of business activities. Similarly, economic impacts from thunderstorm events can often be far reaching as the damage from these events are often widespread, affecting both homes and businesses. This damage can result in business and economic disruption through the recovery process.
Environment	Moderate	Downed trees and other forms of vegetation are often one of the most visible impacts to the environment from a tornado. Additionally, building material or other debris can be carried or thrown great distances by the force of wind and end up spread out in unexpected places such as natural areas. Coordinated statewide cleanup efforts after a tornado can include removal of debris, but much debris ends up remaining in local habitats. Finally, if hazardous materials facilities are impacted by the tornado, these may release dangerous chemicals into the environment that can cause long-term harm. Thunderstorms can impact crops via high wind and flooding and can also impact the natural environment through these elements. Flooding can kill plants and animals as well as contaminate drinking water supplies for human populations. High wind can harm forests by bringing down trees and cause fires from downed power lines that impact the environment.

Tornado/Thunderstorm Hazard Vulnerability for State-Owned Facilities

Tornado Vulnerability for State-Owned Facilities

Based on the atmospheric nature of tornadoes and previous occurrences having been reported in all regions of the state, all state-owned facilities should be considered vulnerable to tornadoes.

Thunderstorm Vulnerability for State-Owned Facilities

Based on the atmospheric nature of thunderstorms and previous occurrences having been reported in all regions of the state, all state-owned facilities should be considered vulnerable to thunderstorms.

3.4.5.12 Geological Hazard Vulnerability

Landslide Vulnerability

To evaluate County-level vulnerability to the landslide hazard, a GIS analysis was run to identify buildings that intersect with USGS "Very High" and "High" landslide risk zones. Table 3-43 provides a summary of the findings from that analysis.

Table 3-43 Building Exposure to Landslide Hazard Areas

County Name	Number of Buildings in Very High Risk Zone	Value of Buildings in Very High Risk Zone	Number of Buildings in High Risk Zone	Value of Buildings in High Risk Zone
Alexander	3	$4,484,894	0	0
Alleghany	25	$4,191,545	23	$2,728,838
Anson	0	0	77	$39,815,520
Ashe	0	0	64	$20,215,409
Avery	8	$92,483,269	0	0
Buncombe	39	$13,497,117	5	$110,266
Cabarrus	19	$6,523,031	0	0
Caldwell	15	$1,976,681	0	0
Caswell	0	0	14	$1,639,192
Catawba	17	$9,422,773	0	0
Chatham	103	$22,135,858	23	$8,361,935
Cherokee	0	0	17	$3,236,964
Clay	0	0	6	385593
Durham	35	$7,254,084	1	$47,335
Gaston	14	$4,858,989	0	
Graham	0	0	8	$811,461
Guilford	0	0	11	$2,848,329
Haywood	0	0	23	$4,058,503
Henderson	5	$1,525,168	0	0
Jackson	2	$169,709	30	$4,927,778
Lee	0	0	1	$840,118
Macon	3	$593,067	18	$1,965,963
Madison	0	0	18	$3,345,449
McDowell	3	$1,493,765	0	0

County Name	Number of Buildings in Very High Risk Zone	Value of Buildings in Very High Risk Zone	Number of Buildings in High Risk Zone	Value of Buildings in High Risk Zone
Mecklenburg	84	$613,584,440	0	0
Montgomery	1	$2,879,262	0	0
Orange	209	$3,297,947,247	1	$0
Person	0	0	17	$5,512,389
Polk	13	$2,370,197	0	0
Rockingham	1	$50,760	43	$19,895,260
Stanly	31	$7,454,625	0	0
Surry	41	$11,686,693	0	0
Swain	0	0	8	$1,538,883
Transylvania	15	$6,449,980	0	0
Watauga	71	$597,721,683	14	$873,827
Wilkes	34	$21,142,510	0	0
Yancey	46	$12,358,714	2	$366,575
North Carolina	837	$4,744,256,061.00	424	$46,984,535.00

Source: USGS and NCEM-RM

Sinkhole Vulnerability

To evaluate County-level vulnerability to the sinkhole hazard, a GIS analysis was run to identify buildings that are within 50-yards of an existing sinkhole based on data received from North Carolina Geological Survey. Table 3-44 provides a summary of the findings from that analysis.

Table 3-44 Building Exposure to Existing Sinkholes

County Name	Number of Buildings within 50 Yards of Existing Sinkholes	Value of Buildings within 50 Yards of Existing Sinkholes
Brunswick	1693	$274,060,857
Jones	4	$466,228
New Hanover	1223	$617,106,193
Onslow	1311	$50,397,642
Pender	97	$4,325,222
North Carolina	4328	$946,356,142.00

Source: North Carolina Geological Survey and NCEM-RM

Coastal Erosion Vulnerability

To evaluate County-level vulnerability to the coastal erosion hazard, a GIS analysis was run to identify buildings that are within 50-yards of an eroding shoreline as identified by North Carolina Division of Coastal Management. Table 3-45 provides a summary of the findings from that analysis.

Table 3-45 Building Exposure to Coastal Erosion

County Name	Number of Buildings within 50 yards of eroding shoreline	Value of Buildings within 50 yards of eroding shoreline
Brunswick	101	$16,954,506
Carteret	23	$5,855,243
Currituck	3	$422,148

Dare	279	$44,564,918
New Hanover	39	$30,862,658
Onslow	130	$21,965,739
Pender	52	$4,569,816
North Carolina	**627**	**$125,195,028.00**

Source: North Carolina Division of Coastal Management and NCEM-RM

Geological Hazards Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Geological hazards such as landslides/rock falls and sinkholes can pose a threat to human life and safety, as these events often occur with very little warning time due to a lack of available data on risk. Landslides/rock falls are especially a risk in the more mountainous western part of the state where several fatalities have been caused by in this region historically. The quick and unexpected slide of rocks, dirt, and other debris is extremely dangerous and can cover and destroy homes, thereby causing injuries and death. Sinkholes are a much larger risk in the eastern part of the state where soils are more conducive to this type of activity. Similar to landslides/rock falls, these events are often unexpected as they can develop from underneath the ground and suddenly cause a collapse of soil at the surface level, causing loss of life or injury. Any event that can cause loss of life could potentially have an impact on public confidence, however, since these events are often geographically confined to a small area and do not have wide-ranging impacts on large segments of the population, public confidence is typically not affected to a great degree.
Responders	Low	In most cases, responders are not directly impacted by geological events to any greater degree than the public. However, it should be noted that responders should generally be wary when responding to a geological event because of the risk of secondary events (additional landslides/rock falls or sinkholes). When the ground has been disrupted by one of these events, it could set the stage for additional events and any disruption to the soil by responders during their response may further exacerbate those conditions. Additionally, responders working on site of a geological event may find that the uneven terrain provides an extra challenge in terms of operating normally and carrying out life-saving tactics.
Operations/Continuity of Operations	Low	Continuity of operations during a geological event is unlikely to be interrupted in any major way. As mentioned previously, geological events tend to be confined to small areas and so it is unlikely that operations centers would be impacted. If they are, it should not prove too much of a challenge to move operations to a backup facility and continue normal operations from there.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Impacts on the built environment are probably the greatest effect of geological events. During both landslide/rock fall and sinkhole events, people's homes and/or businesses may be impacted and most typical insurance policies in the state do not cover these kinds of events so homeowners may suffer total losses to their homes. Even when these events do not cause complete destruction

Category	Impact Rating	Description of Impacts
		of homes, they can frequently damage foundations of structures and make them unsafe for dwelling. Similarly, landslides/rock falls and sinkholes that occur around major infrastructure such as roadways and other utilities can cause severe damage to key facilities. In western North Carolina, landslides/rock falls have occurred a number of times along major highways such as I-40 and caused local and state officials to have to shut down these roadways until equipment can be brought in to remove the large boulders and return the road to normal conditions. Similarly, sinkholes in the eastern part of the state have caused breaks in roadways, making them unsafe for driving. In many locations across the state, sinkholes have shut down primary roadways for weeks while the issues were addressed and roads were rebuilt. At times the cause of these sinkholes are man-made as leaking or faulty water/wastewater infrastructure can create the same conditions that cause sinkholes to form naturally.
Economy	Low	Although geological events could impact local businesses and therefore affect the economy, this would likely have very minor effects overall. The greatest impact to the economy from an economic standpoint would be related to the impacts on infrastructure such as roadways. When these are shut down for long periods of time, local economies can be dramatically affected, especially in more rural areas. If traffic has to be re-routed around these areas due to road closures for weeks or even just days, losses in revenue could be significant and have a negative impact on business owners. Both landslides/rock falls and sinkholes have the capacity to cause this level of shutdown as has been the case during a number of past events in the state.
Environment	Low	In general, the environment would be unaffected by a geological event. Some of the minor impacts that might be expected are damage to trees and habitats from falling rocks/debris or from other types of damage to the soil/ground. In past events, large swaths of mountainside have been torn away creating large dead areas where plant life is ripped away. These impacts would be generally confined to a small area and therefore would not have sweeping implications for the ecosystems overall. It is also possible that debris or structural materials could end up in streams or rivers as a result of the event and cause damage to localized populations in these habitats.

Geological Hazards Vulnerability for State-Owned Facilities

Landslide Vulnerability for State-Owned Facilities

Table 3-46 provides information about the number and value of state-owned facilities located in the very high and high-risk landslide hazard zones as indicated by USGS. More detailed site assessments would have to be conducted to determine more exact estimates of vulnerability for these facilities.

Table 3-46 State-Owned Facilities in Landslide Hazard Zones

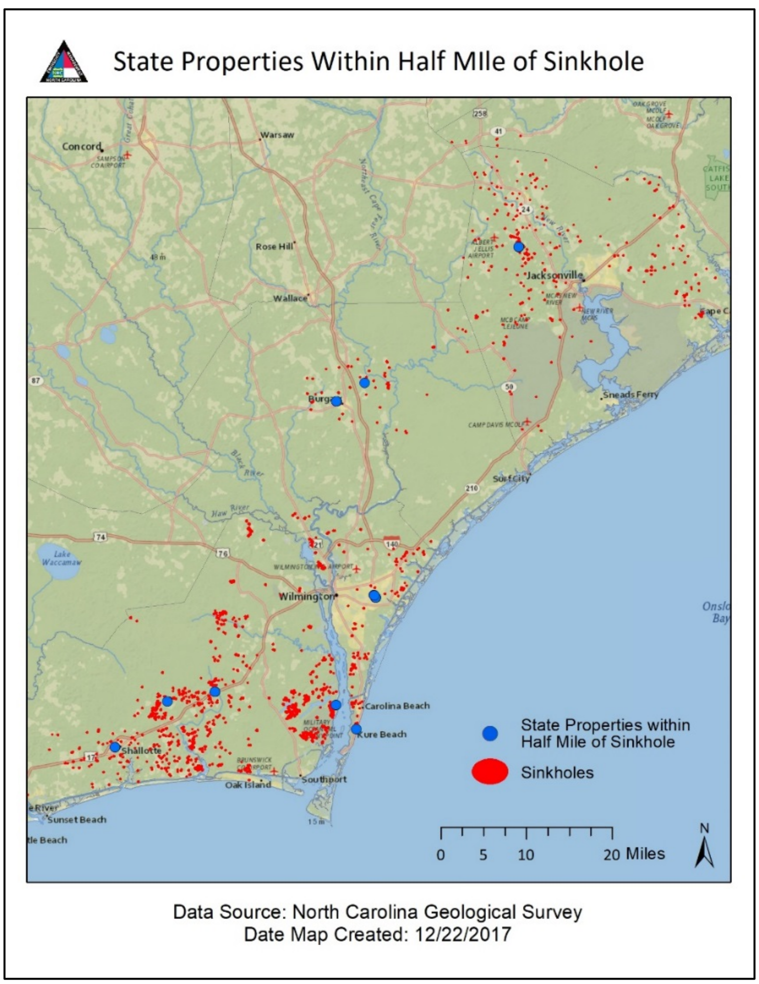
Landslide Hazard Zone	Number of State-Owned Facilities in Zone	Value of State-Owned Facilities in Zone
Very High Risk	843	$4,744,658,492
High Risk	418	$123,139,994

Source: USGS and NCEM-RM

Sinkhole Vulnerability for State-Owned Facilities

There are 67 State-owned facilities with a value of $1,933,889 located within a half mile of an existing sinkhole.

Figure 3-74 Sinkholes and State-Owned Facilities



Coastal Erosion Vulnerability for State-Owned Facilities

GIS analysis indicated just one state-owned facility within 50 yards of an eroding shoreline.

3.4.5.13 Infectious Disease Hazard Vulnerability

At this time, there is no available method for determining dollar losses for infectious disease vulnerability. Future updates of this plan may attempt to better capture these losses if better data becomes available.

Infectious Disease Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The general public can be exposed to infectious diseases through different means based on the particular threat and its potential transmission routes. Vaccinations, when available, are the best means of preventing transmission and infection. Public health information messages will be disseminated via the media in order to provide preventative measures to limit or avoid exposure. According to the North Carolina Public Health Department, in terms of vaccine-preventable diseases, in 2016 there was a slightly higher occurrence rate of Hepatitis A and Mumps in 2016 compared to the five-year average from 2011-2015.50 There were also increased rates of non-vaccine-preventable diseases like Zika which have become more prominent across the United States in recent years. Public confidence in government organizations may be impacted by public health outbreaks. The level of confidence the public possesses is based upon societal expectations, media influence, and past experience following other outbreaks. An effective response to the outbreak can help to guide public confidence toward a favorable level. Collaboration with media outlets can also assist in keeping the public informed and helping to protect them from exposure.
Responders	Low	During a disease outbreak, responders can expect an increase in workload and should practice a higher level of precaution toward exposure than they would normally. Plans exist for first response and health care to address the needs of such situations. Communication between these agencies regarding plans and procedures maximizes the efficiency and effectiveness of these combined efforts. Responders are much more likely on the whole to be impacted by an infectious disease since they will be working directly with those affected to help treat the disease (especially EMS personnel). This will make them more susceptible to becoming infected and, as such, it is critical that they wear the appropriate personal protective equipment to minimize their risk and ensure they can continue providing the care and assistance that is needed

[50] *North Carolina Department of Public Health (2016). Vaccine-Preventable Diseases Reported in North Carolina, 2016. Retrieved August 21, 2017 from: http://epi.publichealth.nc.gov/cd/figures.html*

Category	Impact Rating	Description of Impacts
		to help the public.
Operations/Continuity of Operations	Low	Continuity of operations may be impacted if those in governmental or other key roles are impacted by the disease or public health threat and cannot perform their normal duties. Although plans are in place to ensure continuity of operations, a large-scale event or one that has significant impacts on operational-level staff could negatively affect continuity of operations. Since many diseases are spread through some form of contact with others who have already been infected, a disease event could rapidly disable many of those who are working together to carry out normal operations. Due to their close proximity to one another and need to communicate and coordinate on a daily basis, it is incredibly important to try to reduce the spread of the disease among key personnel once an outbreak has been identified.
Built Environment (Property, Facilities, Infrastructure)	Low	An infectious disease would likely have little direct impact on the built environment itself as the disease would not affect the structural stability of any buildings or infrastructure. However, an infectious disease would have a major impact on the functioning of many structures that would be operating at a high capacity during an infectious disease event, especially medical care facilities. Hospitals and Medical Care Facilities The primary impacts for hospitals/medical facilities during disease outbreaks are an increase in patients and the spread of disease within hospitals. It is highly likely that those affected by the disease will make their way to a medical care facility and it may be necessary to implement quarantines or other measures to reduce the risk of disease spreading. Hospitals and other medical care facilities should have plans in place to deal with such a scenario and also reduce risk of spreading the disease to medical care providers whose workload may be increased as individuals infected with disease may require treatment.
Economy	Low	One of the more significant economic impacts that could be seen in North Carolina involves absenteeism at local businesses which could have a significant impact as the absence of several employees at a small business could force temporary shutdowns or reduced hours of availability. There would also likely be an impact on the local government budget as officials try to respond to the disease and assist those impacted. City centers and downtown areas tend to be where large masses of people congregate and thus may be where the likelihood of disease spread is more prominent. Many people may realize this and avoid these key economic hubs which would result in reduced revenue and a negative impact on the economy overall. Additionally, large events in communities across the state may have to be cancelled if the outbreak is large enough or has the potential to be spread easily and quickly. This would also reduce revenue for many local economies.
Environment	Low	The environmental impact is dependent on the particular biological substance or disease being transmittable to animal or plant life or if

Category	Impact Rating	Description of Impacts
		it can be distributed through the water supply. If the infectious disease in question can be transmitted to other species, there could be an extremely negative impact on species populations. Since animal life does not have the same capacity has humanity to understand the spread of disease and reduce transmission rates, the disease may spread more quickly through animal populations and cause larger-scale loss of life.

Infectious Disease Hazard Vulnerability for State-Owned Facilities

At this time, there is no available method for determining dollar losses relevant to state-owned facilities for infectious disease vulnerability. Future updates of this plan may attempt to better capture these losses if better data becomes available.

3.4.6 Vulnerability to Technological Hazards

3.4.6.1 Hazardous Substances Hazard Vulnerability

Hazardous Substances Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	The accidental or intentional release of a hazardous substance could have both immediate and long-lasting effects on the health of the public. Any release needs to be quickly identified and the proper response guidelines followed to reduce the possible impact on the public. Evacuation is always a consideration when dealing with harmful substances. The public should be aware that hazards exist from the presence of hazardous substances and should take preparedness actions at home and in the workplace to act should a release of substances occur. Hazardous substances can have a significant effect on public confidence in government as incidents often cause serious harm to people via long-term health impacts, contamination of soil or drinking water, and even death. Because of the dangers associated with many hazardous substances and the level of control that humans have over hazardous substance incidents compared to natural hazards, public confidence could be damaged severely in the event of an incident.
Responders	Moderate	First responders must be vigilant when hazardous substances are suspected to be involved. The proper protective apparel must be worn and protocols must be followed to ensure that contaminated individuals and objects go through appropriate decontamination procedures prior to being moved away from the incident, regardless of the situation. Contamination of other responders or citizens must be avoided. The appropriate personnel, such as Hazardous Materials teams, must be notified to ensure that the proper measures are taken to prevent further harm.
Operations/Continuity of Operations	Moderate	During a hazardous substance incident, normal operations are likely to be maintained with only moderate stress on daily

Category	Impact Rating	Description of Impacts
		operations. In the event of a larger scale hazardous substance spill, there could be some loss of continuity of operations as a result of strain on personnel and equipment, but typically this will not be the case.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Hazardous Materials Facilities A hazardous substance event is most likely to take place where the substance is created or stored. Hazardous materials facilities have their own highly-trained personnel for handling and cleaning up the particular substances stored onsite. The facility's plans are highly specific to the substances stored there, thus providing for effective responses to incidents that involve these substances. Some facilities contain hazardous substances that can spread or leak quickly, or are held in extremely dangerous concentrations. There can still be significant effects on workers and others in close proximity despite having good planning in place. These facilities are inventoried in the state through Tier II reporting and there have been some major incidents in the state historically. Utilities Natural gas distribution lines can be problematic with some hazardous substances if contact is made with the natural gas supply. Most of the natural gas infrastructure is located underground, making exposure highly unlikely. However, natural gas itself can be the hazardous substance involved in the incident. One example of how this may occur is if a utility, work crew, or citizen strikes a gas line causing a leak. Degradation of the line may also be the cause of a release. A gas leak would cause an immediate threat and explosions and fires would be significant concerns for the immediate vicinity. Transportation Systems Hazardous substances can have an impact on interstate transportation if a release occurs on or in the vicinity of the roadway which may be the case if a truck or other vehicle carrying hazardous materials is involved in a traffic accident. Significant traffic disruptions may occur, slowing commerce or forcing alternative routing and further congestion of other areas. Similarly, rail lines are one of the more prominent places that hazardous substances are transported. A hazardous substance event on the rail system can impact rail traffic and the overall system. Cleanup efforts wherever the event occurred could be costly and go on for extended periods, shutting down that part of the rail system for that time. Critical Facilities Hospitals utilize and store some hazardous substances on site. Biological materials and radioactive wastes are the primary concerns in a hospital setting. Plans are in place to manage these concerns in both routine and emergency situations. An external hazardous substance event that occurs near the hospital or directly impacts a hospital could create service disruptions such as patient care. A large event may also create a high demand on hospital

Category	Impact Rating	Description of Impacts
		services and cause an overload on resources. Similarly, some emergency services facilities such as emergency shelters may be opened if homes have been exposed to hazardous substances and evacuations occur. Other Structures Commercial, industrial, and residential buildings all may have hazardous substances contained within them that are not reported through the Tier II reporting system but which could still present a smaller scale hazard. Proper containers and labeling can prevent inappropriate use, but accidents can still cause workers to be exposed. Cleaning products, fertilizers, and pesticides are common examples of supplies that are considered hazardous substances and which could cause a smaller incident.
Economy	Moderate	The economic impact of a hazardous substance related incident can be significant locally. Affected commerce is the greatest concern, as spills and releases can force businesses such as shopping centers, markets, and financial centers to be shut down for indeterminate periods of time. Contaminated water can be especially problematic as it can cause extensive shutdowns and put many people in danger. The overall costs depend on the substance(s) involved, how much is released, the processes and time used to manage the spill or release, who or what is contaminated, whether a fire takes place, etc. Cleanup can be a less significant cost and is typically handled by the party responsible for the spill or release. A hazardous substance incident could occur at any large gathering if it was the target of a terrorism event (see Terrorism below). Also, a large event arena could be forced to deal with a hazardous substance incident if it is located in close proximity to them. Arenas and other major event venues may be at significant threat as they are often situated along transportation routes where vehicles transporting such substances could become involved in an accident.
Environment	High	The environmental impact is highly dependent on the location and the severity of the event. Some of the substances involved in these incidents can be cleaned up or do not have lasting impacts on the areas affected. Others may cause crops and other vegetation to be destroyed, sometimes beyond the ability to grow back and animal populations may become displaced or killed. Some areas may be deemed uninhabitable or not fit for development. Water sources may also be impacted by hazardous substance releases or spills, which can affect fish, animal, and plant populations as well as humans that come in contact with contaminated water. The threat to water sources is perhaps the greatest potential threat of a hazardous substance spill on the environment. Water can rapidly transport the substance great distances and expand the scope of the incident. This can make it difficult to respond to the incident and cause serious health impacts.

3.4.6.2 Radiological Emergency – Fixed Nuclear Facility Hazard Vulnerability

Radiological Emergency – Fixed Nuclear Facility Risk, Vulnerability and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	Although many areas of the state are well outside of the defined risk zones for a radiological emergency, there are also a number of areas that are located within the emergency planning risk zones, including several of the major metropolitan areas of the state. Areas located within 10 miles of a nuclear 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. In the 50-mile zone, the public would be most impacted from ingesting radiological materials through home grown crops, milk produced from livestock which have fed on contaminated grasses, and consuming contaminated surface water. Ingestion of radiological materials may result in internal contamination if ionizing radiation is released in the body. This can cause serious health risks, especially if critical organs are affected. Some organs such as the thyroid take in certain isotopes. It is extremely difficult to purge the material from the body. The public will be extremely concerned about their health and safety during and after a nuclear incident. Confidence will be dependent upon the availability of information and perceived quality of response by government and non-government service providers, but it is likely that confidence in the state's governance will be a significant concern.
Responders	High	First responders are vulnerable to the same impacts as the general public but will also be at greater risk due to their need to function outdoors and operate in contaminated environments. These responders will likely need to operate in personal protective equipment to limit their outdoor exposure. Proper decontamination is likely to be necessary to reduce the spread of contamination. Since responders will be first on the scene and directly dealing with the issues of a radiological incident, their risk will potentially be very high.
Operations/Continuity of Operations	Moderate	In the wake of a nuclear accident, continuity of operations could be impacted. It is very likely that many key employees could be a part of the evacuation if their homes are located within the 10-mile evacuation zone. This could cause many issues with maintaining continuity of operations and, depending on the severity of the event, there may be significant disruption to normal operations. Generally, it is likely that operations would proceed from outside their normal location, as there are plans at all stations for setting up command posts outside of high risk areas when incidents occur. This will likely impact continuity of operations to some degree,

Category	Impact Rating	Description of Impacts
		though exercises on radiological incidents are carried out frequently.
Built Environment (Property, Facilities, Infrastructure)	Moderate	It is unlikely that a radiological incident would cause the kind of damage that is typical of many other hazards identified in this plan as there would be minimal destruction of buildings and other infrastructure as a result of this type of incident. However, many structures and facilities could potentially be contaminated with radioactivity rendering it extremely dangerous for humans to be near them or live/work there. In this sense, a major radiological event may cause significant damage to the built environment and result in large areas that must be quarantined or considered off-limits to the public after an incident. Further, checkpoints and decontamination stations may need to be set up along routes that leave the evacuation zones, resulting in increased travel times along major roadways and necessitating traffic re-routes.
Economy	Moderate	Economies within the risk zones are likely to see decreased spending as evacuation takes place. Travel and tourism across the state may be limited for an extended period of time due to travelers associating the entire state with the incident. Interstate commerce may be impacted as decontamination stations may need to be established and some drivers may elect to attempt to circumnavigate the state altogether extending travel times and increasing the time to market for products on a regional and statewide level. Employers in the surrounding areas may see increased absenteeism and requests for leaves of absence to deal with the aftermath of the event and some employees may self-evacuate, resulting in a loss of productivity.
Environment	High	Environmental impacts as a result of a radiological incident may be very serious. Contaminants may impact the land and water for many years and wildlife may experience increased likelihood of cancer and other health problems. In general, habitats and ecosystems will suffer long-term from a radiological incident as the organisms within these areas will face similar impacts to those that humans experience, but since they are unable to evacuate or permanently migrate to new locations, they will be exposed for longer periods and be impacted to a greater degree.

Radiological Emergency – Fixed Nuclear Facility Hazard Vulnerability

The following map displays the population changes during the day and night (as modeled in RTI International's U.S. Synthetic Household Population™ dataset) for the entire state of North Carolina, which demonstrates how vulnerability changes at different time periods. These changes were analyzed using pre-existing data of the population's residences, schools, workplaces, and commuting patterns. It also includes 50-mile buffer zones around each nuclear facility that touches part of the state.

Figure 3-75: Day Time Population Density within 50 Miles of Nuclear Power Plants in NC

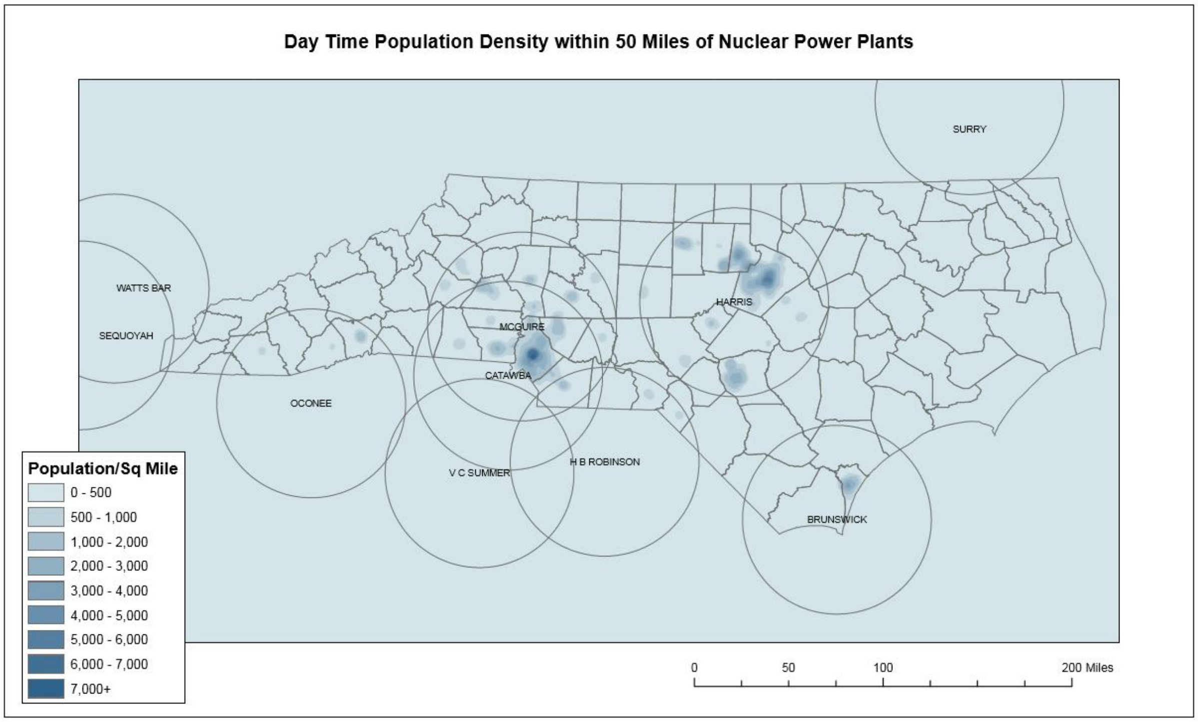
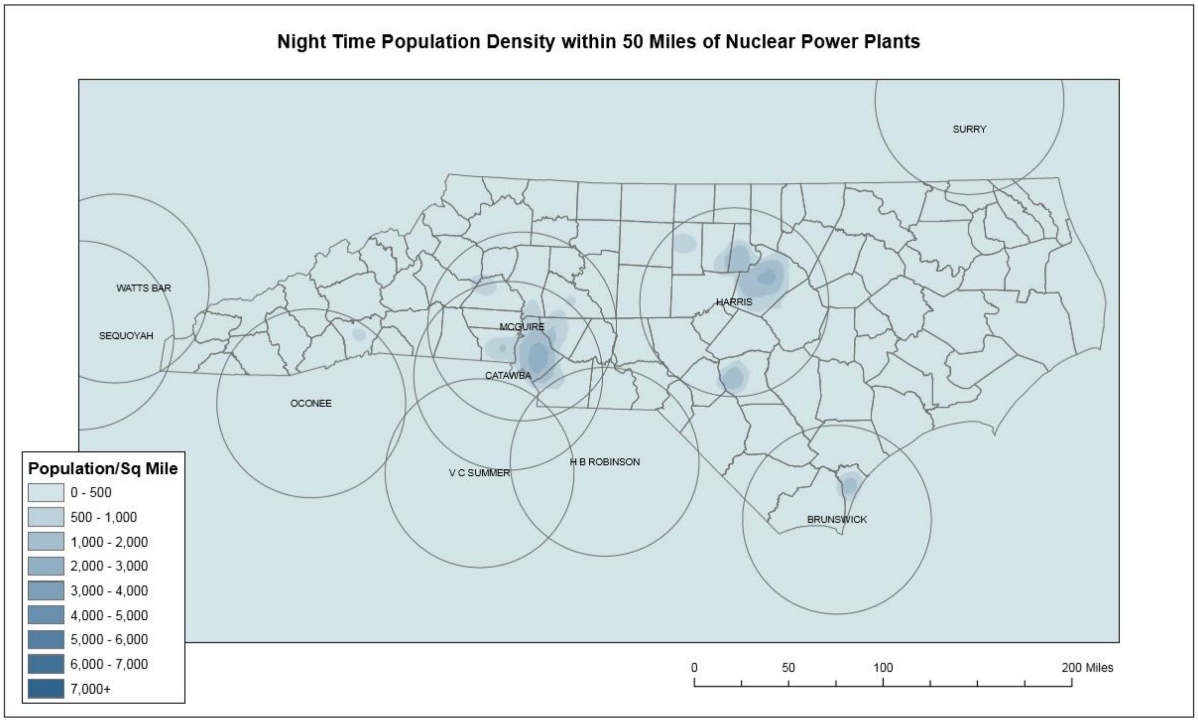


Figure 3-76: Night Time Population Density within 50 Miles of Nuclear Power Plants in NC



Harris Nuclear Plant

Figure 3-71 depicts the location of the Harris Nuclear Plant and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-47. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night.

Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Harris Nuclear Plant are more likely to be at their homes and therefore more vulnerable to a plant emergency during the nighttime hours. The population change is most apparent near Research Triangle Park in Wedge 1.

Figure 3-77: Population Density Changes in Areas Surrounding Harris Nuclear Plant

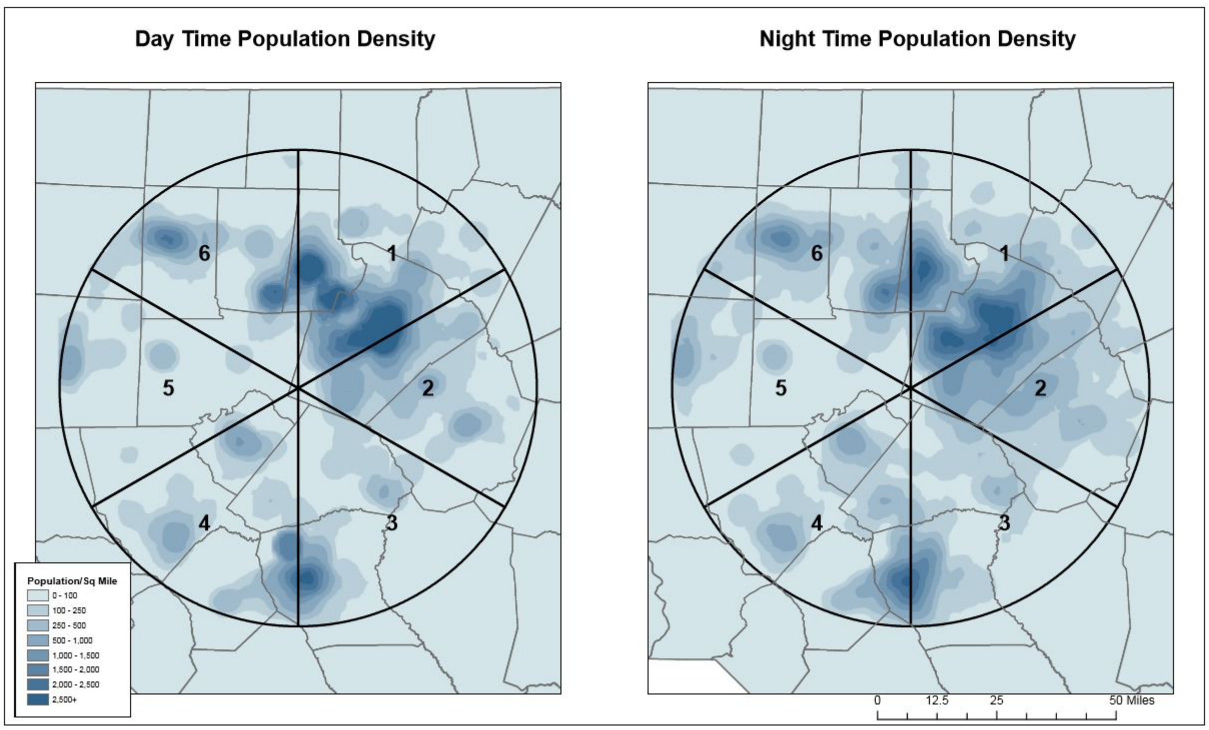


Figure 3-72 and Figure 3-73 below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-78: Population Density Changes 20 Miles Surrounding Harris Nuclear Plant

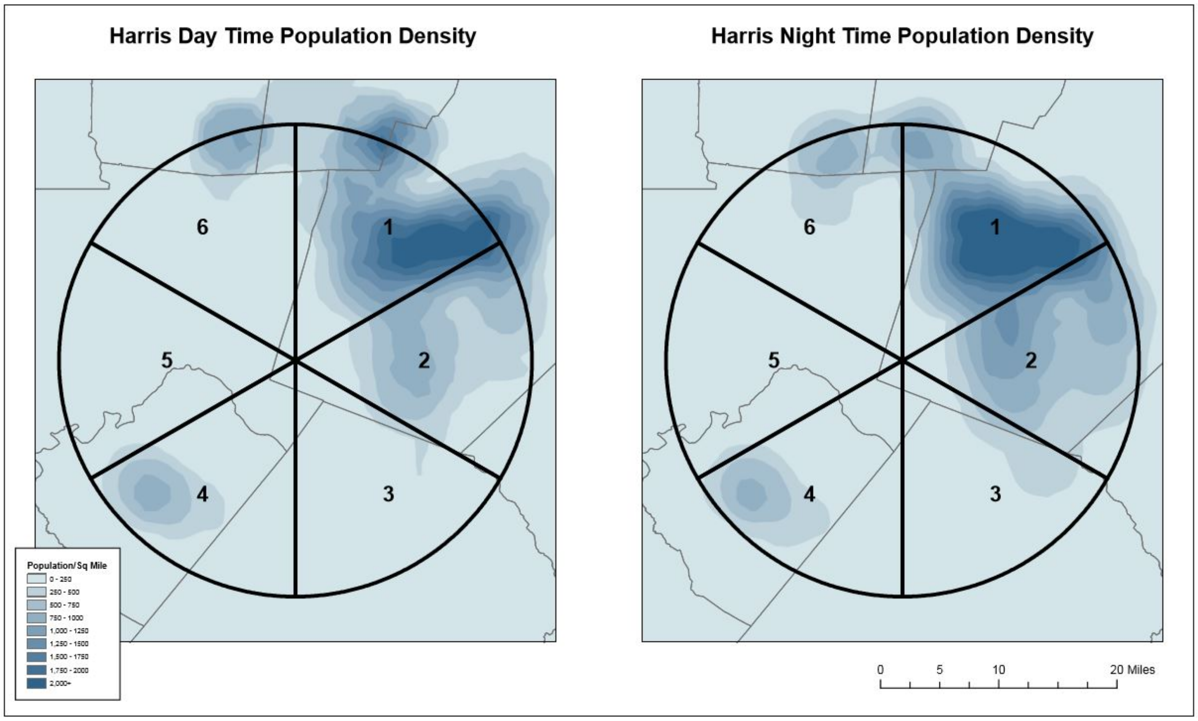
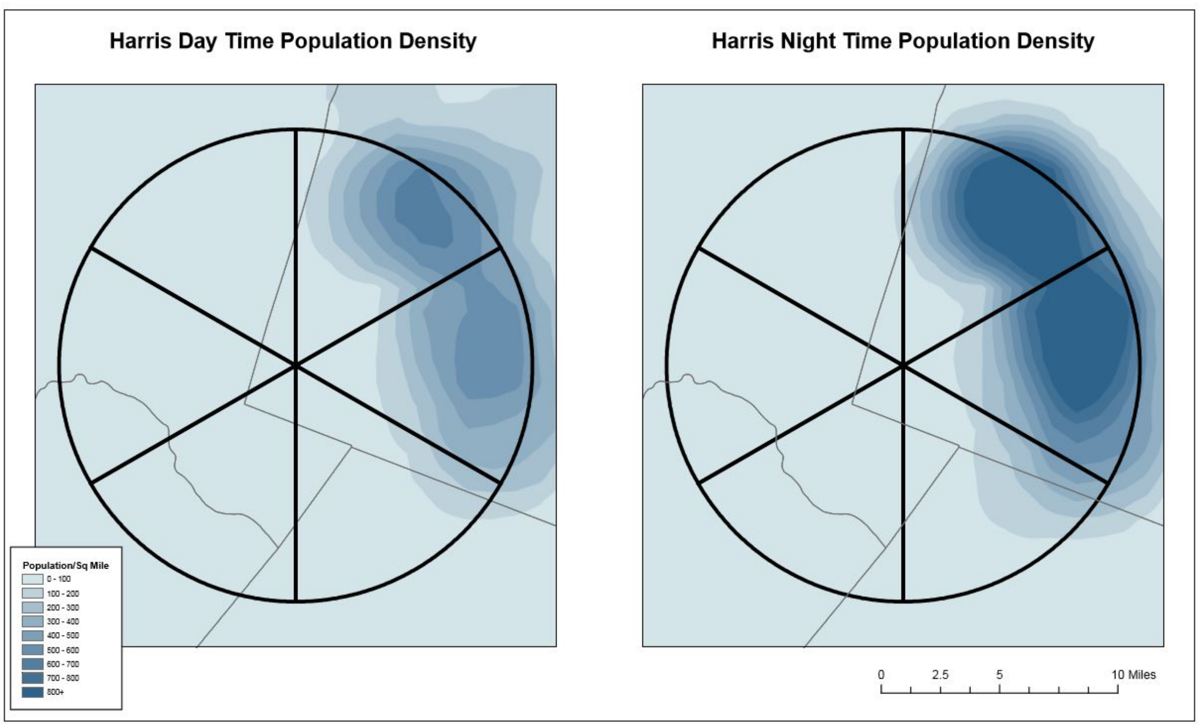


Figure 3-79: Population Density Changes 10 Miles Surrounding Harris Nuclear Plant



The following tables list all municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Wake Franklin Durham Orange Granville Vance Person	Durham Raleigh Creedmoor Oxford	Cary Morrisville Wake Forest Youngsville Butner Stem Apex Holly Springs Rolesville Bunn Franklinton Louisburg Kittrell	n/a

Wedge 2

Counties	Cities	Towns	Villages
Wake Franklin Harnett Johnston Wayne Wilson Nash	Raleigh	Archer Lodge Clayton Four Oaks Pine Level Selma Smithfield Wilson’s Mills Angier Apex Cary Fuquay-Varina Garner Holly Springs Knightdale Wendell Bunn Kenly Micro Princeton Wilson’s Mills Bailey Middlesex	n/a

Wedge 3

Counties	Cities	Towns	Villages
Wake Chatham Harnett Johnston Sampson Cumberland Wayne Robeson	Fayetteville Dunn	Eastover Falcon Godwin Linden Wade Angier Benson Coats Hope Mills Stedman Dunn Erwin Lillington Autryville Newton Grove Salemburg Spring Lake	n/a

Wedge 4

Counties	Cities	Towns	Villages
Wake Chatham Harnett Moore Cumberland Lee Robeson Hoke Richmond Montgomery	Fayetteville Sanford	Broadway Cameron Carthage Southern Pines Vass Spring Lake Hope Mills Raeford Aberdeen Foxfire Taylortown Parkton	Pinehurst Whispering Pines

Wedge 5

Counties	Cities	Towns	Villages
Wake Chatham Alamance Moore Lee Randolph Guilford	Sanford Asheboro Randleman	Goldston Pittsboro Siler City Robbins Liberty Ramseur Staley Pleasant Garden Biscoe Candor Star Franklinville Seagrove	n/a

Wedge 6

Counties	Cities	Towns	Villages
Wake Durham Orange Chatham Alamance Guilford Person Caswell	Burlington Graham Mebane Durham Greensboro Roxboro	Green Level Haw River Swepsonville Pittsboro Chapel Hill Carrboro Hillsborough Elon Gibsonville Ossipee Gibsonville Sedalia Whitsett	Alamance

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-47: Number and Value of Building Vulnerable to Nuclear Accident at Harris Nuclear Plant

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	338,332	$82,848,227,625	94,419	$30,826,291,852	12,897	$3,212,949,868
2	216,809	$33,379,154,883	68,133	$12,897,383,269	17,899	$4,024,396,295
3	146,610	$33,803,877,585	19,681	$3,103,774,864	4,308	$733,461,820
4	176,124	$29,878,067,919	26,177	$2,873,365,076	678	$282,050,522
5	109,898	$10,925,541,857	10,212	$1,491,725,021	1,829	$504,511,088
6	189,285	$33,088,624,270	21,385	$6,157,949,855	1,596	$413,361,617
Totals	1,176,451	$222,766,353,802	239,829	$56,484,919,279	39,170	$8,355,219,836

Source: NCEM

North Carolina's agricultural industry is extremely important to the state's economy, and it is important to consider how a nuclear emergency would impact agricultural areas surrounding nuclear plants. Since 2012, North Carolina has been the top ranked state from the value of sales from poultry, and number 2 from hogs and pigs[51]. It is also a top ranking state in milk and dairy production. In the event of an emergency, processing plants would need to shut down and be evacuated, which could cause many negative effects on the economy. The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Harris Nuclear Plant, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more

[51] *https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA*

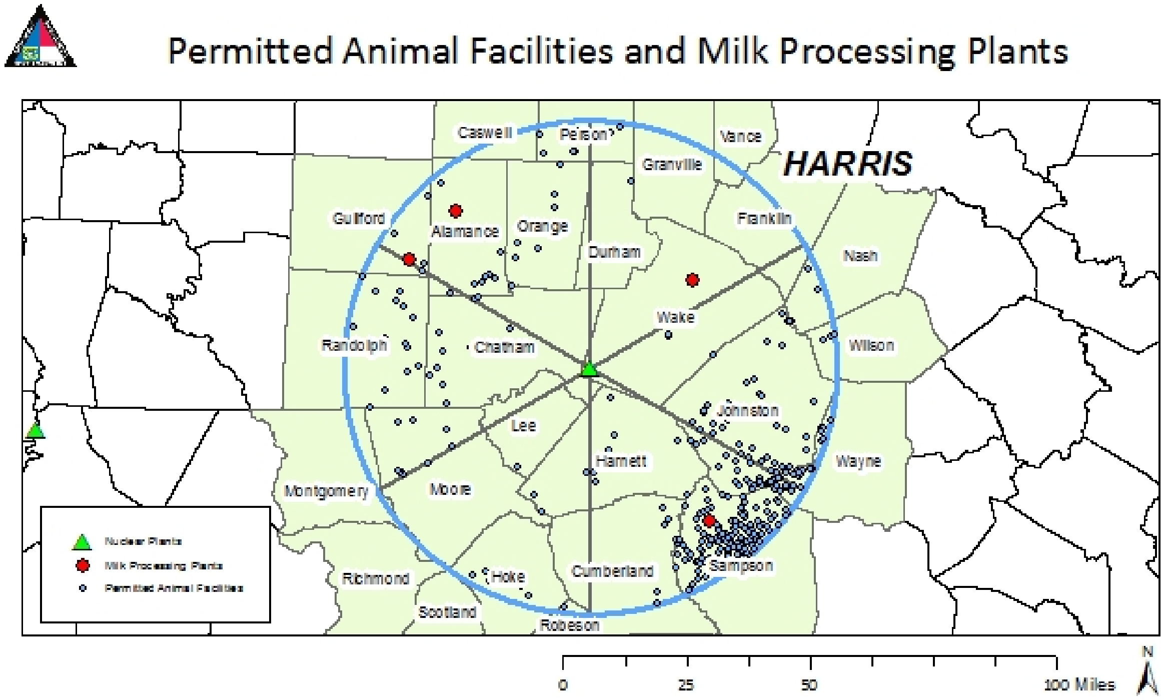
agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 3.

Table 3-48: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Harris Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Beef Cattle	1
	Swine	2
	Milk Processing Plant	3
2	Dairy	1
	Swine	65
	Poultry	1
3	Dairy	1
	Swine	193
	Milk Processing Plant	1
4	Swine	12
5	Beef Cattle	4
	Dairy	14
	Swine	19
6	Beef Cattle	1
	Dairy	17
	Swine	17
	Poultry	1
	Milk Processing Plant	3

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

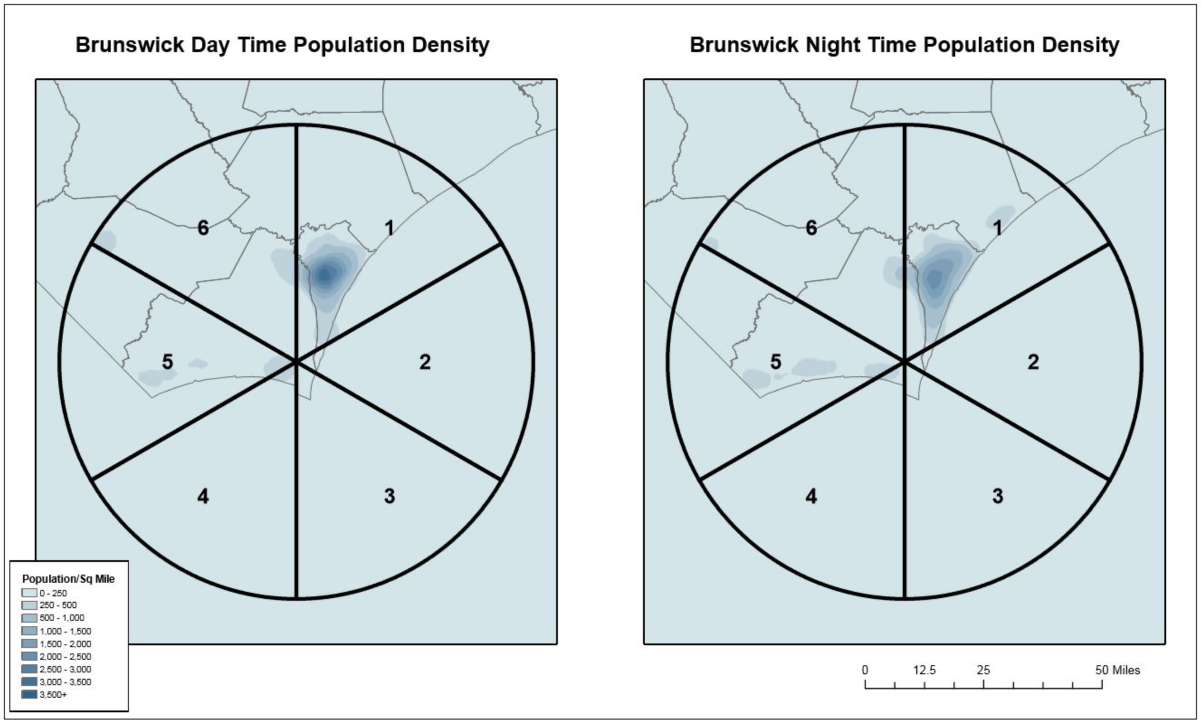
Figure 3-80: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Harris Nuclear Plant



Brunswick Nuclear Plant

Figure 3-75 below portrays the location of the Brunswick Nuclear Plant and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-49. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. The data suggests that the biggest population change takes place in New Hanover County, just outside of the plant's center in Wedge 1.

Figure 3-81: Population Density Changes In Areas Surrounding Brunswick Nuclear Plant



The 2 maps below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-82: Population Density Changes 20 Miles Surrounding Brunswick Nuclear Plant

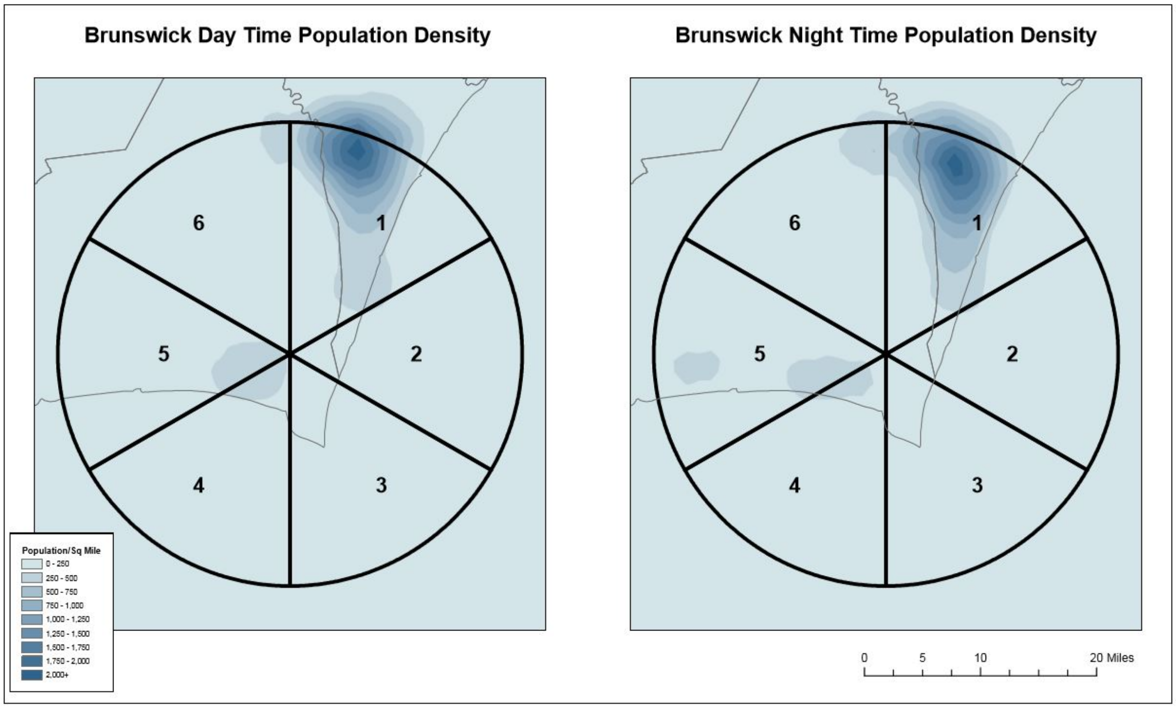
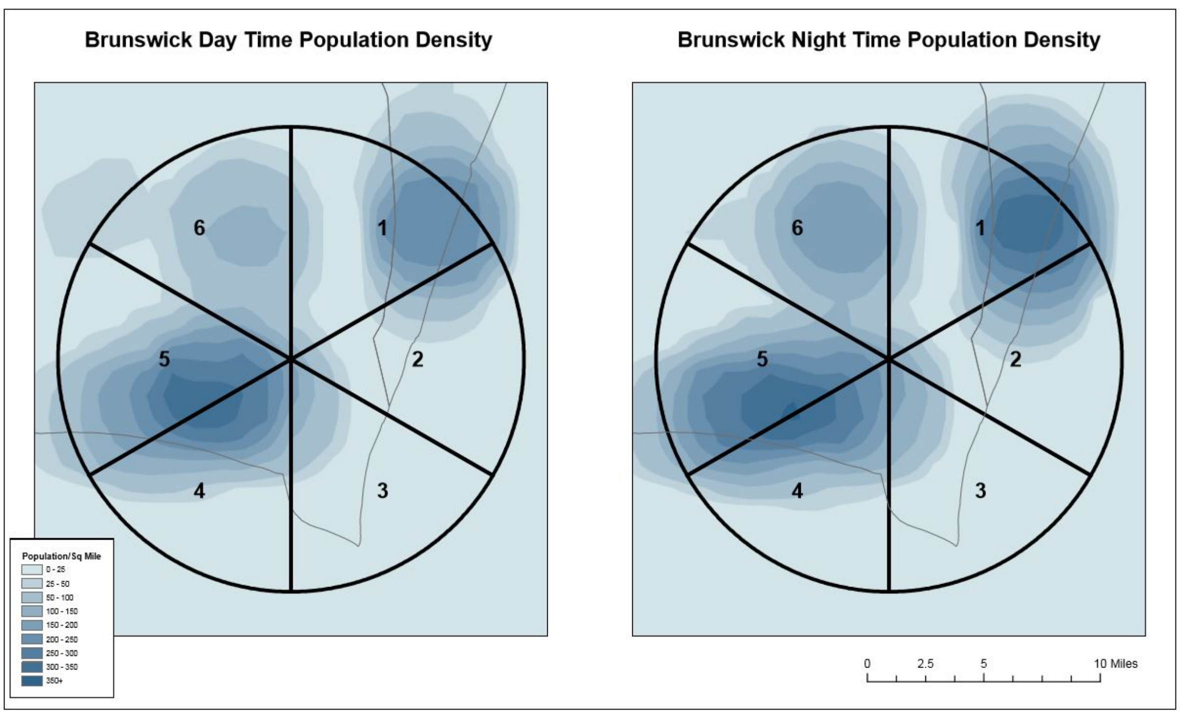


Figure 3-83: Population Density Changes 10 Miles Surrounding Brunswick Nuclear Plant



The following tables list all municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Pender New Hanover Brunswick Onslow	Southport Wilmington	Belville Leland Navassa Carolina Beach Kure Beach Wrightsville Beach Holly Ridge Surf City Burgaw Topsail Beach Watha North Topsail Beach	Saint Helena

Wedge 2

Counties	Cities	Towns	Villages
New Hanover Brunswick	n/a	Kure Beach	n/a

Wedge 3

Counties	Cities	Towns	Villages
n/a	Southport	n/a	Bald Head Island

Wedge 4

Counties	Cities	Towns	Villages
Brunswick	Southport	Caswell Beach Oak Island	Bald Head Island

Wedge 5

Counties	Cities	Towns	Villages
Brunswick Columbus	Boiling Springs Lake Southport Whiteville	Calabash Carolina Shores Holden Beach Oak Island Ocean Isle Beach Saint James Shallotte Sunset Beach Varnamtown Brunswick Tabor City	n/a

Wedge 6

Counties	Cities	Towns	Villages
Pender New Hanover Brunswick Columbus Bladen Sampson	Boiling Springs Lake Northwest Southport Whiteville	East Arcadia Belville Bolivia Leland Navassa Sandy Creek Bolton Brunswick Lake Waccamaw Sandy Field Atkinson	

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-49: Number and Value of Building Vulnerable to Nuclear Accident at Brunswick Nuclear Plant

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	127,995	$31,022,961,898	51,049	$13,672,332,444	6,223	$2,105,186,314
2	1,406	$747,960,939	1,406	$747,960,939	1,406	$747,960,939
3	1,483	$638,703,925	1,483	$638,703,925	1,483	$638,703,925
4	4,414	$767,464,188	4,414	$767,464,188	4,414	$767,464,188
5	59,174	$7,474,035,322	24,901	$2,547,170,032	7,807	$1,104,578,034
6	37,235	$5,585,945,847	9,405	$901,696,007	2,635	$258,253,601
Totals	231,608	$46,178,214,033	92,577	$19,225,604,363	23,899	$5,573,043,696

Source: NCEM

The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Brunswick Nuclear Plant, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 6.

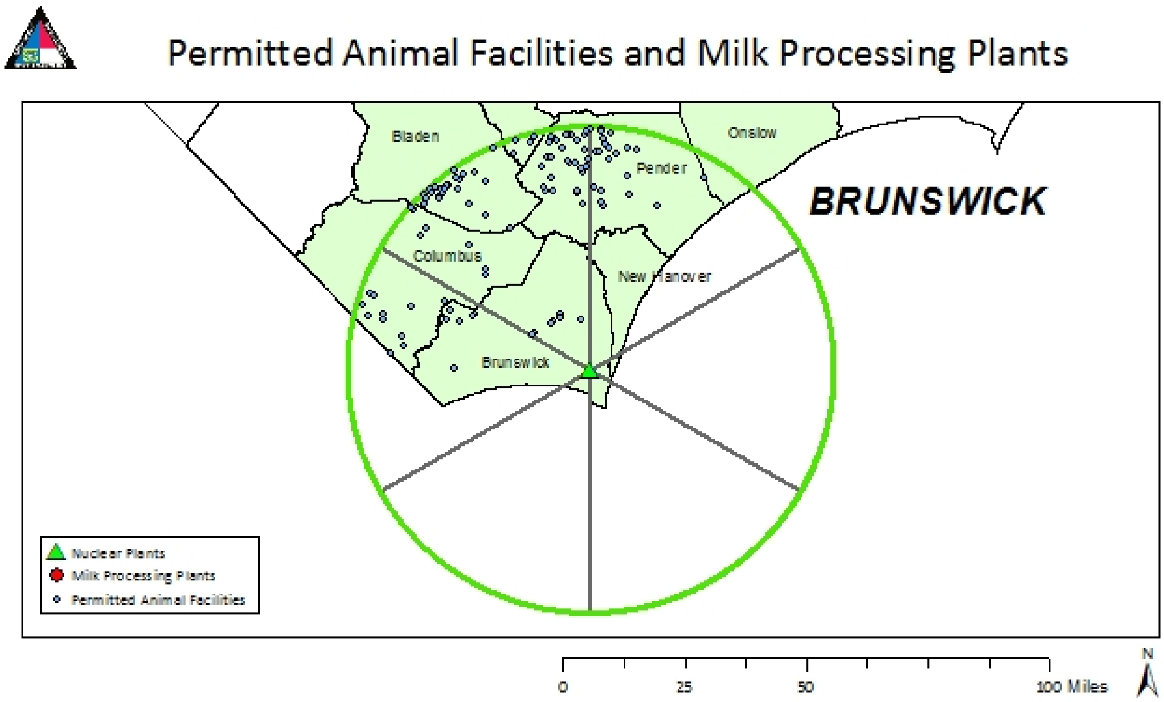
Table 3-50: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Brunswick Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Swine	24
5	Swine	21
6	Swine	91

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&e

xclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

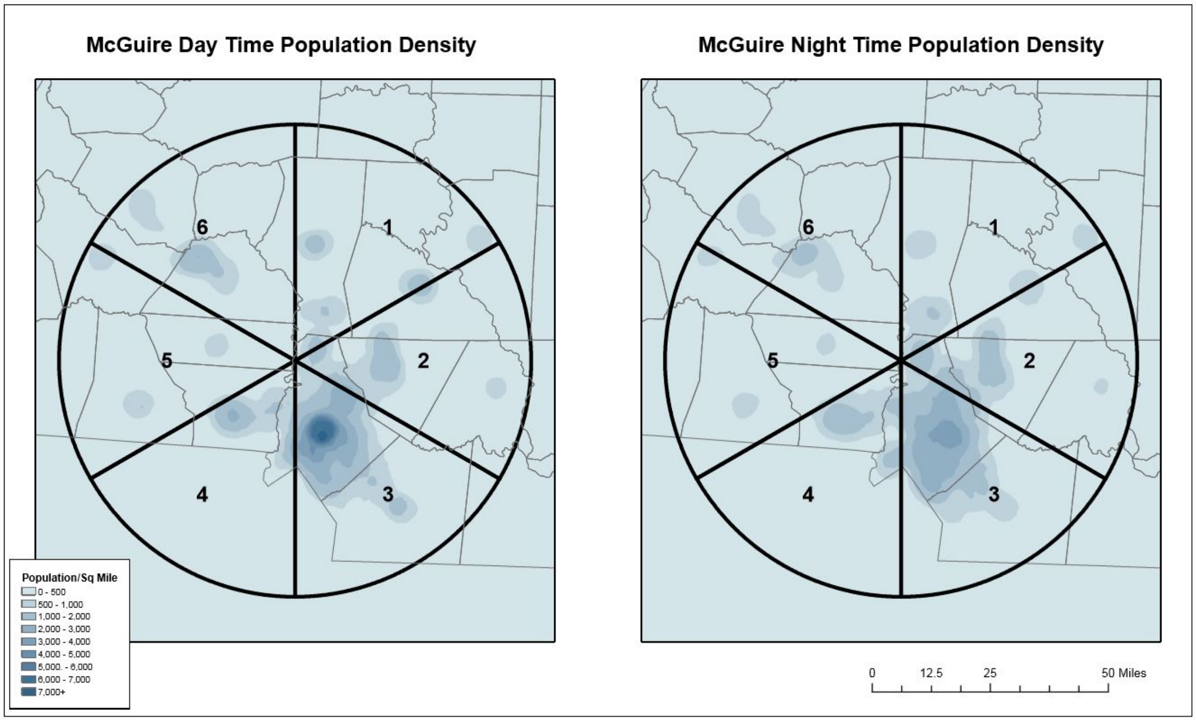
Figure 3-84: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Brunswick Nuclear Plant



McGuire Nuclear Station

Figure 3-79 depicts the location of the McGuire Nuclear Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-51. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the McGuire Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is most apparent near Charlotte in Wedge 3.

Figure 3-85: Population Density Changes In Areas Surrounding McGuire Nuclear Plant



The 2 maps below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-86: Population Density Changes 20 Miles Surrounding McGuire Nuclear Plant

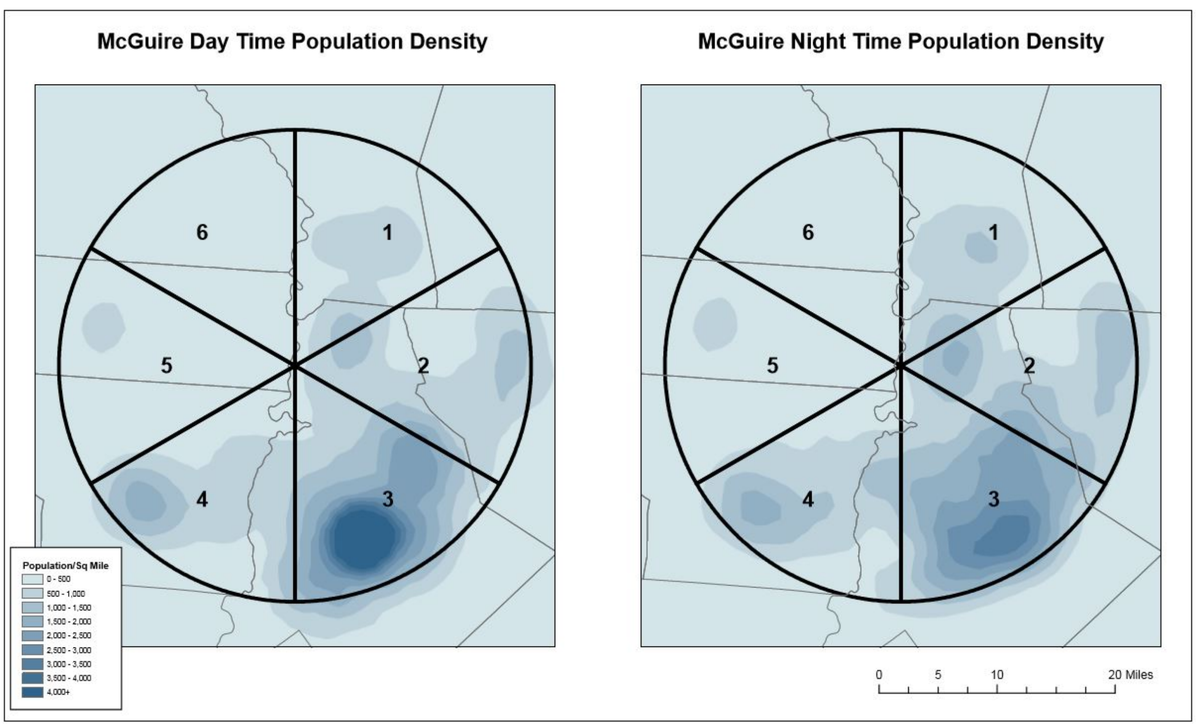
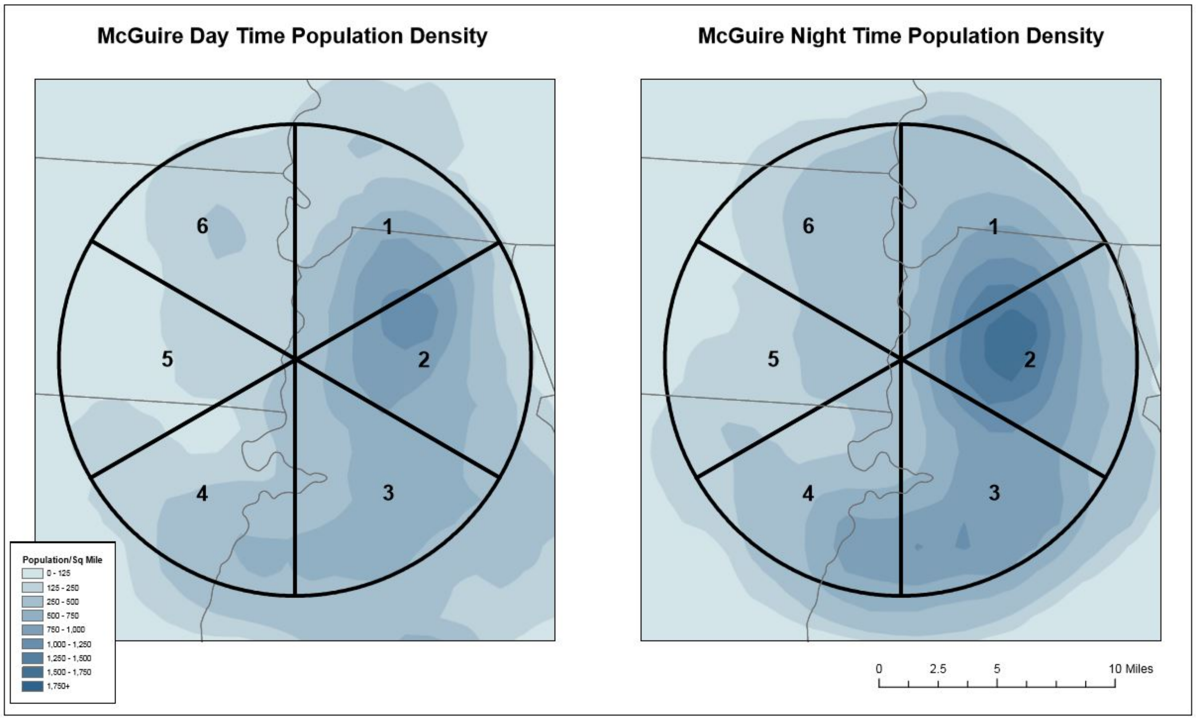


Figure 3-87: Population Density Changes 10 Miles Surrounding McGuire Nuclear Plant



The following tables list all municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Iredell Wilkes Rowan Davidson Davie Forsyth Yadkin Lincoln Mecklenburg Catawba	Lexington Statesville Salisbury	Bermuda Run Cooleemee Mocksville Harmony Cleveland Yadkinville Davidson Mooresville Troutman Davidson Landis	Clemmons

Wedge 2

Counties	Cities	Towns	Villages
Cabarrus Anson Montgomery Stanly Rowan Davidson Randolph Union Iredell Mecklenburg	Lexington Salisbury Albemarle Locust Charlotte Concord Kannapolis	Denton East Spencer Faith Granite Quarry Rockwell Spencer Badin New London Richfield Midland Mount Pleasant Stanfield Oakboro Red Cross Harrisburg Cornelius Davidson Huntersville China Grove	Misenheimer

Wedge 3

Counties	Cities	Towns	Villages
Anson Union Cabarrus Mecklenburg Stanly Gaston	Charlotte Monroe Mount Holly Monroe	Waxhaw Fairview Midland Mint Hill Pineville Fairview Hemby Bridge Indian Trail Stallings Unionville Weddington Matthews Harrisburg Huntersville Peachland Marshville Mineral Springs Wingate	Lake Park Marvin Wesley Chapel

Wedge 4

Counties	Cities	Towns	Villages
Mecklenburg Gaston Cleveland Lincoln	Charlotte Kings Mountain Bessemer City Gastonia Lowell Belmont Mount Holly	Cramerton Dallas McAdenville Ranlo Spencer Mountain Stanley Grover Huntersville	n/a

Wedge 5

Counties	Cities	Towns	Villages
Cleveland Rutherford Burke Gaston Lincoln Catawba Burke Mecklenburg	Morganton Kings Mountain Shelby Bessemer City Cherryville Gastonia High Shoals Lincolnton	Belwood Casar Fallston Kingstown Lattimore Lawndale Polkville Waco Dallas Dellview Stanley Boiling Springs Earl Grover Mooresboro Patterson Springs Bostic Ellenboro Forest City	n/a

Wedge 5

Counties	Cities	Towns	Villages
Iredell Wilkes Catawba Burke Caldwell Alexander Lincoln Mecklenburg	Morganton Hickory Lenoir Statesville Claremont Conover Newton	Taylorsville Connelly Springs Drexel Rhodhiss Rutherford College Valdese Cajah's Mountain Gamewell Granite Falls Hudson Sawmills Long View Love Valley North Wilkesboro Wilkesboro Hildebran Brookford Catawba Maiden	Cedar Rock

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-51: Number and Value of Building Vulnerable to Nuclear Accident at McGuire Nuclear Plant

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	222,548	$25,912,608,925	55,780	$11,789,238,724	16,756	$5,502,454,626
2	216,139	$30,250,605,052	79,264	$17,790,277,638	22,437	$6,884,027,575
3	357,743	$96,023,235,395	143,205	$48,044,104,739	21,768	$5,037,453,322
4	156,111	$19,950,179,881	116,855	$14,245,462,969	18,698	$3,539,609,251
5	177,920	$20,199,280,078	57,046	$9,438,365,834	11,206	$3,026,259,723
6	240,180	$27,530,012,006	42,602	$6,433,551,384	11,908	$3,345,729,662
Totals	**1,369,949**	**$216,413,623,573**	**494,380**	**$104,607,776,283**	**102,594**	**$24,739,981,985**

Source: NCEM

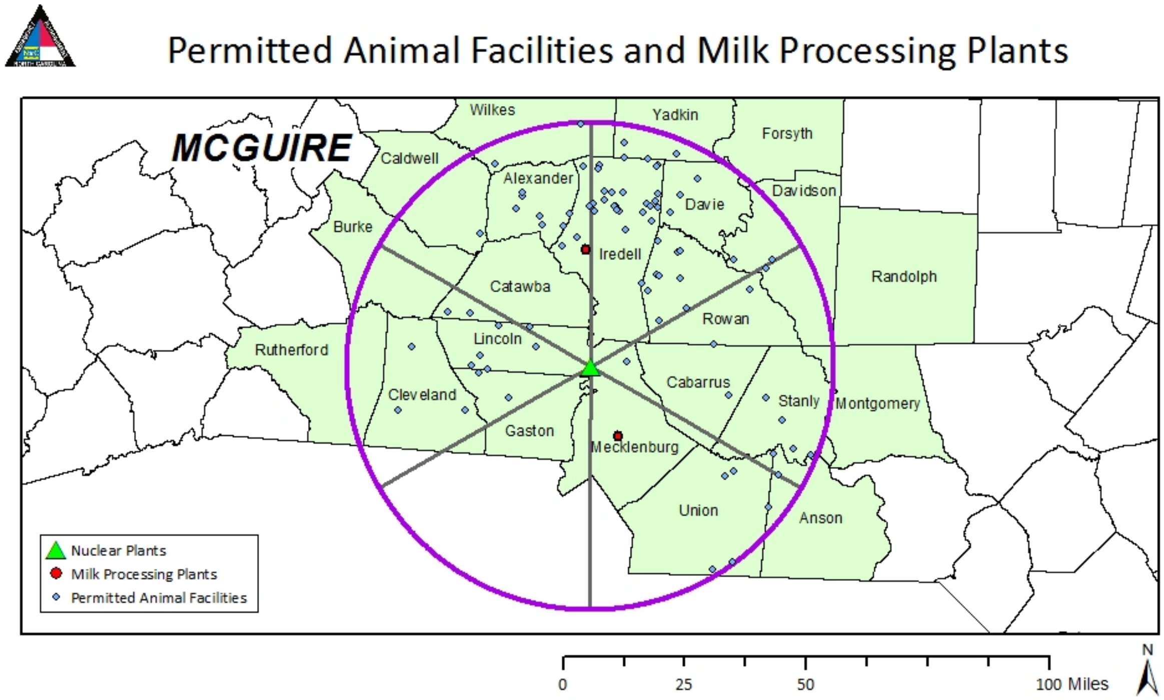
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the McGuire Nuclear Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 1.

Table 3-52: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at McGuire Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Beef Cattle	2
	Dairy	249
2	Dairy	7
	Swine	4
	Poultry	3
3	Dairy	1
	Swine	3
	Poultry	1
	Milk Processing Plant	1
5	Beef Cattle	2
	Dairy	20
6	Beef Cattle	3
	Dairy	25
	Swine	1
	Milk Processing Plant	1

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

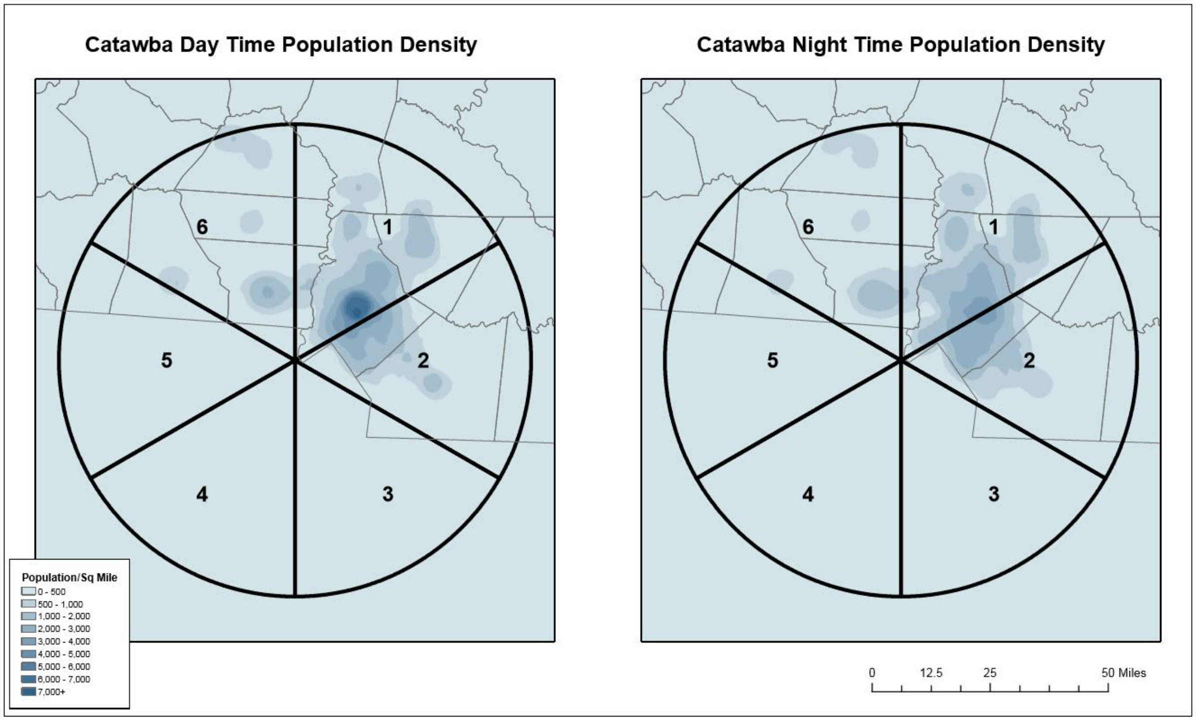
Figure 3-88: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at McGuire Nuclear Plant



Catawba Nuclear Station

Figure 3-83 depicts the location of the Catawba Nuclear Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-53. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Catawba Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is most apparent near Charlotte in Wedge 1.

Figure 3-89: Population Density Changes In Areas Surrounding Catawba Nuclear Station



The 2 maps below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-90: Population Density Changes 20 Miles Surrounding Catawba Nuclear Station

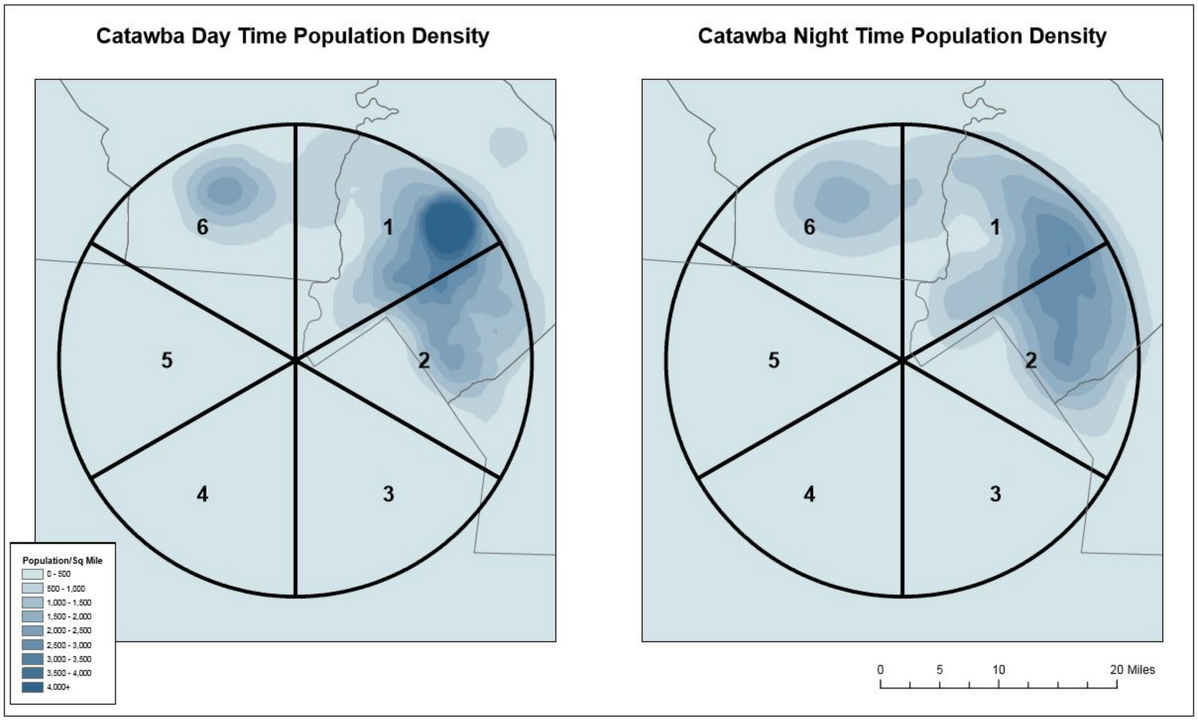
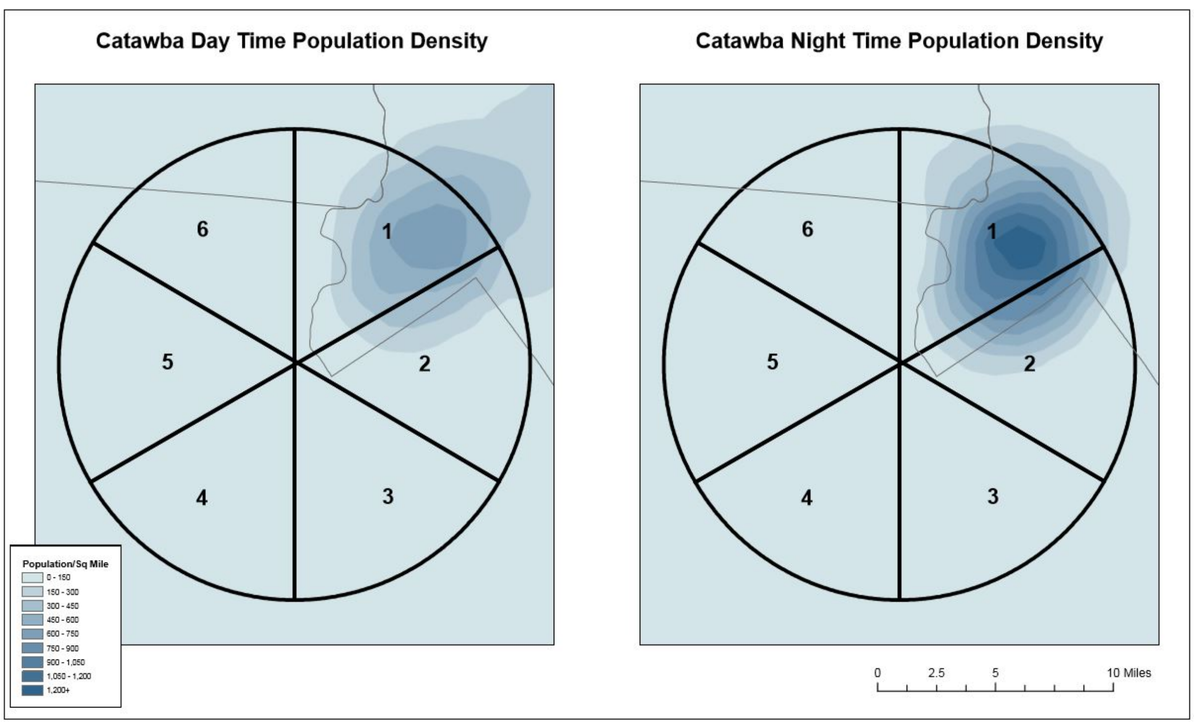


Figure 3-91: Population Density Changes 10 Miles Surrounding Catawba Nuclear Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Mecklenburg Gaston Lincoln Cabarrus Iredell Stanly Rowan	Belmont Mount Holly Charlotte Concord Kannapolis Salisbury Statesville	Cramerton McAdenville Stanley Huntersville Harrisburg Mount Pleasant Cornelius Davidson China Grove Faith Rockwell Catawba Davidson Mooresville Troutman Landis	n/a

Wedge 2

Counties	Cities	Towns	Villages
Mecklenburg Union Cabarrus Anson Stanly	Charlotte Monroe Locust	Polkton Fairview Midland Mint Hill Pineville Hemby Bridge Indian Trail Stallings Unionville Waxhaw Weddington Matthews Mount Pleasant Stanfield Red Cross Mineral Springs Wingate	Lake Park Marvin Wesley Chapel

Wedge 3

Counties	Cities	Towns	Villages
Union	n/a	Waxhaw	n/a

Wedge 5

Counties	Cities	Towns	Villages
Rutherford Gaston Cleveland	Kings Mountain Shelby	Bostic Forest City Grover Earl Lattimore Mooresboro Patterson Springs Ellenboro	n/a

Wedge 6

Counties	Cities	Towns	Villages
Rutherford Gaston Cleveland Lincoln Catawba Burke Iredell	Kings Mountain Bessemer City Gastonia Lowell Shelby High Shoals Lincolnton Claremont Conover Newton Hickory	Cramerton Dallas McAdenville Ranlo Spencer Mountain Stanley Belwood Casar Fallston Kingstown Lattimore Lawndale Polkville Waco Dellview Brookford Catawba Long View Maiden Hildebran	n/a

The following table lists the number of buildings and value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-53: Number and Value of Building Vulnerable to Nuclear Accident at Catawba Nuclear Station

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	424,709	$98,271,121,086	120,634	$37,398,697,819	17,316	$5,501,323,272
2	244,544	$51,748,608,344	93,909	$30,605,071,527	4,315	$1,586,462,022
3	3,290	$318,709,390	196	$14,070,714	-	-
4	-	-	-	-	-	-
5	29,674	$2,883,319,615	272	$29,287,977	-	-
6	300,182	$28,325,710,580	90,221	$7,029,078,318	3,196	$160,710,507
Totals	**1,001,986**	**$181,242,672,516**	**305,008**	**$74,824,871,840**	**24,763**	**$7,134,706,496**

Source: NCEM

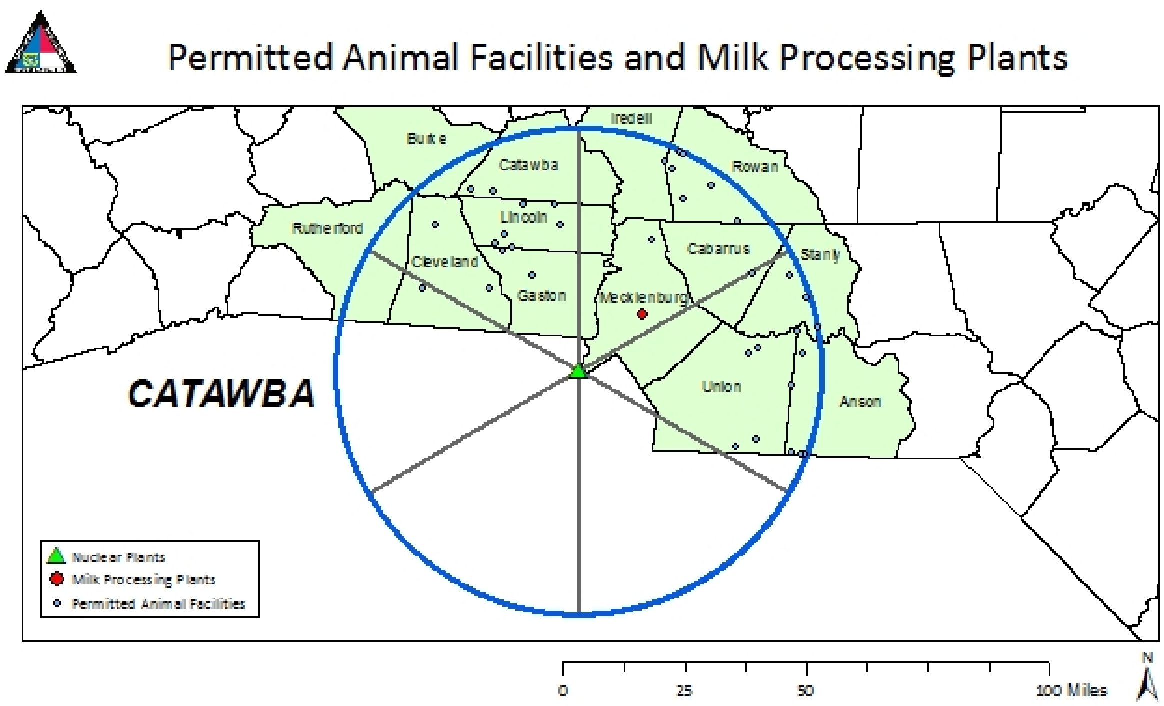
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Catawba Nuclear Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 6.

Table 3-54: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Catawba Nuclear Station

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Dairy	9
	Milk Processing Plant	1
2	Dairy	3
	Swine	9
	Poultry	4
5	Beef Cattle	1
6	Beef Cattle	1
	Dairy	34

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

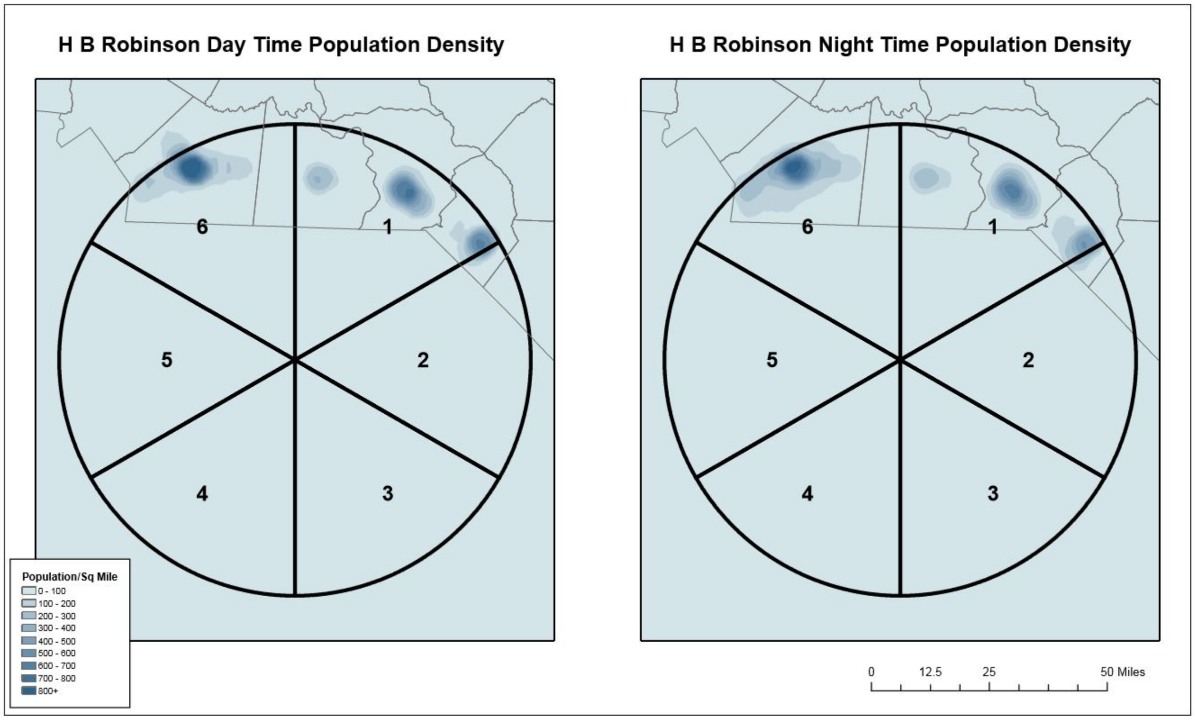
Figure 3-92: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Catawba Nuclear Station



H.B. Robinson Nuclear Generating Station

Figure 3-87 depicts the location of the H.B. Robinson Nuclear Generating Station and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-55. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the H.B. Robinson Nuclear Generating Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is most apparent in Union County.

Figure 3-93: Population Density Changes In Areas Surrounding H.B. Robinson Nuclear Generating Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Anson Scotland Richmond	Hamlet Laurinburg	Ansonville Lilesville McFarlan Morven Wadesboro Dobbins Heights East Laurinburg Gibson	n/a

Wedge 2

Counties	Cities	Towns	Villages
Robeson Scotland	Laurinburg	Rowland	n/a

Wedge 6

Counties	Cities	Towns	Villages
Anson Union	Monroe	Polkton Waxhaw Marshville Mineral Springs Unionville Wingate	Wesley Chapel

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-55: Number and Value of Building Vulnerable to Nuclear Accident at H.B. Robinson Nuclear Generating Station

Wedge	# of Buildings within 50 Miles	Value of Buildings ($)
1	48,041	$8,388,703,177
2	3,820	$448,177,927
3	-	-
4	-	-
5	-	-
6	53,017	$5,288,671,922
Totals	**104,868**	**$14,123,090,840**

Source: NCEM

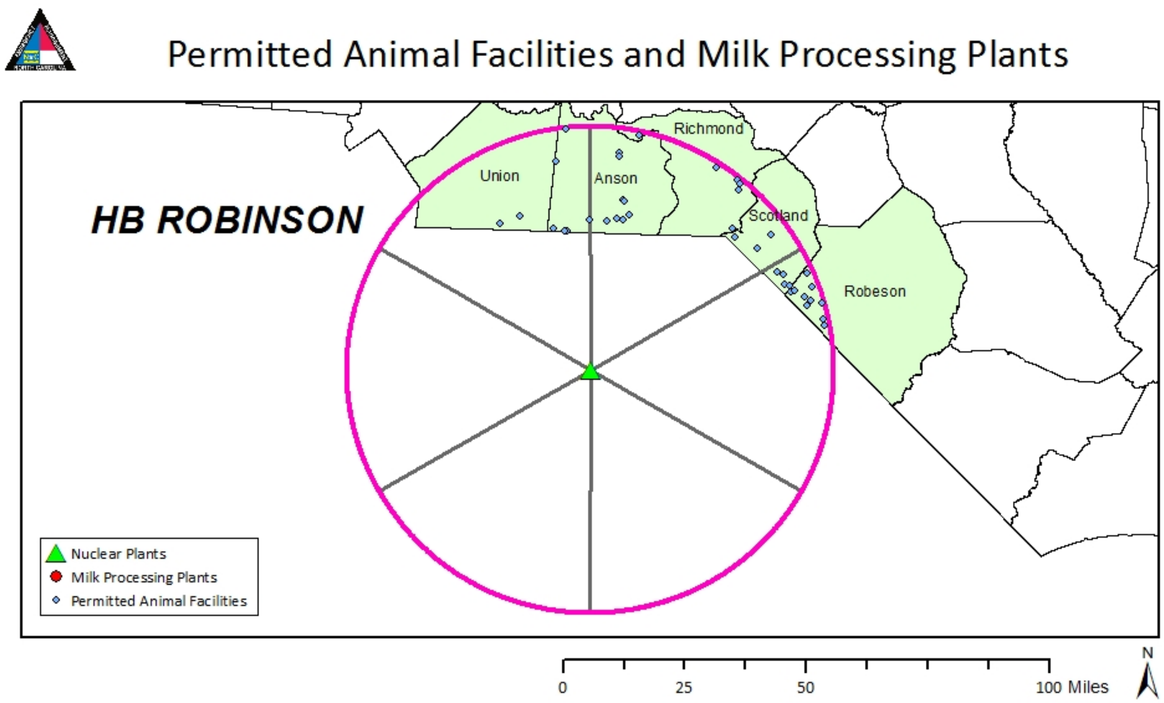
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the H.B. Robinson Nuclear Generating Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 1.

Table 3-56: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at H.B. Robinson Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Swine	18
2	Swine	14
6	Dairy	2
	Swine	5
	Poultry	1

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

Figure 3-94: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at H.B. Robinson Nuclear Generating Station

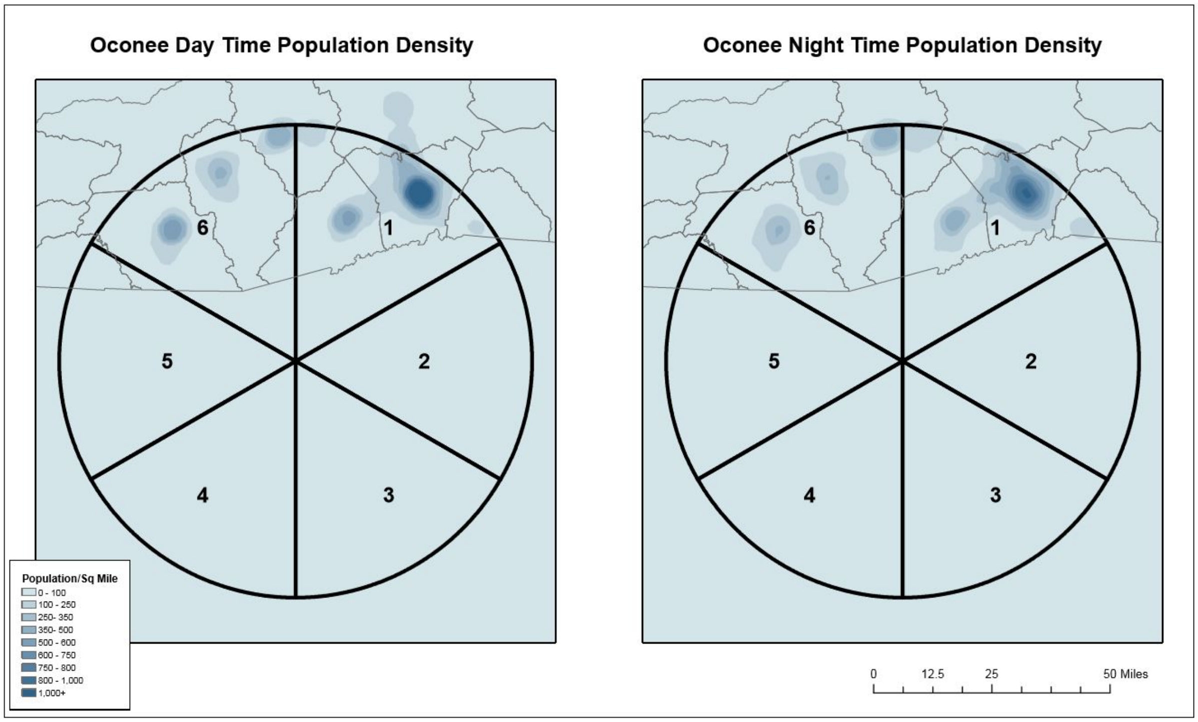


Oconee Nuclear Station

Figure 3-89 depicts the location of the Oconee Nuclear Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-57. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the

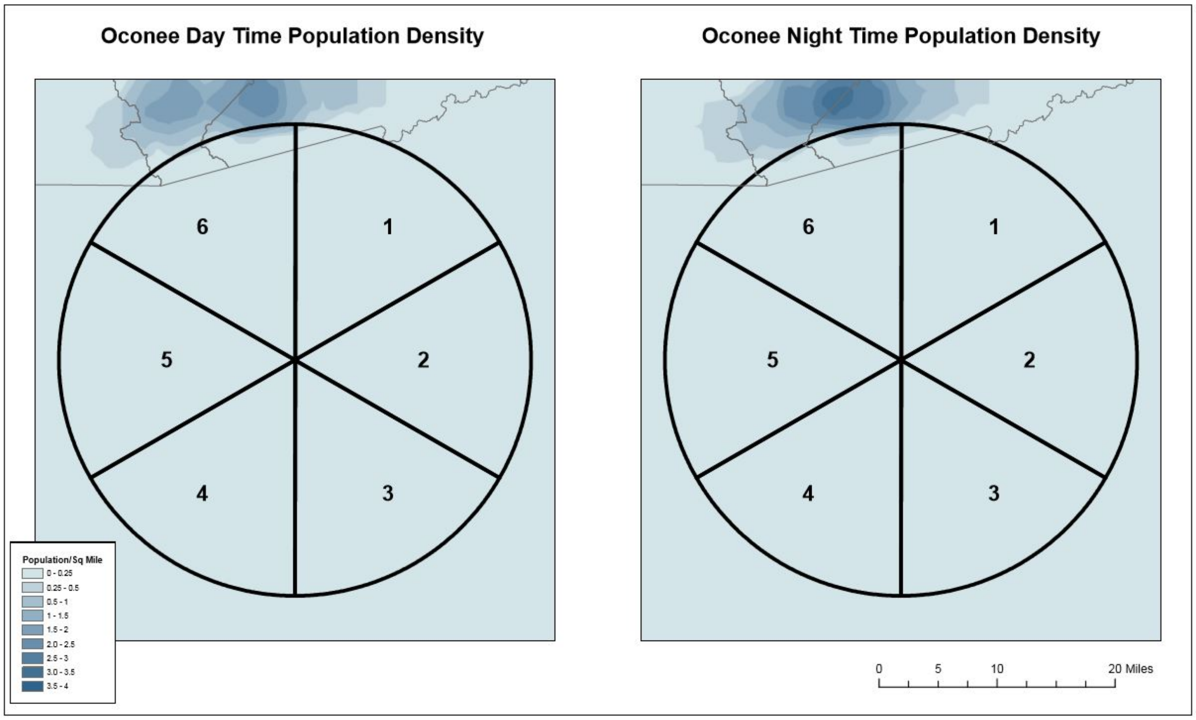
50-mile buffer around the Oconee Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is most apparent near Henderson County.

Figure 3-95: Population Density Changes In Areas Surrounding Oconee Nuclear Station



The map below depicts population density changes in the 20-mile buffer zone around the plant's center, which just barely lies in North Carolina.

Figure 3-96: Population Density Changes 20 Miles Surrounding Oconee Nuclear Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Jackson Transylvania Henderson Polk Haywood Buncombe	Asheville Hendersonville Saluda Brevard	Canton Fletcher Laurel Park Mills River Columbus Tryon Rosman	Flat Rock

Wedge 5

Counties	Cities	Towns	Villages
Macon Clay	n/a	n/a	n/a

Wedge 6

Counties	Cities	Towns	Villages
Jackson Transylvania Macon Clay Haywood Swain	n/a	Maggie Valley Waynesville Highlands Sylva Webster Franklin Highlands	Forest Hills

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile and 20-mile radius around the plant's center.

Table 3-57: Number and Value of Building Vulnerable to Nuclear Accident at Oconee Nuclear Station

Wedge	# of Buildings within 50 Miles	Value of Buildings ($)	# of Buildings within 20 Miles	Value of Buildings ($)
1	80,031	$12,522,796,981	68	$9,930,992
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	2,183	$264,738,559	-	-
6	61,367	$11,732,606,952	157	$17,732,793
Totals	143,570	$24,518,653,332	225	$27,663,785

Source: NCEM

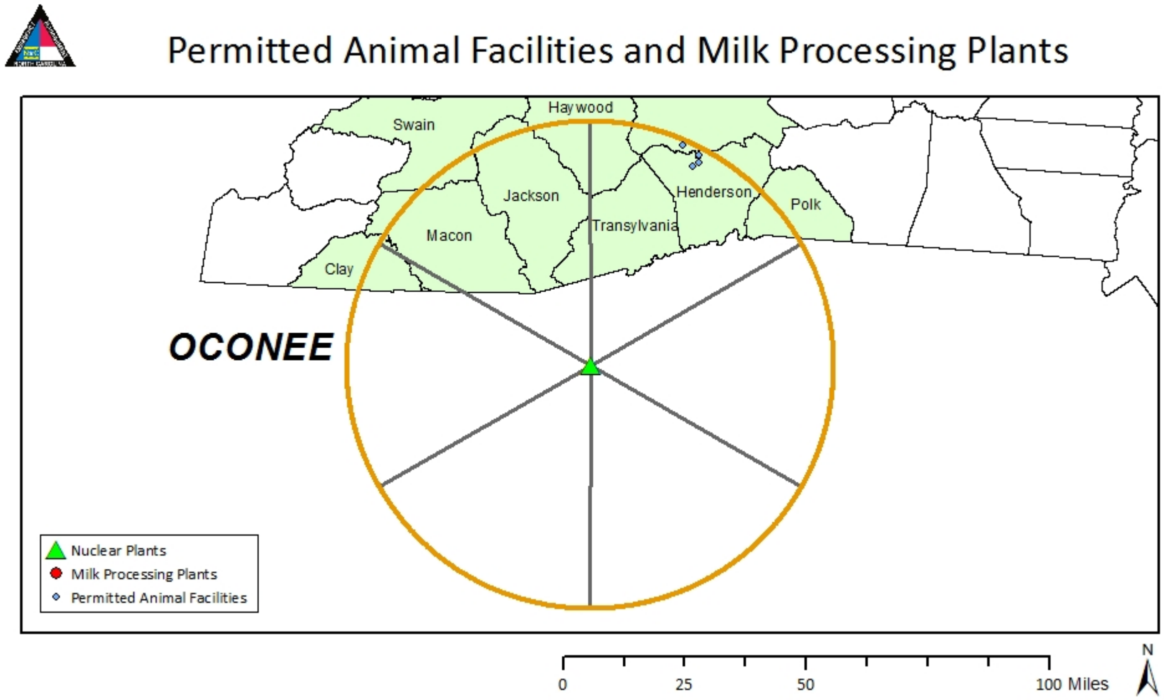
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Oconee Nuclear Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, the only facilities are located in Wedge 1 and mostly lie within Henderson County.

Table 3-58: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Oconee Nuclear Station

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Dairy	5

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

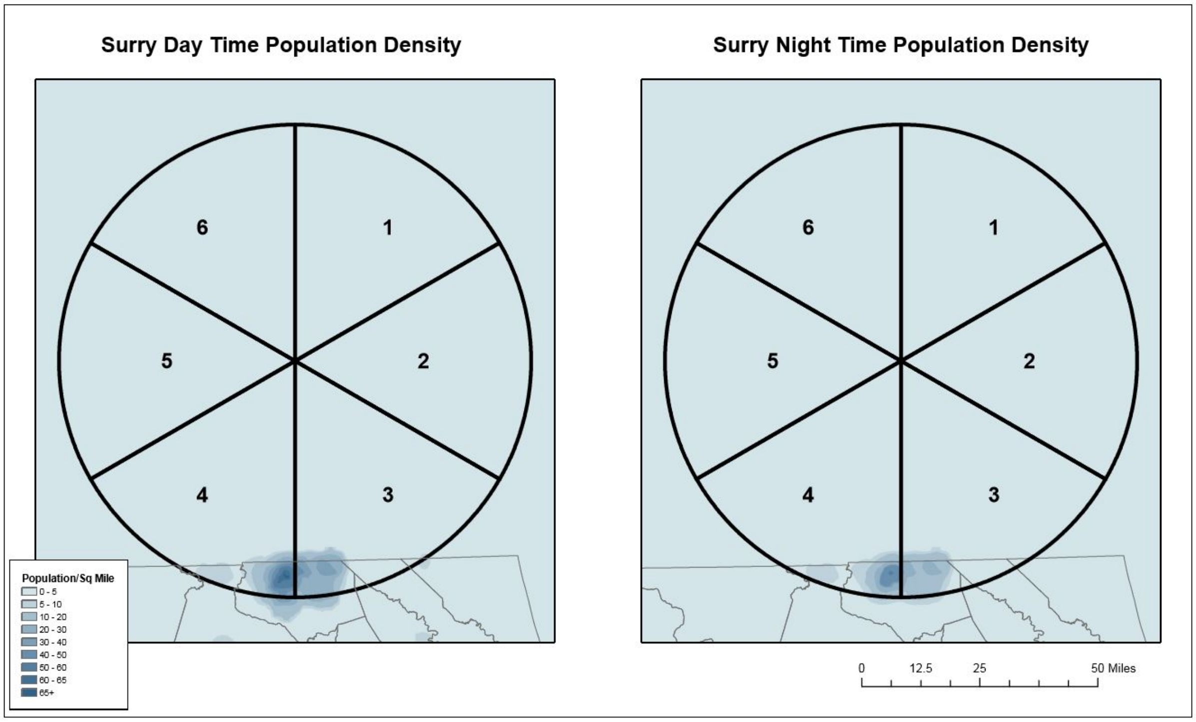
Figure 3-97: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Harris Nuclear Plant



Surry Power Station

Figure 3-92 depicts the location of the Surry Power Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-59. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Surry Power Station in North Carolina are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is visible in Gates County.

Figure 3-98: Population Density Changes In Areas Surrounding Surry Power Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 3

Counties	Cities	Towns	Villages
Camden Gates Currituck Pasquotank	n/a	n/a	n/a

Wedge 4

Counties	Cities	Towns	Villages
Gates Northampton Hertford	n/a	Como	n/a

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-59: Number and Value of Building Vulnerable to Nuclear Accident at Surry Power Station

Wedge	#of Buildings within 50 Miles	Value of Buildings ($)
1	-	-
2	-	-
3	2,262	$189,727,036

4	2,299	$181,492,366
5	-	-
6	-	-
Totals	**4,559**	**$370,984,653**

Source: NCEM

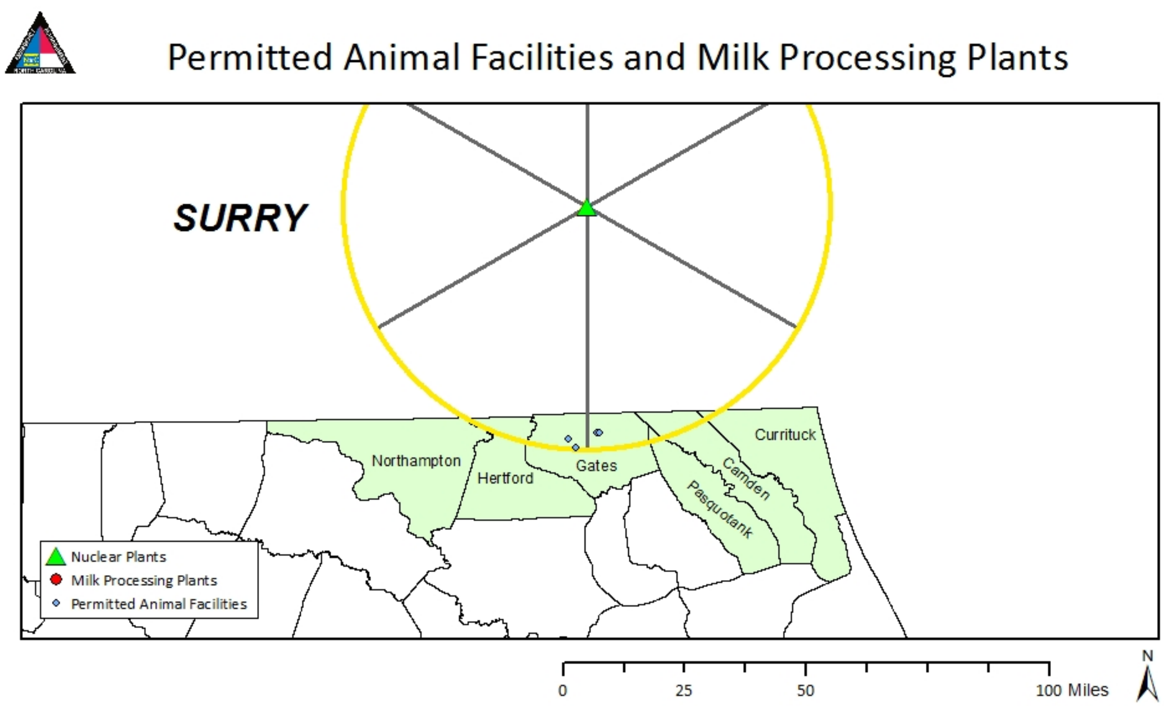
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Surry Power Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, the only facilities are located in Gates County.

Table 3-60: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Surry Power Station

Wedge	Type of Permitted Facility	Number of Permitted Facilities
3	Swine	2
4	Swine	2

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

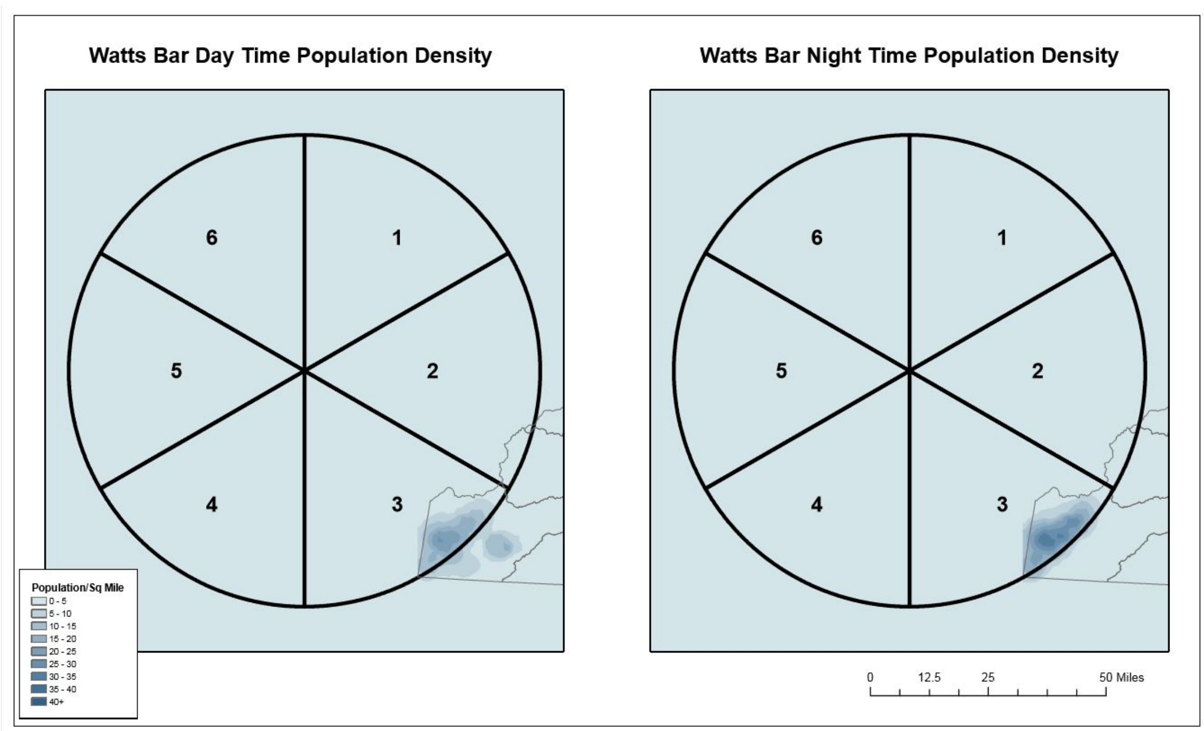
Figure 3-99: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Surry Power Station



Watts Bar Nuclear Plant

Figure 3-94 depicts the location of the Watts Bar Nuclear Plant and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-61. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Watts Bar Nuclear Plant are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is most apparent in Wedge 3 in Cherokee County.

Figure 3-100: Population Density Changes In Areas Surrounding Watts Bar Nuclear Plant



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 2

Counties	Cities	Towns	Villages
Cherokee Graham Swain	n/a	n/a	n/a

Wedge 3

Counties	Cities	Towns	Villages
Cherokee Graham	n/a	n/a	n/a

Source: NCEM

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-61: Number and Value of Building Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant

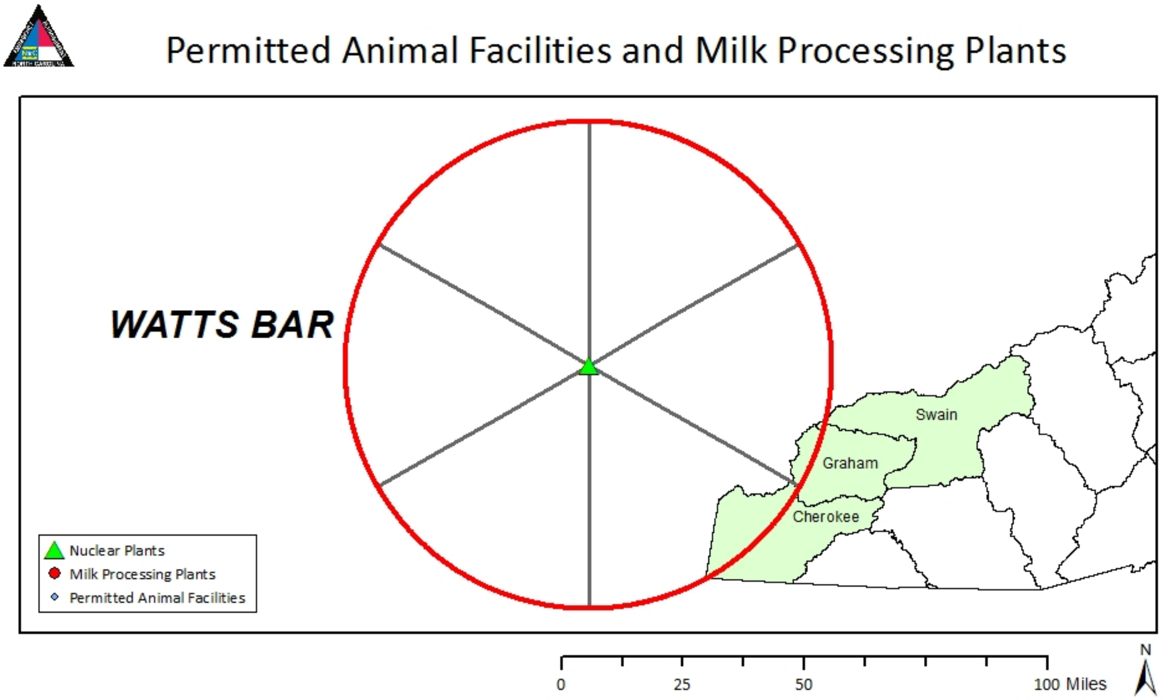
Wedge	Number of Buildings within 50 Miles	Value of Buildings ($)
1	-	-
2	39	$504,062,668
3	3,227	$269,120,119
4	-	-
5	-	-
6	-	-
Totals	**3,280**	**$774,028,847**

Source: NCEM

Based on data from the NC Department of Environmental Quality (DEQ), there are no agricultural facilities in North Carolina that fall within a 50-mile radius of the plant's center and therefore vulnerable to a potential emergency.

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

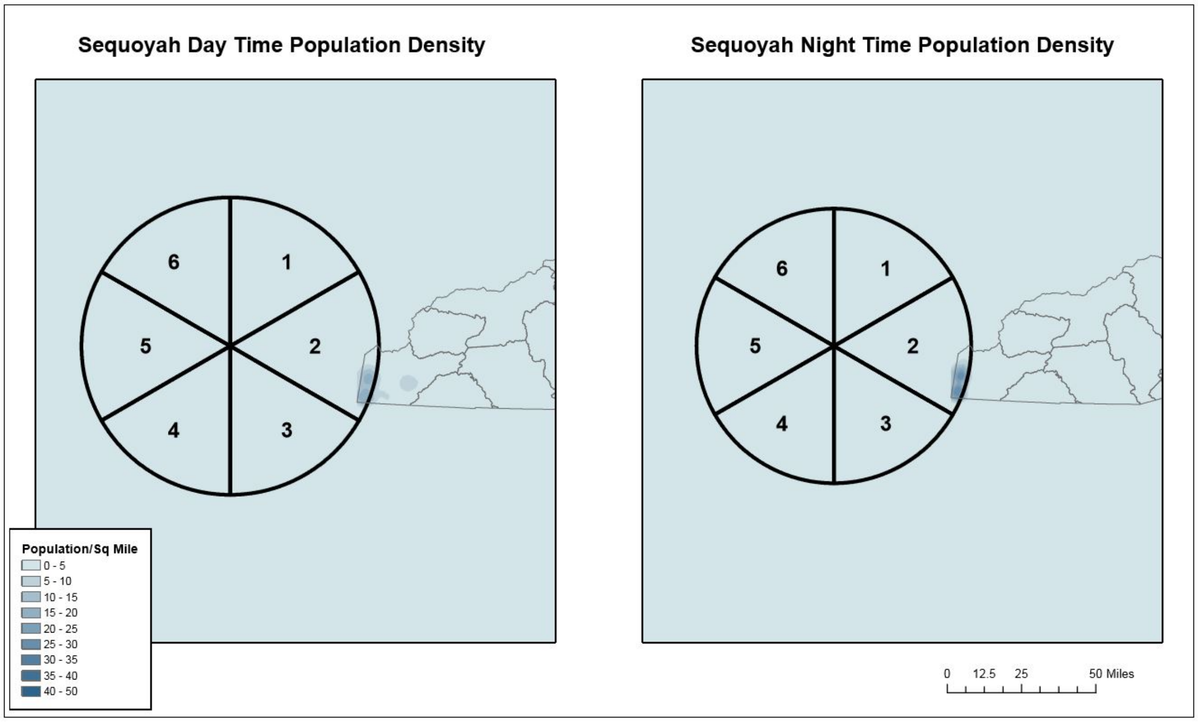
Figure 3-101: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant



Sequoyah Nuclear Plant

Figure 3-96 depicts the location of the Sequoyah Nuclear Plant and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-62. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Sequoyah Nuclear Plant are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is most visible in Wedge 2 in Cherokee County.

Figure 3-102: Population Density Changes In Areas Surrounding Sequoyah Nuclear Plant



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 2

Counties	Cities	Towns	Villages
Cherokee	n/a	n/a	n/a

Source: NCEM

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-62: Number and Value of Building Vulnerable to Nuclear Accident at Sequoyah Nuclear Plant

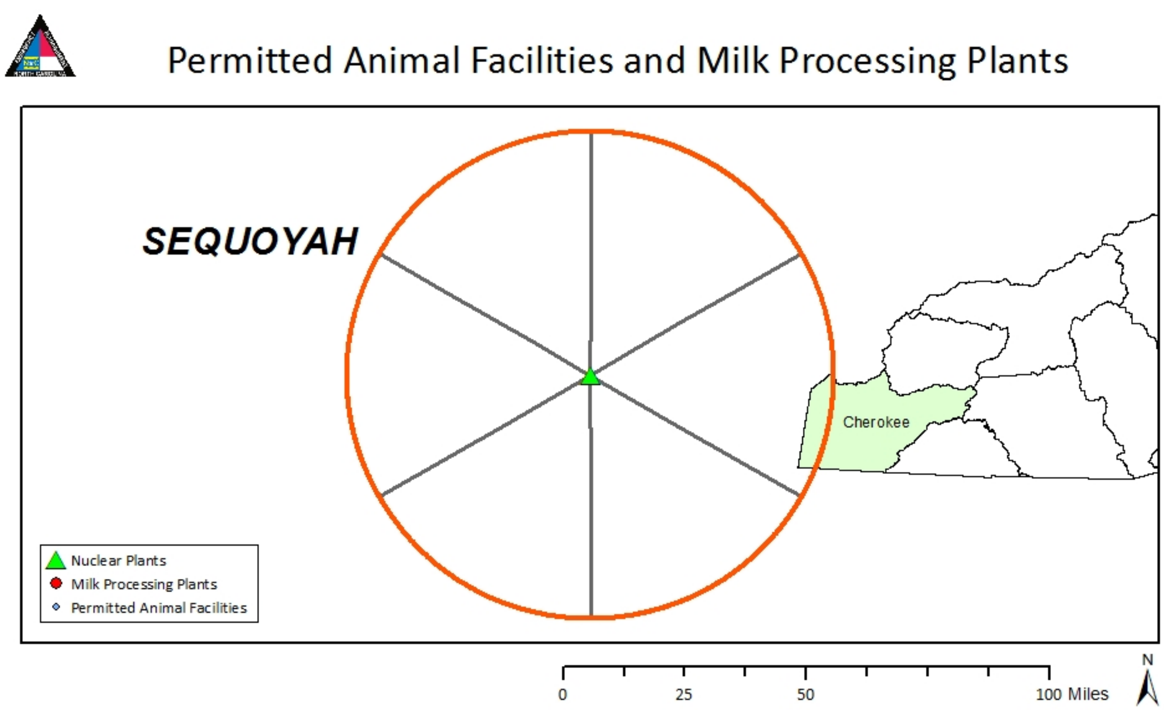
Wedge	Number of Buildings within 50 Miles	Value of Buildings ($)
1	-	-
2	1,756	$135,743,112
3	-	-
4	-	-
5	-	-
6	-	-
Totals	1,756	$135,743,112

Source: NCEM

Based on data from the NC Department of Environmental Quality (DEQ), there are no agricultural facilities in North Carolina that fall within a 50-mile radius of the plant's center and therefore vulnerable to a potential emergency.

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

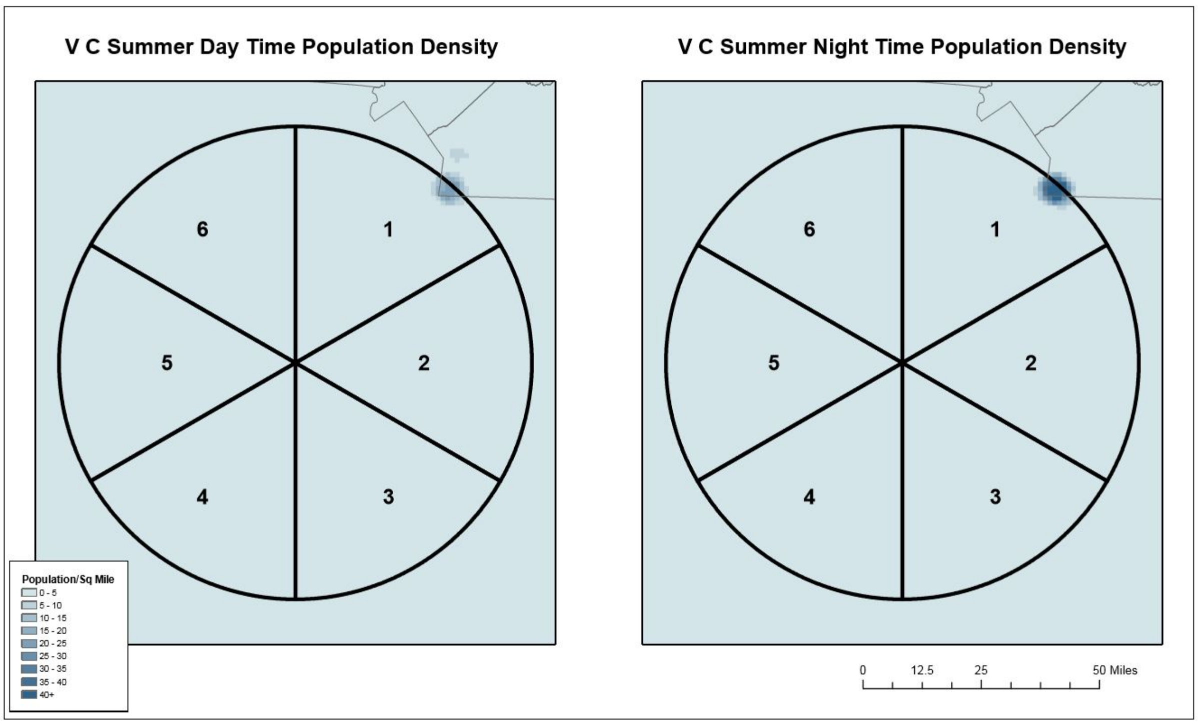
Table 3-63: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant



V.C. Summer Nuclear Plant

Figure 3-97 depicts the location of the V.C. Summer Nuclear Station and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-64. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the V.C. Summer Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is visible in Wedge 1 in Union County.

Figure 3-103: Population Density Changes In Areas Surrounding V.C. Summer Nuclear Plant



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Union	n/a	n/a	n/a

Source: NCEM

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-64: Number and Value of Building Vulnerable to Nuclear Accident at V.C. Summer Nuclear Plant

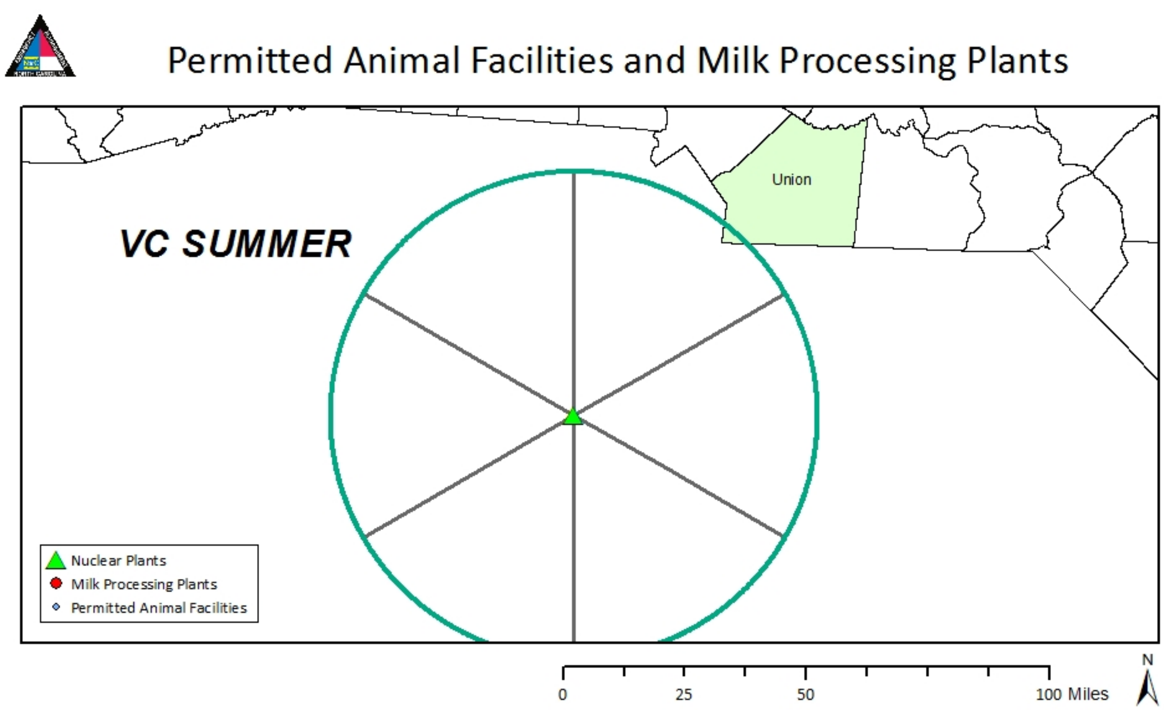
Wedge	Number of Buildings within 50 Miles	Value of Buildings ($)
1	718	$63,354,482
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
Totals	718	$63,354,482

Source: NCEM

Based on data from the NC Department of Environmental Quality (DEQ), there are no agricultural facilities in North Carolina that fall within a 50-mile radius of the plant's center and therefore vulnerable to a potential emergency.

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

Figure 3-104: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant



3.4.6.3 Terrorism Hazard Vulnerability

Terrorism Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	In addition to the clear impacts that terrorism can have on human life and safety, there are a number impacts on the public that will be more widespread if major events take place. As seen after the attacks on September 1, 2001 in New York City and Washington, D.C., there can be significant impacts far away from the site of the incident. Fear and worry about additional attacks or for loved ones in areas affected are just a couple examples of impacts that could occur. Other impacts include discrimination or changed interactions between people of differing nationalities depending on the nature and intent of the attack(s) and who perpetrated the attack(s). During and after a terrorism event, the public will be expecting services to be provided despite the uncertainty of any existing hazards or further impacts. The partnership and involvement of the media is crucial not just for providing public guidance, but also for keeping the public informed of the efforts underway or of any obstacles or concerns hindering response efforts. Although public confidence will almost certainly be shaken, agencies and organizations in the government working together in an efficient and effective way will provide for the best chance of positive public perception of the government.
Responders	High	The danger to human life in a terrorist event is dependent on the form of attack utilized as well as its location, severity, and scope (see Section 3). In any terror incident, responders must conduct a scene size-up to determine hazards to themselves and others. Decisions must be made about how to handle victims and those in close proximity that may have been victimized or exposed. If hazardous materials are present, it could change the strategy as well. Fear and panic will be significant in the case of a terrorist act, whether it occurs in North Carolina or elsewhere in the nation. As front-line government officials, responders will be at a significant risk during an attack and may even be the object of the attack in some cases. Depending on the location, the scope, and the nature of the event(s), response efforts could last hours, days, or potentially longer. Collaboration at all levels can provide for the most stable, effective, and efficient effort in returning to normal activities and operations. Identification of further threats and open communication lines can prevent further harm or detriment to response operations.
Operations/Continuity of Operations	High	A terrorist event would likely have a high impact on continuity of operations, especially due to the disorder that would result and the unpredictability of this kind of event. Emergency personnel may be directly affected or targeted, which would cause definitive harm to maintaining continuity of operations. Furthermore, continuity of operations can be impacted by personnel. Equipment, and/or consumables being exhausted or depleted.

Category	**Impact Rating**	**Description of Impacts**
Built Environment (Property, Facilities, Infrastructure)	Moderate	Major Events/Centers Often terrorist events are targeted at major events or at large event centers in an attempt to create widespread loss on a large number of people. Therefore, large arenas, convention centers, and event spaces may be at higher risk of a terrorist attack than most other buildings. Likewise, churches and schools are soft targets and are often targeted as such. Similarly, prominent or symbolic structures may also be at an elevated risk for targeting. Critical Facilities At hospitals, the primary concern with a terrorism event is the influx of patients requiring care. Terrorism may pose a specific hazard to a hospital structure itself, but it is more likely to be impacted when in close proximity to a target. Many patients could be injured or their medical condition worsened by the impacts of a terrorism event. In general, emergency services buildings are not considered high probability targets for terrorists to strike. In other countries, ambulance services and 9-1-1 centers have been targets; however, that pattern has not been seen here in the United States. Alternate locations should be set up so that emergency operations can continue if an emergency services facility was affected or targeted by a terrorism event. Shelters may need to be activated in a terrorism event to house and care for displaced individuals. Transportation Systems Bridges found throughout the interstate system may be targeted by terrorism. Not only would the actual structural failure affect those on, under, or near the bridge, but the loss of its functionality would also significantly hinder travel and commerce. Past experiences with terrorists using airplanes for terrorist activity suggest a need for planning and collaboration with all parties of interest at airports including local, state, and federal agencies. In terms of railway transportation, the most likely means of disrupting these lines would be the derailing of a train, primarily by sabotage of the rail or the switching control system. Using explosives would be more likely because hacking into systems to cause collisions and other undesired actions to moving rail cars would be more complex operations. In addition to disrupting rail traffic, a derailing can impact other means of travel such as a nearby road or airport. The rail cars involved in an incident could contain hazardous materials, which would add an element of complexity to the situation. Utilities Damage to high voltage lines or power plants structures could disrupt power distribution for a large area, affecting emergency response and other facets of government and business. The economic impacts may also be significant as extended outages can be costly. Natural gas lines are also a concern as a target for terrorists. Major pipelines run through the state, but natural gas itself must be exposed to oxygen before it could cause an

Category	Impact Rating	Description of Impacts
		explosion. Most natural gas explosions are small and rarely deadly. The real concern is in shutting off natural gas to end consumers. Sabotage of a pipeline could disconnect a significant number of homes and businesses for considerable periods of time. Other Structures Single-family dwellings and small businesses or industries are not likely to be targets for terrorism. However, areas that have high concentrations of people could be vulnerable to an attack. These areas of assembly tend to be soft targets and are easily accessible. Buildings in close proximity to a targeted event center may also be more likely to experience indirect impacts. Depending on the method of attack, impacts could include stray bullets or debris from explosions. These could affect people, electrical systems, water systems, cause structural collapse, or fires. Also, the presence of chemical agents can create health hazards through dangerous reactions with water sources or building materials.
Economy	Moderate	The economic impact of a terrorist attack can vary from minimal to severe. If the incident occurs in North Carolina, it could hinder the state's economy but may not have an impact at the national level. Tourism and some commerce could decline significantly if people, events, or businesses are hesitant to come to the area following an incident. An incident in a major city or a financial hub could affect the entire country. For example, the events of September 11, 2001 had an immediate impact on local, state, and national economies. This event and other large-scale attacks like it can drastically alter the economy in both the short- and long-term. Note: Charlotte, North Carolina is the second largest financial hub in the nation. Major Events/Centers Terrorism can occur in city centers during large public gatherings or during business hours to cause the most harm and promote the most fear. Political gatherings would be high priority targets as well. Arenas can be targeted by terrorism, particularly during events that may have some form of political, cultural, or historical value, or simply any event with a large number of people in attendance. These could all have a negative impact economically on the state.
Environment	Moderate	Impacts on the environment depend on the type of attack utilized by terrorists. A biological, chemical, radiological or other hazardous material can have impacts on human, animal, and plant populations alike. The impacts can vary depending on the particular hazard(s) at play, but there will certainly be at least some negative impacts from a terrorist attack including potentially the release of smoke, chemicals, or debris into the environment.

3.4.6.5 Cyber Attack Hazard Vulnerability

Cyber Attack Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The aim of a cyber attack is typically to corrupt or exploit protected information. Depending on the target of the ploy, a significant number of people can be victims of identity theft, fraud, or other forms of technology-based crime. Anyone with an account, membership, or other relationship with an entity that requires storage of information is vulnerable. An individual/user must rely on the entity of affiliation to create and maintain safeguards against the intrusion of computerized systems. However, even the strongest of safeguards can be corrupted or evaded. Continual monitoring of attempted or successful attempts at cyber attacks is warranted to lessen the potential impacts. Public confidence in the response of government organizations may be impacted by a cyber attack based upon societal expectations and media influence with respect to cyber attacks. There may be an expectation that government entities should do a better job of patrolling cyber crime and hold those responsible accountable. Public confidence may be impacted by media interpretation and reporting of the event, positive or negative.
Responders	Low	Cyber attacks may be used to try to intrude into electronic safety equipment or systems. This may increase call volume, block systems, or otherwise hinder emergency operations. Although responders are not likely to be at risk to a cyber attack in a physical sense, they may be impacted financially or through identity theft, much like members of the public.
Operations/Continuity of Operations	Moderate	In the event of a cyber attack, continuity of operations could be impacted if many of the services (such as internet or other IT programs) that are required to maintain daily operations are shut down by the attack. This could cause considerable disruption to normal operations in the state and could make the state potentially vulnerable to other events that may be occurring simultaneously.
Built Environment (Property, Facilities, Infrastructure)	Low	Cyber attacks may have the effect of disrupting life sustaining equipment or systems in hospitals or medical facilities by causing technological disruptions. These attacks may also sabotage information networks and communications equipment that could disrupt services within medical facilities. Normal operations in communications equipment such as telephones, cell phones, and internet could all be severely impacted by a cyber attack which would impact large numbers of people including critical facilities operators.
Economy	High	Freezing, redirecting, or stealing financial assets can have drastic impacts on a business. Banking and credit institutions are commonly affected or targeted by fraudulent activities and often store a great deal of information on businesses, so large-scale intrusions can have significant impacts on the local economy. Large employers are more likely to be targeted by cyber attacks than individuals or small businesses. Larger businesses generally have greater assets to exploit and store more personal information on

Category	Impact Rating	Description of Impacts
		private individuals or employees.
Environment	Low	Because cyber attacks occur in cyberspace and would not truly have any impacts outside of the physical sphere, there are no expected environmental impacts from this type of event.

3.4.6.6 Electromagnetic Pulse (EMP) Hazard Vulnerability

Electromagnetic Pulse (EMP) Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The entire State of North Carolina's population is vulnerable to the impacts of an EMP/geomagnetic storm, regardless of the measured magnitude, although most low-classification events will not have any noticeable impact on the daily lives of people. If a large event were to occur and cause widespread power outages or communications systems disruptions, there may be a panic and people may temporarily be unable to undertake normal activities such as cooking or using mobile devices. Consumer electronics may also be damaged, including HVAC systems, newer model appliances, radios, and televisions. EMP/geomagnetic storms have some likelihood of affecting public confidence due to their highly visible impacts and the fact that most members of the public are unaware of the hazard and may be confused about the cause of loss of power/communications systems.
Responders	High	Responders could be critically affected by an EMP/geomagnetic storm event as response personnel rely heavily on communications equipment to carry out their normal operations. If a large event were to occur that knocked out communications equipment for several hours or possibly more than a day, this would significantly hinder responders' abilities to perform their duties. Additionally, other electronic equipment or devices used by responders may be damaged by an EMP/geomagnetic storm further impacting their ability to respond to emergencies following an event.
Operations/Continuity of Operations	High	Continuity of operations would potentially be impacted in many ways by a major EMP/geomagnetic storm. As mentioned above, if communications equipment is disrupted, it would be challenging for government officials to coordinate with one another and respond to citizen needs such as emergency medical care. It is also possible that some satellites will be damaged, affecting satellite-based communications. Additionally, if power is lost, there would be a disruption to normal operations, though there are generally plans in place to maintain continuity of operations in this case as several operations centers have backup power systems.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Critical Infrastructure The primary impact on the built environment from an EMP/geomagnetic storm would be on communications and power infrastructure. Most of the built environment (e.g. homes,

Category	Impact Rating	Description of Impacts
		buildings, roadways) would not be impacted in any way by this type of event. However, if power or communications systems are damaged or temporarily shut down, some aspects of the built environment will be impacted such as traffic lights, street lights, and cell phone towers. Additionally, electronic equipment and control systems could also be damaged and water and wastewater systems, gas stations, and pipelines may be shut down throughout the state.
Economy	Moderate	An EMP/geomagnetic storm can impact any area of the State of North Carolina at any time and may bring with it an interruption of service for local businesses as well as governments that lose power or cannot utilize communications systems. As a result, there will be significant disruption of the local economy as long as the effects (such as power or communications loss) of the EMP/geomagnetic storm remain in place. ATMs, credit card processing, and other electronic financial transactions may also be disrupted, further impacting the economy.
Environment	Low	There will likely be relatively minimal impacts on the environment from an EMP/geomagnetic storm. These types of events do not directly impact plants or animals and typically do not have any effect on water systems or other natural areas. There may be indirect impacts if, for example, power systems are damaged at facilities that house hazardous materials, causing releases into the environment. However, the likelihood of this occurring is relatively low.

3.4.7 Critical Asset Vulnerability

3.4.7.1 State and Local Critical Assets

For the purposes of this plan, NCEM Risk Mitigation Branch staff identified the following as critical assets:

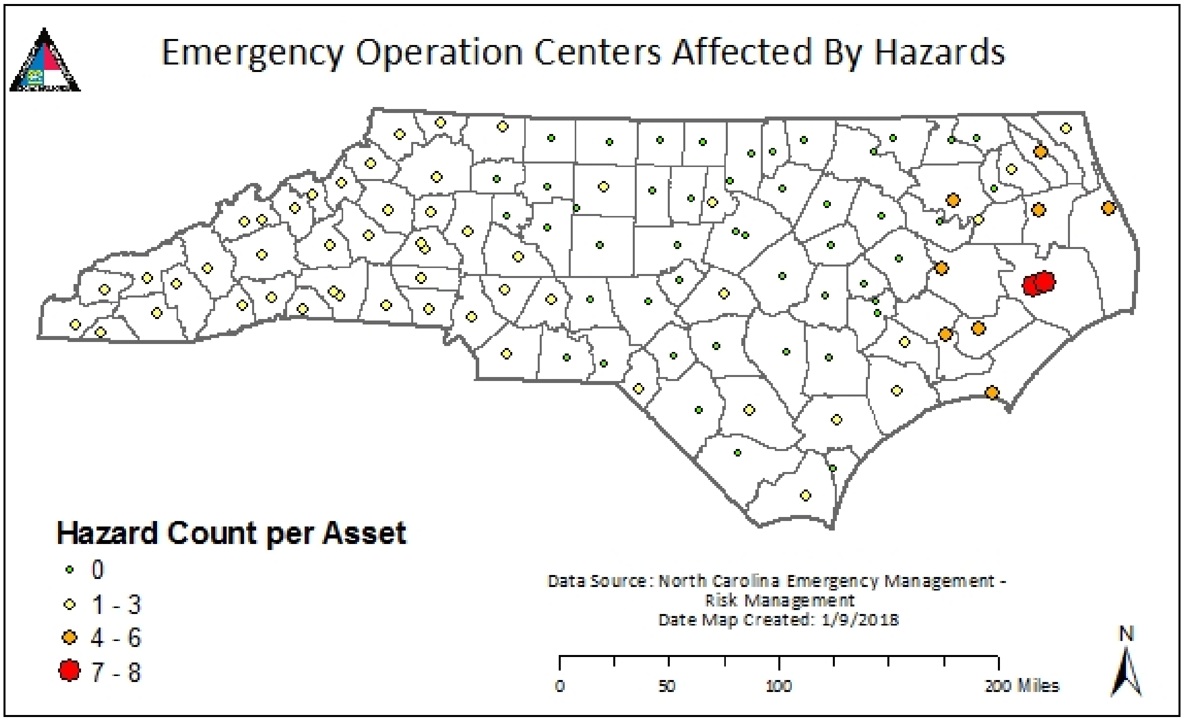
1. Emergency Operations Centers
2. State Police (Trooper) Stations
3. Local Police stations
4. Local Fire Stations
5. Hospitals
6. Shelters

The following table and associated maps present a summary of the critical assets located in North Carolina and a graphical representation of whether or not those facilities are vulnerable to natural hazards. The critical assets that intersect with the most hazard zones are depicted with the largest symbols and are colored red. The critical assets that are exposed to no hazards are depicted with the smallest symbols and are colored green.

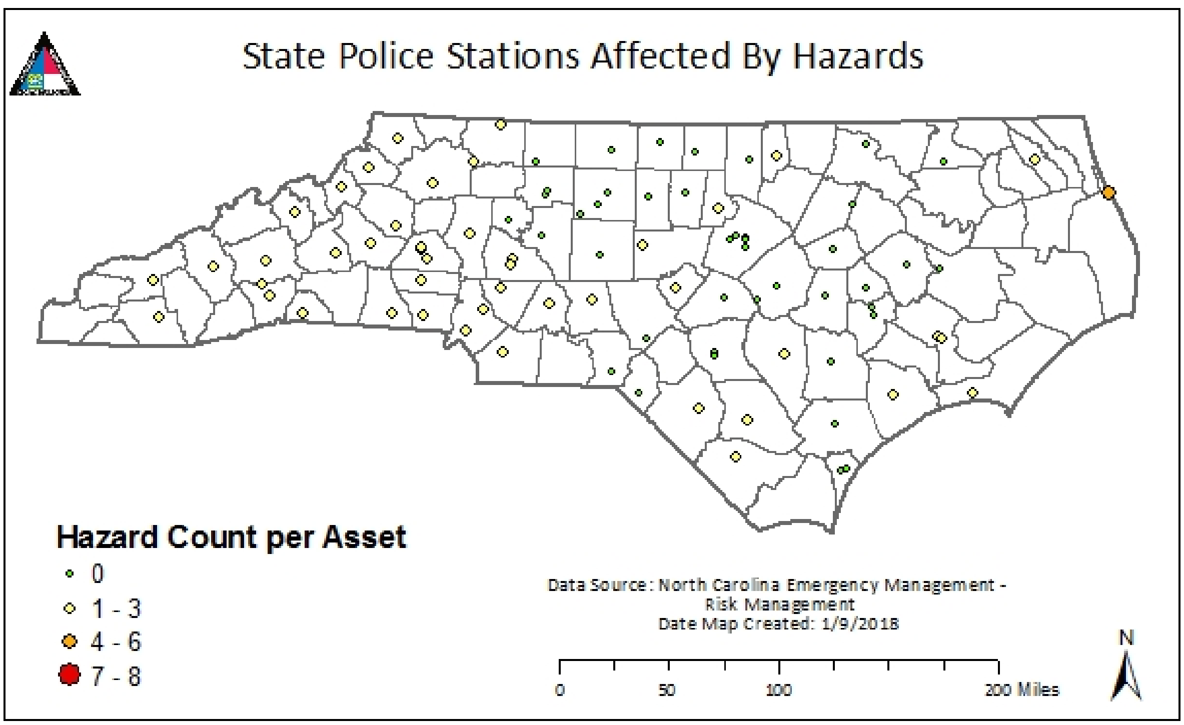
Table 3-65 Critical Assets and Hazard Zones

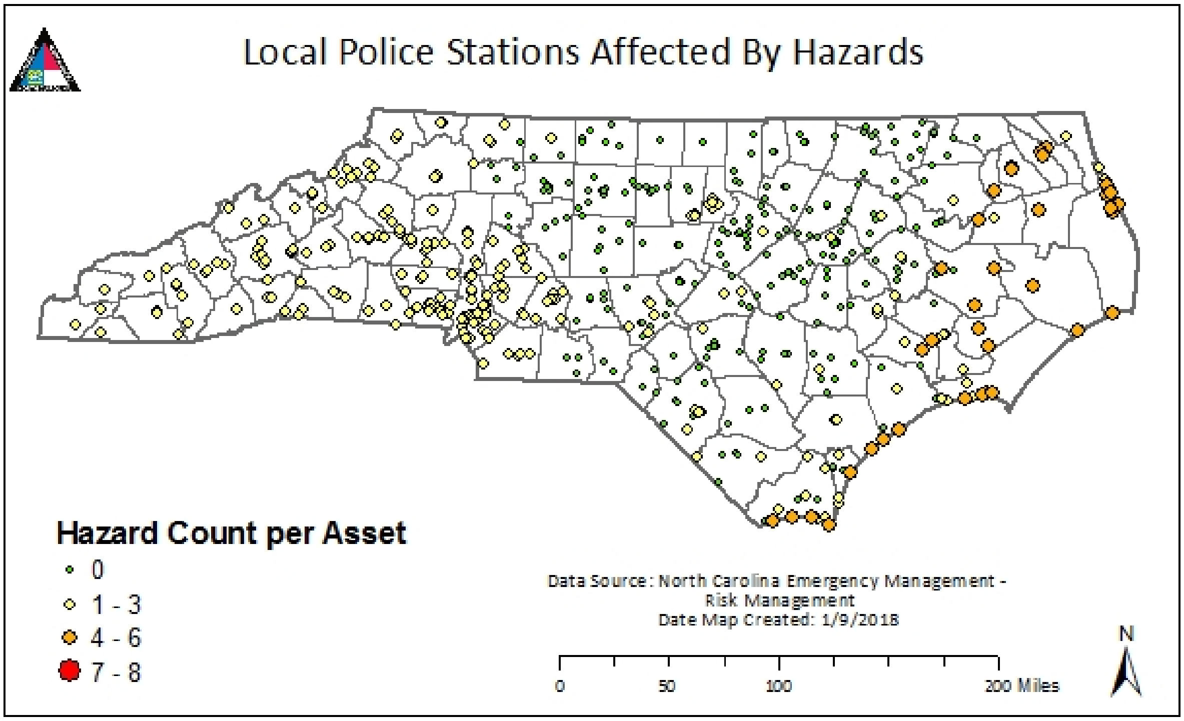
		Hazard Zones										
Critical Assets	**Total Assets Statewide**	**Flood**		**Surge**					**Wildfire**	**Landslide**	**Winter Storm**	**Earthquake**
		1% ACH	**.2% ACH**	**Cat 1**	**Cat 2**	**Cat 3**	**Cat 4**	**Cat 5**	**High WUI (7-9)**	**Very High Risk**	**Western Branch**	**High Risk (8-15% g)**
Fire Stations	3463	167	87	45	101	166	217	271	374	488	963	49
Hospitals	125	0	1	0	0	2	4	6	6	27	50	2
Sheriff's Office	101	10	9	2	6	7	10	13	7	15	34	4
Public Schools	2107	49	34	10	33	54	81	107	175	378	729	19
Police Stations State	91	2	2	0	0	2	6	6	7	17	30	1
Police Stations Local	584	39	26	10	32	45	53	64	31	104	192	8
EOCs	111	9	8	2	9	11	15	16	5	16	37	4
Shelters	1156	43	16	2	9	14	24	39	82	272	569	25

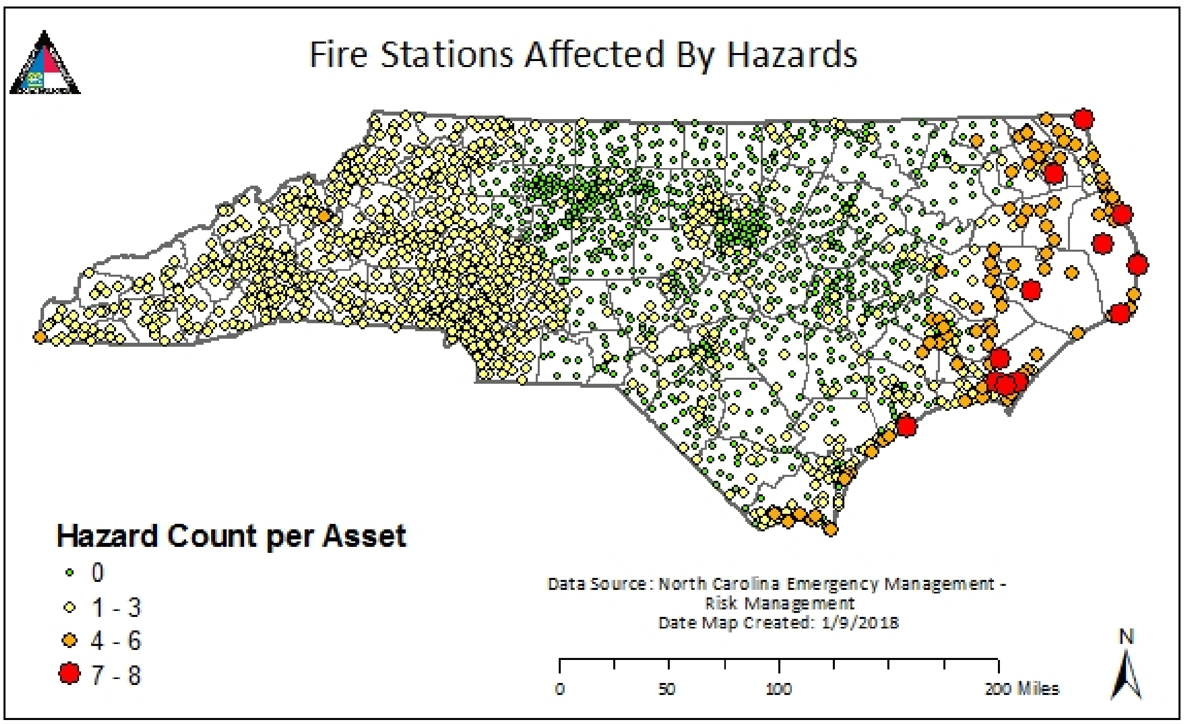
Source: NCEM-RM
Note: There were no critical assets within 50 yards of either existing sinkholes or eroding shorelines.

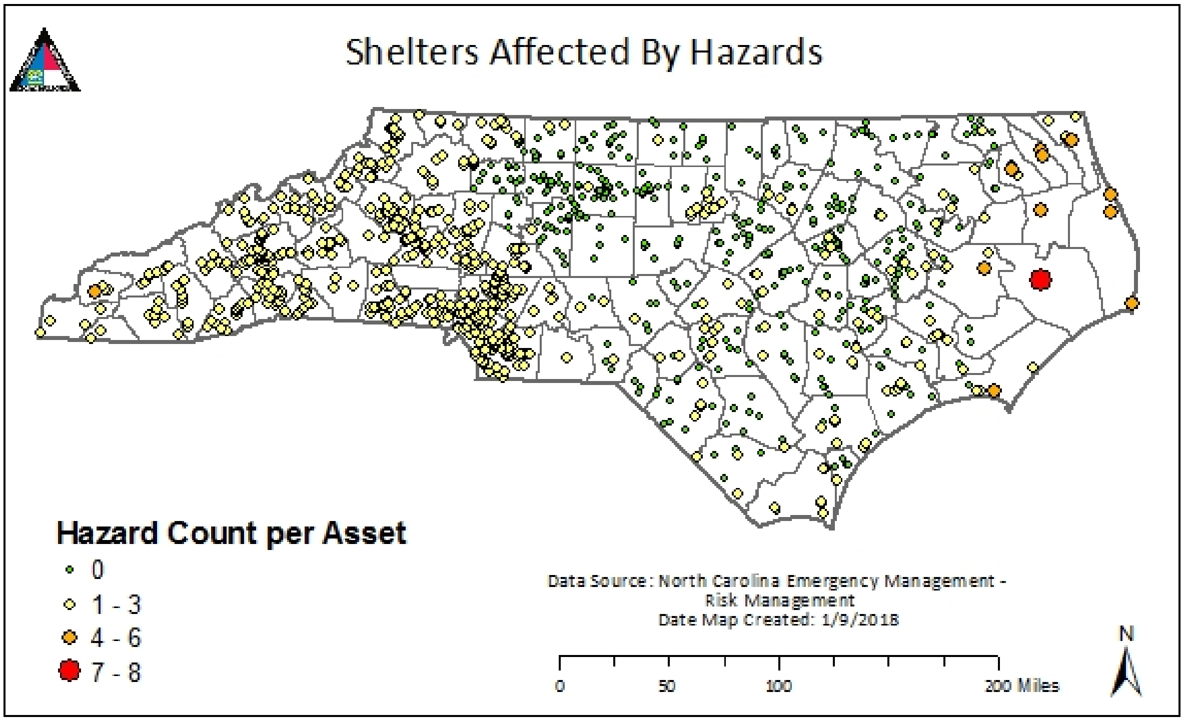


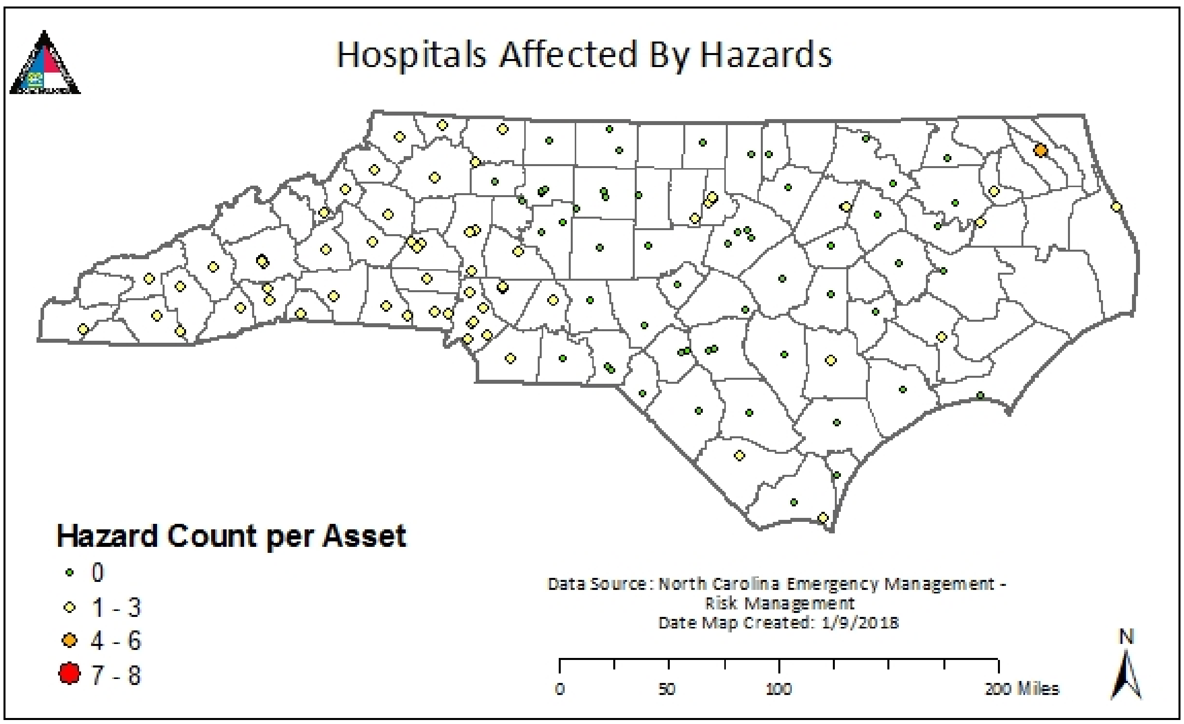
Note: This map includes the State Emergency Operation Center in Raleigh and the NCEM Branch Offices located in Conover (Western Branch), Butner (Central Branch) and Kinston (Eastern Branch). The Eastern Branch Office also serves as the State's backup EOC.

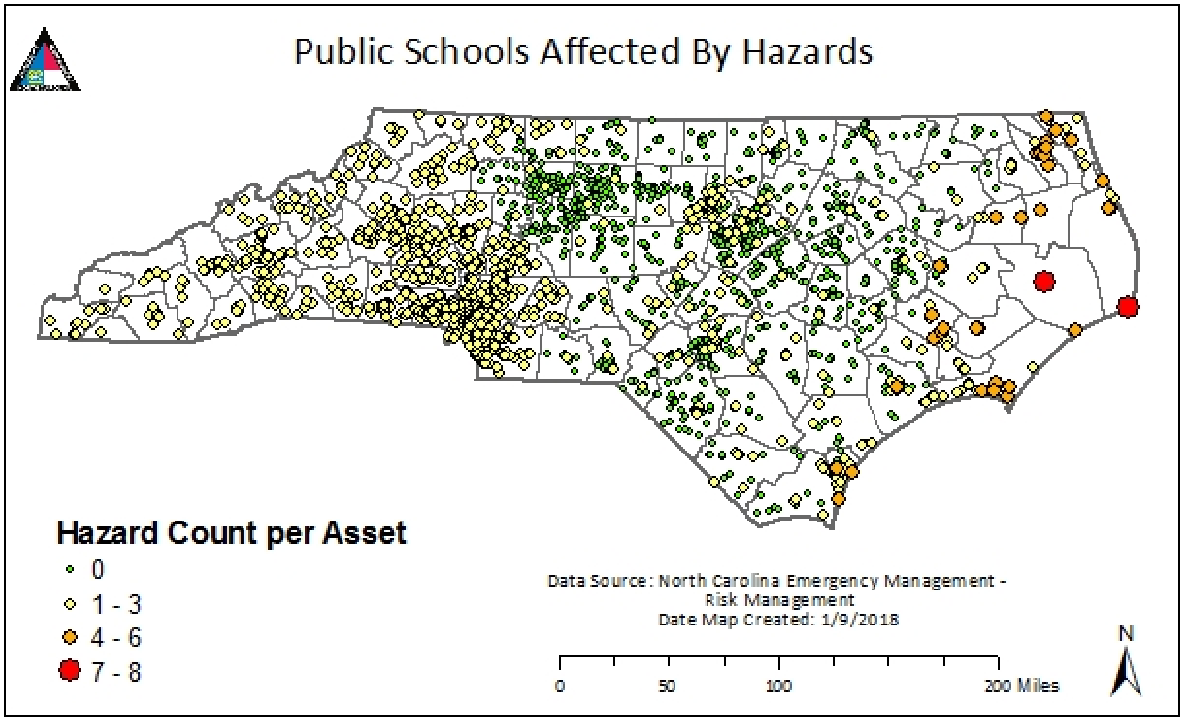



Local Police Stations Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management -
Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N


Fire Stations Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management -
Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N


Shelters Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management - Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N


Hospitals Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management - Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N



3.4.8 Risk and Vulnerability Summary

3.4.8.1 Summary of Annualized Losses

The following tables provide summary information on hazard vulnerability in North Carolina. Table 3-66 provides statewide annualized loss estimates. For flood, hurricanes, earthquakes and tornadoes, the annualized loss estimates were calculated using the methodologies used by NCEM-RM's iRISK program. For winter storm, drought, and thunderstorms, annualized losses were calculated using NCEI data.

Table 3-67 provides building exposure totals for all buildings located in hazards zones. For wildfire, that includes the high WUI vulnerability zone. For landslide, that includes the very high landslide risk zone based on USGS data, for sinkholes that includes buildings within 50 yards of existing sinkholes (per North Carolina Geological Survey) and for coastal erosion that includes buildings within 50 yards of eroding shorelines (per North Carolina Division of Coastal Management).

Table 3-66 Summary of Statewide Annualized Losses

Hazard	Statewide Annualized Loss Totals
Flood	$120,618,328
Hurricanes	$1,706,637,980
Winter Storm	$56,283,245
Earthquake	$36,593,358
Drought	$5,297,055

Tornado	$86,182,710
Thunderstorm	$5,665,515

Source: NCEM-RM and NCEI

Table 3-67 Summary of Statewide Building Exposure

Hazard	Building Exposure to Hazard Zones	Notes
Wildfire	$129,521,418,846	Value of All Buildings in High WUI Zones (Zones 7-9)
Landslide	$4,791,240,596	Value of All Buildings in USGS High and Very High Landslide Zones
Sinkholes	$946,356,142	Value of All Buildings within 50 yards of existing sinkhole
Coastal Erosion	$125,195,028	Value of All Buildings within 50 yards of eroding shoreline

Source: NCEM-RM

3.4.8.2 Most Vulnerable Jurisdictions

According to the annualized loss estimates and exposure data for all of the natural hazards presented in this section, the following counties demonstrate a higher vulnerability to hazards when compared to other counties in the State:

Table 3-68 Counties with Highest Annualized Loss Estimates and Building Exposure to Hazards

County	High Annualized Losses for the Following Hazards	High Exposure to the Following Hazards
Mecklenburg	Hurricane, Earthquake, Tornado	Wildfire, Landslide
Wake	Hurricane, Earthquake	Wildfire
New Hanover	Hurricane	Wildfire, Sinkhole, Coastal Erosion
Onslow	Hurricane	Wildfire, Sinkhole, Coastal Erosion
Buncombe	Flood, Earthquake	
Dare	Hurricane	Coastal Erosion
Brunswick		Sinkhole, Coastal Erosion
Cumberland	Earthquake	Wildfire

Section 4. MITIGATION CAPABILITIES

44 CFR Reference

Requirement §201.4(c)(3)(ii): [The State mitigation strategy shall include a] discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas [and] a discussion of State funding capabilities for hazard mitigation projects; a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

Requirement §201.3(c)(5): Provide technical assistance and training to local governments to assist them in applying for HMGP planning grants, and in developing local mitigation plans.

Requirement §201.4(c)(4)(i): A description of the State process to support, through funding and technical assistance, the development of local mitigation plans.

Enhanced Plan Requirements:

44 CFR §201.5(b)(1): Demonstration that the plan is integrated to the extent practicable with other State and/or regional planning initiatives (comprehensive, growth management, economic development, capital improvement, land development, and/or emergency management plans) and FEMA mitigation programs and initiatives that provide guidance to State and regional agencies.

44 CFR §201.5(b)(4): Demonstration that the State is committed to a comprehensive state mitigation program, which might include any of the following:

(i) A commitment to support local mitigation planning by providing workshops and training, State planning grants, or coordinated capability development of local officials, including Emergency Management and Floodplain Management certifications.

(ii) A statewide program of hazard mitigation through the development of legislative initiatives, mitigation councils, formation of public/private partnerships, and/or other executive actions that promote hazard mitigation.

(iii) The State provides a portion of the non-Federal match for HMGP and/or other mitigation projects.

(iv) To the extent allowed by State law, the State requires or encourages local governments to use a current version of a nationally applicable model building code or Standard that addresses natural hazards as a basis for design and construction of State sponsored mitigation projects.

(v) A comprehensive, multi-year plan to mitigate the risks posed to existing buildings that have been identified as necessary for post-disaster response and recovery operations.

(vi) A comprehensive description of how the State integrates mitigation into its post-disaster recovery operations.

44 CFR §201.5(b)(2)(i): Documentation of the State's project implementation capability, identifying and demonstrating the ability to implement the plan, including: Established eligibility criteria for multi-hazard mitigation measures.

44 CFR §201.5(b)(2)(ii): A system "to rank the measures according to the State's eligibility criteria. A system to determine the cost effectiveness of mitigation measures, consistent with OMB Circular–94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs."

44 CFR §201.5(b)(2)(iv): A system and strategy by which the State will conduct an assessment of the completed mitigation actions and include a record of the effectiveness (actual cost avoidance) of each mitigation action.

44 CFR §201.5(b)(3): Demonstration that the State effectively uses existing mitigation programs to achieve its mitigation goals.

This section provides an overview of the State's capabilities to integrate other planning functions into mitigation and to implement the Mitigation Strategy. It includes: an overview of NCEM planning integration, an identification, review, and analysis of the current resources for reducing hazard impacts including an evaluation of State laws, regulations, policies, and programs related to hazard mitigation and development in hazard-prone areas; a discussion of State funding capabilities for hazard mitigation projects; and a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

This section consists of the following subsections:

- State Planning Functions and Integration
- Mitigation Programs Evaluation
- Mitigation Funding
- Local and Tribal Mitigation Capabilities
- Mitigation Planning
- Summary

4.1 STATE PLANNING FUNCTIONS AND INTEGRATION

This subsection provides an overview of other planning functions within NCEM and how they are integrated either into the NCEHMP or how the NCEHMP is integrated into them. This is a key component of ensuring the planning function across NCEM are aligned and do not contradict each other in any way. This also promotes effective use of funding streams across the board to ensure there are not multiple projects, data collection, or studies of a similar nature being performed within NCEM.

NCEM Risk Mitigation staff have worked hard during this update to ensure that the State Hazard Mitigation Plan is integrated to the extent practicable with other State and/or regional planning initiatives This has been done through the following activities:

4.1.1 North Carolina Emergency Operations Plan

The North Carolina Emergency Operations Plan (NCEOP) is a vital document in guiding the state's pre- and post-disaster capabilities[1]. The NCEOP is built on all hazards principal while still having some specific hazard annexes. The NCEOP may contain additional annexes that identify operating procedures for other identified hazards. These annexes have been developed in regards to frequency of regional occurrence, the potential impact of a hazard, and the need for abnormal response procedures.

The North Carolina Enhanced Hazard Mitigation Plan is responsible for the hazard identification and risk assessment (HIRA) for all hazards and developing mitigation policies, programs, and strategies that will lessen both current and future vulnerability. All hazards identified in the NCEOP are also identified in the NCEHMP and assessed for risk. When hazards are added to either of the two documents there is coordination between the Planning and Homeland Security and Risk Management Sections to ensure plan integration is maintained throughout the different planning functions.

4.1.2 Emergency Management Accreditation Program (EMAP)

In 2008, NCEM initiated the EMAP assessment process that includes an analysis of all its policies, programs, and capabilities. The accreditation is good for a period of five years and then the agency must be re-accredited. EMAP provides NCEM with a baseline for continuing assessments that will be considered in future Plan reviews and updates. NCEM underwent the re-accreditation process again in 2013 and is currently preparing for the 2018 re-accreditation process. The 2018 EMAP re-accreditation process has been a driving force for the early update of this plan.

4.1.3 Threats Hazards Identification and Risk Assessment/State Preparedness Report

The THIRA is an all-hazards capability-based assessment tool suited for use by all jurisdictions. The THIRA allows a jurisdiction to understand its threats and hazards and how their impacts may vary according to time of occurrence, seasons, locations, and community factors. Results are capture by way of the Uniform Reporting Tool (URT) housed on Max.gov portal. The captured knowledge allows a jurisdiction to establish informed and defensible capability targets and commit appropriate resources drawn from the whole community to closing the gap between a target and a current capability or for sustaining existing capabilities.

The hazards addressed in the THIRA are all hazards identified in the HIRA section of this plan. The Risk Mitigation Branch has been coordinating closely with the Plans and Homeland Security Section for this update of the Enhanced State Hazard Mitigation Plan to ensure that the hazards in the THIRA are included in the North Carolina Enhanced Hazard Mitigation Plan.

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[11] *The current NCEOP is based upon guidelines contained in the National Response Plan (NRP) and the Comprehensive Preparedness Guide (CPG) 101 version 2.*

4.1.4 North Carolina State Homeland Security Strategy (NCSHSS)

The State Homeland Security Strategy outlines North Carolina's strategy and goals for enhancing the State's overall preparedness and resiliency against identified natural, human and technological threats and hazards. North Carolina is dedicated to ensuring the public safety of all its residents through collaborative efforts with private, local, State and Federal partners to prevent, protect, mitigate, respond to and recover from those aforementioned elements by aligning state efforts with the National Preparedness System (NPS) and National Preparedness Goal (NPG).

The North Carolina Homeland Security Strategy (NCHSS) is based on a shared responsibility to preparedness by which working together, everyone contributes to keeping the State safe from harm and resilient when impacted by any hazard. The NCHSS consists of a five-phase approach: Analyze, Develop, Design, Implement and Evaluate. The approach is dependent upon active communication and collaboration between stakeholders from the public and private sector and all levels of government. The NCHSS establishes five goals and sixteen objectives.

4.1.5 CAMA Land Use Plans

The SHMO provides courtesy reviews of Coastal Area Management Act (CAMA) Land Use Plan updates for the 20 coastal counties upon request from DEQ. The review is designed to ensure that CAMA plans are consistent with local hazard mitigation plans and the State Hazard Mitigation Plan. Also, the State Hazard Mitigation Branch coordinates with the Division of Coastal Management (DCM) when it comes to working in designated CAMA counties. For mitigation projects planned in these counties, NCEM staff coordinates with DCM to ensure that work will not conflict with an area of Environmental Concern according to CAMA regulations.

4.1.6 Housing

In response to damage from Hurricane Matthew and Tropical Storms Julia and Hermine the Essential Single-Family Rehabilitation Loan Pool – Disaster Recovery was created and is being administered by the North Carolina Housing Finance Agency (NCHFA). The source of funds includes specially-appropriated loan funds from the NC General Assembly. The NCHFA is working closely with NCEM and NC Department of Commerce as recovery efforts continue.

4.1.7 Continuity of Operation Plan

The Continuity of Operations Plan (COOP) establishes procedures for Continuity for North Carolina Emergency Management and the State Emergency Response Team (when activated). It describes essential functions—those that must continue in every circumstance, and cannot be put off even for periods of 14 to 30 days. The concept of operations for this plan involves mainly relocation from the primary emergency operations center to an alternate or Continuity facility.

4.2 MITIGATION PROGRAMS EVALUATION

This subsection provides an overview of the State's pre- and post-hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas. This section also provides an overview of how North Carolina administers federal mitigation funding.

4.2.1 North Carolina's Administration of Federal Government Pre- and Post-Hazard Management Policies, Programs, Funding, and Capabilities

4.2.1.1 The Stafford Act/Disaster Mitigation Act of 2000

The **Robert T. Stafford Disaster Relief and Emergency Assistance Act**, (Public Law 93-288, as amended by Public Law 100-707) is intended by Congress "… to provide an orderly and continuing means of assistance by the federal government to state and local governments in carrying out their responsibilities to alleviate … suffering and damage which result from … disasters." Section 401(f) of the Act sets up the procedures for Disaster Declaration and the assistance that follows. Title 44, Chapter I, Part 206 (44 CFR 206) contains relevant regulations implementing the Stafford Act. In the event of a major disaster declaration by the President, the NC Director of Emergency Management assumes the role of the Governor's Authorized Representative and the State Coordinating Officer.

On October 30, 2000, the President of the United States signed into law the **Disaster Mitigation Act of 2000** (DMA 2000) (Public Law 106-390) to amend the Stafford Act. This legislation reinforces the importance of pre-disaster mitigation planning to reduce the Nation's disaster losses, and it is aimed primarily to control and streamline the administration of federal disaster relief and mitigation programs.

The federal assistance programs established by the Stafford Act and the DMA 2000 are designed to assist disaster victims to begin personal recovery through disaster housing grants and individual assistance in the form of grants and loans and to assist government agencies recoup disaster expenses and losses. The financial programs are traditionally a cost share between the federal and state government. Many of the disaster programs involve a hazard mitigation component that has proved invaluable in North Carolina for reducing losses and increasing resiliency to natural hazards in many communities.

Among the mitigation programs administered by NCEM is the **Hazard Mitigation Grant Program** (HMGP), established in Section 404 of the Stafford Act. HMGP provides a federal cost-share for mitigation measures that are available to states and local governments following a declared disaster. Because the State of North Carolina recognizes the importance of these funds for local mitigation efforts, and because many communities, especially those located in rural areas, do not have sufficient resources to provide matching funds, the State has a long-standing tradition of providing the required match for local communities that apply for HMGP planning and project funds.

Section 406 of the Stafford Act establishes the **Public Assistance** (PA) Program, also administered by NCEM. The Public Assistance Program provides supplemental aid for disaster recovery to state and local governments and certain private non-profit organizations. PA grants are available for the repair, restoration, and replacement of facilities damaged by a declared major disaster, and may include some hazard mitigation measures.

Section 203 of the Disaster Mitigation Act of 2000 establishes the **Pre-Disaster Mitigation** (PDM) program that provides technical and financial assistance to states and local governments. Unlike the HMGP and Public Assistance Programs, the PDM is not triggered by a disaster declaration. PDM funds are available for implementation of pre-disaster hazard mitigation measures designed to reduce injuries, loss of life, and damage and destruction of property, including damage to critical services and facilities.

The **Flood Mitigation Assistance** (FMA) program is a pre-disaster federal grant program that provides annual funding assistance to communities for flood mitigation activities such as acquisition or relocation of structures, the purchase of real property, and the creation of flood mitigation plans. Its principle goal is reduction of claims against the NFIP.

As implemented by the NC Division of Emergency Management, the main objectives of these various federal mitigation grant programs include:

- To prevent future losses of lives and property due to disasters
- To implement state or local mitigation plans
- To enable implementation of mitigation measures during a state's or community's immediate recovery from a disaster

To provide funding for mitigation measures identified in local and regional Hazard Mitigation Plans that benefit the disaster area

Of the programs administered by FEMA, the most useful funding source for mitigation projects in North Carolina communities that have experienced a recent declared disaster has been the HMGP. Communities that have not received disaster-related funds have made use of PDM and FMA funding. PDM and FMA grants awards have been more limited in this plan update period due to limited funding amounts and FEMA funding priorities. More details about various funding programs are available later in this section.

Mitigation Planning Under DMA 2000 and SB 300

In addition to providing funds for mitigation projects, **Section 322** of the Disaster Mitigation Act provides a new and revitalized approach to mitigation planning for which the Division of Emergency Management is responsible at both the state and federal levels. Section 322 specifically calls for the following:

- Establishes a new requirement for local and tribal mitigation plans
- Authorizes up to 7 percent of the Hazard Mitigation Grant Program (HMGP) funds available to a state to be used for development of state, local, and tribal mitigation plans
- Provides for states to receive an increased percentage of HMGP funds (from 15 percent to 20 percent) if, at the time of the declaration of a major disaster, they have in effect an approved Enhanced State Mitigation Plan that meets the criteria in the law

In June of 2001, the North Carolina General Assembly passed **Senate Bill 300**: An Act to Amend the Laws Regarding Emergency Management as Recommended by the Legislative Disaster Response and Recovery Commission. Among other provisions, this bill requires that local governments have an approved hazard mitigation plan in order to receive state public assistance funds (effective for state-declared disasters after November 1, 2004). The Bill also requires that communities be participants in good standing in the National Flood Insurance Program (NFIP) to receive public assistance for flood-related damage.

Both Senate Bill 300 and the Disaster Mitigation Act of 2000 set forth certain requirements for local governments to have an approved hazard mitigation plan. It is clear that North Carolina takes the need for comprehensive all-hazard mitigation plans very seriously, both at the state and local levels. Now, with planning requirements tied to mitigation and public assistance funding, the sense of urgency is growing throughout the State to complete the task of developing plans that not only meet minimum criteria, but will work toward reducing vulnerability to natural hazards. In 2005, NCEM began prioritizing use of mitigation planning funds toward communities that expressed interest in joining neighboring municipalities and counties in a regional approach to Hazard Mitigation Planning. As of this update, approximately 180 single-jurisdiction plans have been replaced by 25 regional plans and 8 single county multi-jurisdictional plans. (For more details on local hazard mitigation planning in North Carolina, see discussion of the Hazard Mitigation Planning Initiative below as well as the Local and Tribal Mitigation Capabilities Section of this Capability Assessment.)

4.2.1.2 Unified Hazard Mitigation Assistance

FEMA is the lead federal agency responsible for providing technical and financial assistance to both state and local governments for disaster mitigation planning and the implementation of mitigation projects. There are several different mitigation grant programs available from FEMA to the State and to communities in North Carolina, including UHMA program which includes the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation (PDM) program, and the Flood Mitigation Assistance (FMA) program. These are described in detail here.

The main objectives of FEMA's various mitigation grant programs are as follows:

- To prevent future losses of lives and property due to disasters
- To implement state or local mitigation plans

- To enable mitigation measures to be implemented during a state's or community's immediate recovery from a disaster
- To provide funding for previously identified mitigation measures that benefit the disaster area

The programs under the Unified Hazard Mitigation Assistance program offer a source of funding for local governments that have experienced a recent declared disaster and also, provide communities that have not received disaster-related funds to make use of UHMA non-disaster program funding. A significant number of jurisdictions in North Carolina have benefited from the implementation of mitigation activities utilizing Declared Disaster and Non-Disaster Funding.

To summarize, current sources of FEMA Funding utilized by NCEM are:

- Flood Mitigation Assistance Program (FMA)
- Pre-Disaster Mitigation Assistance Program (PDM)
- Hazard Mitigation Grant Program (HMGP)
- Public Assistance Program (PA)
- Earthquake Consortium Grant (Current)

4.2.1.3 National Flood Insurance Program/Community Rating System

The National Flood Insurance Program (NFIP)

The Federal Insurance Administration (FIA) administers the National Flood Insurance Program, a self-supporting program requiring no taxpayer funds to pay claims or operating expenses. The National Flood Insurance Program (NFIP) was enacted in 1968 by the National Flood Insurance Act. This act made federally subsidized flood insurance available to property owners in municipalities and counties that agree to participate in the NFIP.

Floodplain Management Under the NFIP

There is no cost to participate in the NFIP. However, if a community wishes to participate in the program, it must make application to join with FEMA, adopt a resolution of intent to abide by the program regulations, and adopt and administer a floodplain ordinance that meets criteria established in 44 CFR 60.3. These criteria include:

- Require and maintain permits for development within designated floodplains
- Review development plans and subdivision proposals to determine whether proposed sites will be reasonably safe from flooding
- Require protection of water supply and sewage systems to minimize infiltration of floodwater
- Obtain, review, and utilize all base flood elevation data
- Assure the maintenance of flood carrying capacities within all watercourses

Model documents and specific instructions to assist local communities to enroll in the program are available from NCEM.

The North Carolina Floodplain Mapping Program maintains a process for continuously updating all the FIRMs in North Carolina. These maps are the central regulatory tool of the NFIP. The maps become effective six months after the preliminary maps are issued. Preliminary flood hazard maps contain valuable information that can be used for floodplain management before they become effective.

In addition to federal flood insurance, other types of federal financial assistance, such as mortgage loans and mitigation planning and project grants, are also only available in those communities with identified flood hazards that adopt and enforce a floodplain management ordinance that meets or exceeds the minimum NFIP standards. If a community agrees to join the NFIP, they may apply for mitigation planning grant funds. A non-participating community must provide a letter stating their intent to join the NFIP with their mitigation planning grant application. If the State determines that the jurisdiction has not made a good-faith effort to join the program as promised, mitigation planning funds must be returned to NCEM. As previously described above, North Carolina's Senate Bill 300 also includes provisions related to participation in the NFIP.

The Link Between NFIP Compliance and Federal Assistance

While participation in the NFIP is voluntary, federal and state restrictions apply to non-participating communities. Some of these restrictions include:

- Flood insurance may not be purchased by anyone living within the community's jurisdiction. A homeowner's policy does not cover damages resulting from rising waters or floods.
- No federal disaster assistance, including SBA, FMHA, VA, etc., may be provided in areas which have been identified as floodprone within the community if the damage was caused by flooding.
- No FDIC or FSLEC guaranteed lender may make a loan with property as collateral to anyone living in the floodplain unless insurance is purchased and maintained for the life of the loan. Lenders do have the option of making a conventional loan.
- Public assistance to recover from flood damage is not available to local governments for state-declared disasters. FEMA PA funds are limited in cases where flood-damaged public buildings in the special flood hazard area did not carry NFIP coverage.
- The community is not eligible to apply for hazard mitigation grants for flood-related mitigation projects.

Floodplain Manager Training and Education

Following Hurricane Fran, FEMA developed a self-contained home-study course designed to educate local floodplain managers in North Carolina about the regulatory permitting process of the NFIP, requirements for compliance, and other aspects of the Program. The study course is modeled on FEMA's Emergency Management Institute (EMI) course for local floodplain managers, with the addition of elements relevant to floodplain management in North Carolina. Introductory workshops are also held to help local communities get started in the NFIP process as well as more technical workshops for enrolled communities. The NCEM Risk Management Section works with the North Carolina Association of Floodplain Managers in the administration of the home-study course and for certifying completion by floodplain managers in order for them to earn Certified Floodplain Manager status. NCEM also regularly administers the FEMA L 273 Course—Managing Floodplain Development through the NFIP. NCEM keeps a current database of local floodplain managers who have earned the designation. Floodplain management training and education programs are an ongoing process; it is the goal of the NC NFIP that all local floodplain managers receive the technical training necessary to build local administrative capacity for comprehensive floodplain management.

Lender and Insurance Agent Training and Education

Flood insurance is required whenever financial assistance from a federally regulated institution is used to purchase or construct a building in a SFHA. As many insurance companies are issuing NFIP policies, their agents require knowledge and skill in writing these policies. The NFIP has contracted with H2O Partners to offer agent training. Insurance agent workshops given by H2O provide training regarding the Flood Insurance Program, rates, regulations, and basic underwriting guidelines.

In the workshop, Coastal Barrier Resource System units (CoBRA Zones) established by the Coastal Barrier Resources Act (CBRA) of 1982 and their related regulations are covered, including the ban on selling federally-backed flood insurance for structures built or substantially improved after October 1, 1983. For those CBRS units added in 1990 by the Coastal Barrier Improvement Act (CBIA), the ban applies to those structures built after November 1, 1990. It should be noted that no NFIP flood insurance claims can be paid if a policy was issued in error.

Increased Cost of Compliance

Increased Cost of Compliance (ICC) is an endorsement to NFIP policyholders' standard flood insurance policy. It applies to all new and renewed flood insurance policies effective on and after June 1, 1997. ICC is available to help owners whose homes or businesses are damaged by flood to meet building requirements imposed by the local floodplain management ordinances to reduce future flood damage. Flood insurance policyholders in high-risk areas (Special Flood Hazard Areas) can get up to $30,000 to help pay the costs to bring their home or business into compliance. The damage must be that caused by flood, not wind and flood.

There are four options offered through ICC to help policyholders comply with the local floodplain management ordinance and help them reduce future flood damage: elevation, relocation, demolition, or flood proofing (available primarily for non-residential buildings). Claims may be filed for Increased Cost of Compliance coverage in two instances. 1) If the community determines that the home or business is damaged by flood to the point that repairs will cost 50 percent or more of the building's pre-damage market value ("substantial damage"); or 2) If the community has a repetitive loss provision in its floodplain management ordinance and determines that the home or business was damaged by a flood two times in the past ten years, where the cost of repairing the flood damage, on the average, equaled or exceeded 25 percent of its market value at the time of each flood ("cumulative damage").

Additionally, there must have been flood insurance claim payments for each of the two flood losses. Note that, since no North Carolina communities have cumulative damage provisions in their floodplain management ordinances (due to the difficulty in administering such provisions), this second opportunity for ICC coverage is not available for policyholders in North Carolina.

Community Rating System (CRS)

The Community Rating System (CRS) is a program administered under the National Flood Insurance Program (NFIP) that allows local governments to earn points resulting in a reduction in flood insurance premiums for residents of the community. The CRS issues credit points for various activities conducted by the local jurisdiction. The number of credit points earned determines the amount of premium discount offered to property insurance holders in that community. Preparing a flood mitigation plan is one of the activities credited under the CRS.

North Carolina has one of the best participation rates in the CRS, with 86 communities enrolled. The state boasts nine Class 9 communities, thirty-nine Class 8 communities, twenty-three Class 7 communities, ten Class 6 communities, four Class 5 communities and one Class 4 community. Class 5 above receive at least a 25% discount on NFIP premiums for property owners.

Many of the local hazard mitigation plans that are being developed by North Carolina communities through the Hazard Mitigation Planning Initiative can also qualify as Floodplain Management Plans to meet CRS requirements. Technical assistance materials that are made available to HMPI communities include guidance on incorporating CRS planning elements into local all-hazards mitigation plans. This strategy reflects Federal Emergency Management Agency (FEMA) policy to integrate all the planning requirements for various federal assistance programs into one comprehensive set of criteria.

A study conducted by FEMA evaluated the effectiveness of flood mitigation activities in North Carolina following Hurricane Floyd. In the report, entitled “Evaluation of CRS Credited Activities During Hurricane Floyd” eight credited CRS activities were evaluated to determine their impact on flood losses. Among the findings were:

- Residents of CRS communities had a higher awareness of their local flood hazard, held more flood insurance, and implemented more flood protection measures.
- Preserving flood-prone areas as open space saved between $47,500 and $111,000 in losses per acre.
- Acquisition and relocation of flood-prone buildings is more effective in reducing flood losses than any other approach. Cost of relocation was paid back in damages foregone within three years.
- Raising structures above the required base flood elevation paid off, and the higher the building, the less flood damage it experienced.
- Homeowners who installed flood protection measures prevented, on average, $9,900 in damage.

4.2.1.4 Risk MAP and Cooperating Technical Partner

Risk MAP is one of the primary programs that provides communities with flood risk data, driving action by helping inform hazard mitigation plans developed at the state and local level in North Carolina. The State of North Carolina, through FEMA's Cooperating Technical Partnership (CTP) initiative, was designated as the first Cooperating Technical State (CTS) on September 15, 2000 and continues to be a valued partner. As a CTP, the State assumes primary ownership and responsibility of the FIRMs for all North Carolina communities as part of the National Flood Insurance Program (NFIP), including flood hazard analyses and producing updated, digital FIRMs (DFIRMs). The State of North Carolina believes that accurate, up-to-date flood hazard information is crucial to protect the lives and property of its residents. FEMA's limited mapping budget had not permitted an adequate response to the mapping update needs, and many counties and communities nationwide lack the necessary resources to take on this responsibility themselves. As a CTP, the State of North Carolina appropriates funding and leverages technology advancements to enhance the quality and quantity of data collection for use in accurate risk assessment and mapping.

NCEM manages the implementation of FEMA's Risk MAP (Mapping, Assessment & Planning) program in North Carolina through the North Carolina Floodplain Mapping Program (NCFMP). According to FEMA, "Risk MAP provides high quality flood maps and information, tools to better assess the risk from flooding, and planning and outreach support to communities to help them take action to reduce (or mitigate) flood risk. Each Risk MAP flood risk project is tailored to the needs of each community and may involve different products and services." Ideally, Risk MAP data and products will better inform communities of their risk so that they may take action to mitigate the risk they face and reduce future flood losses. The Risk MAP program also tracks national statistics for how many mitigation actions are identified or advanced as a result of Risk MAP involvement through meetings, data, or other touch points.

The goals of the NCFMP include:

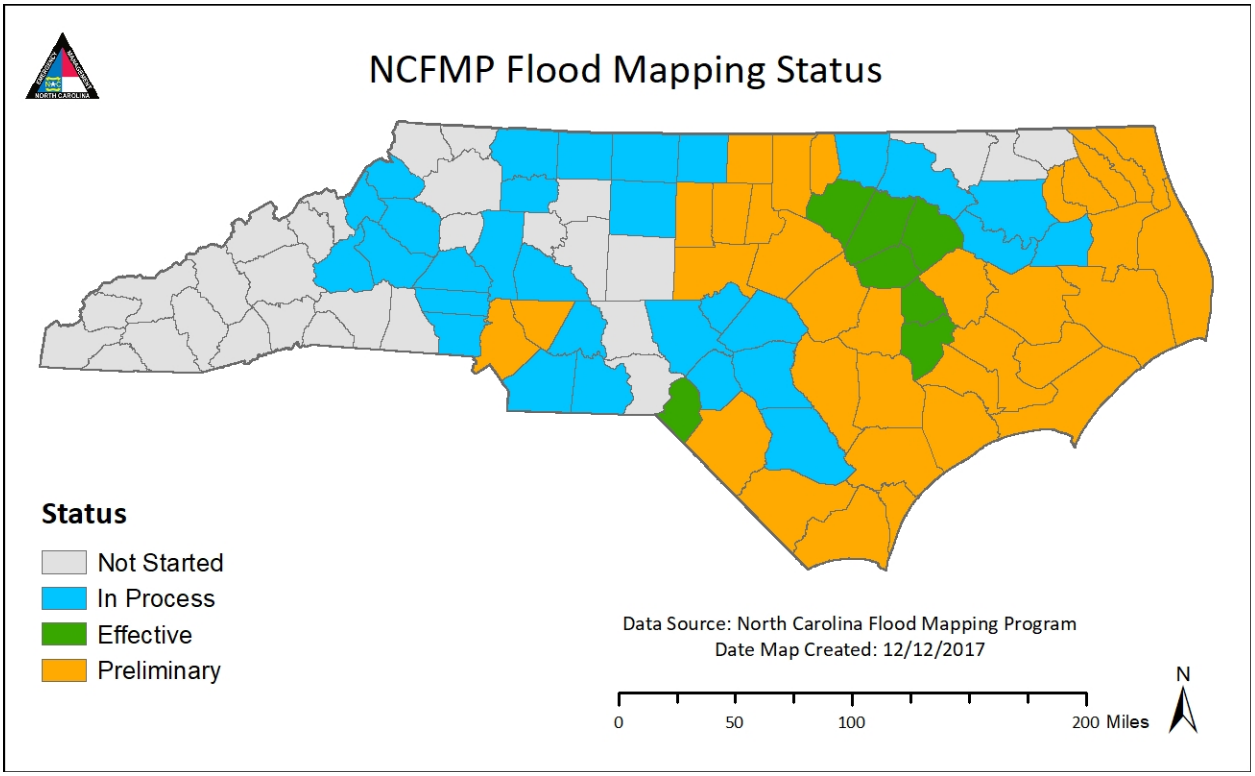
- compiling current, accurate flood hazard data for sound development and design decisions.
- minimizing long-term flood losses through better floodplain management.
- making FIRMs cheaper, more accurate, and faster to update and providing them in digital format to more easily and efficiently alert property owners of the need for flood insurance.
- using digital data to make more precise flood risk determinations.
- providing 24-hour online access to GIS analysis and planning tools.
- making Digital Elevation Models (DEMs) available for almost any engineering or planning application.

Base data for the entire state, including all 100 counties, is updated annually. The State has a Memorandum of Agreement with each county so that the State serves as a data backup source for the geospatial data that is used, providing redundancy in the event of a disaster.

County flood studies are updated every 5-7 years. The updated study data will provide more accurate information for North Carolina communities to inform resilient development practices and mitigation approaches, help with design decisions when rebuilding after flood disasters, building new structures and infrastructure, and retrofitting existing structures.

The following figure provides an overview (as of 10/23/2017) of the current status of flood mapping and all hazard risk data and mapping for the State. This represents the second, and in some cases third, update of flood maps for the counties since 1999.

Figure 4-1 Status of Floodplain Mapping in North Carolina



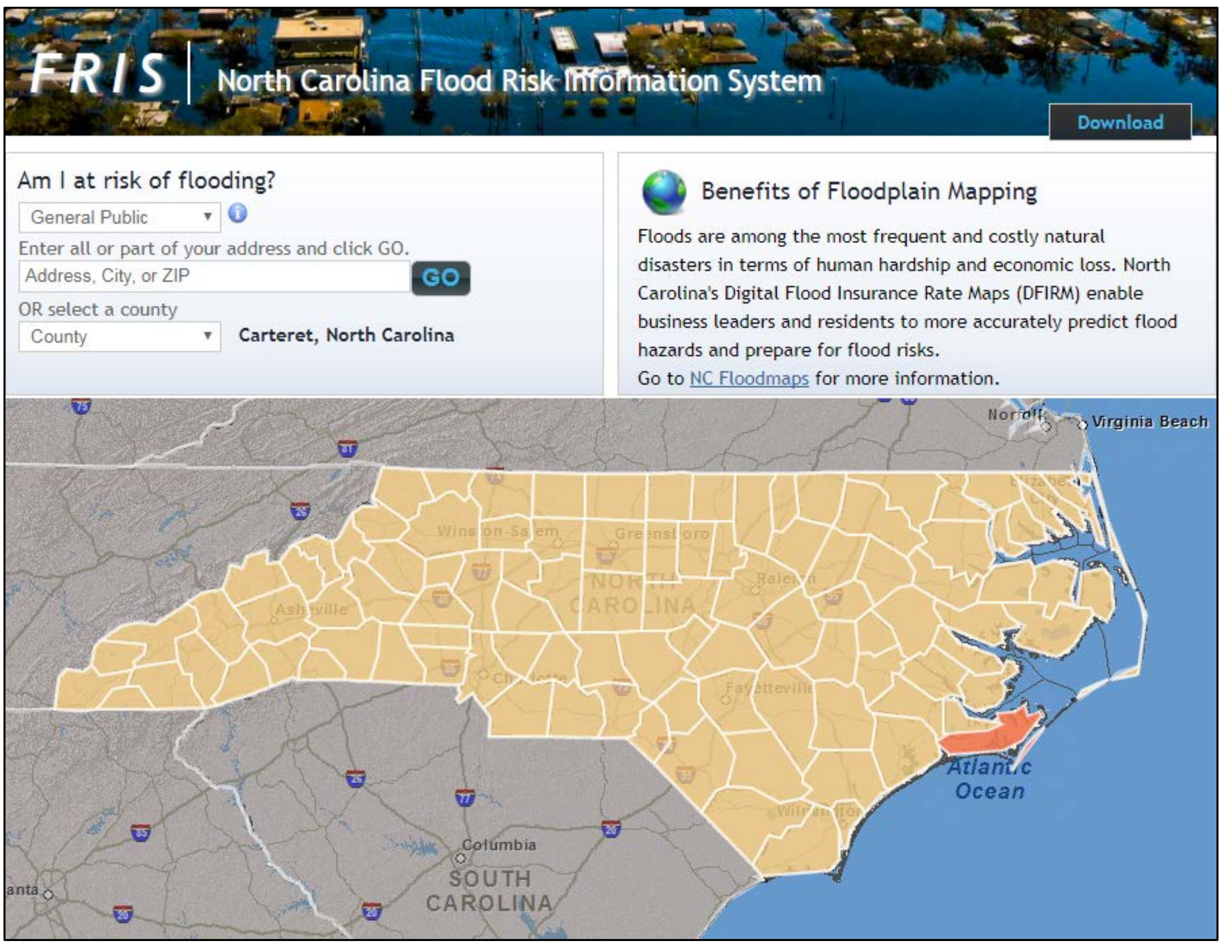
The data created through Risk MAP projects is leveraged by state and local agencies to aid in decision making and planning. The data supports the identification of hazard mitigation opportunities, prioritization, and application development for mitigation and disaster recovery projects as well as the enforcement of building codes and local floodplain management ordinances. Using this data, the State of North Carolina has created several online mechanisms for sharing information for local use, including the Flood Risk Information System (FRIS), Flood Inundation Mapping and Alert Network (FIMAN), and iRisk (Integrated Hazard Risk Management Program).

Flood Risk Information System (FRIS)

The State of North Carolina provides the Flood Risk Information System (FRIS) website as a public service to the citizens of North Carolina which contains digitally accessible flood hazard data, models, maps, risk assessments, and reports that are database driven. This site also provides geospatial base map data, imagery, LiDAR data, along with hydraulic and hydrologic models that is available for download and use. More flood risk information can be found at http://fris.nc.gov/fris/

Managed through NCEM's Risk Management Section, the FRIS website presents information targeted to two audiences: the general public and advanced users. The general public can identify the level of flood risk and estimated damage losses associated with their property. By typing in their address, users can locate their property and view the flood hazard and risk information associated with it such as the flooding source, the flood event water surface elevation, and the flood zone if applicable. Advanced users, such as floodplain managers and government officials, will have the opportunity to download flood hazard data while also being able to identify levels of flood risk for buildings in the community.

Figure 4-2 North Carolina Flood Risk Information System

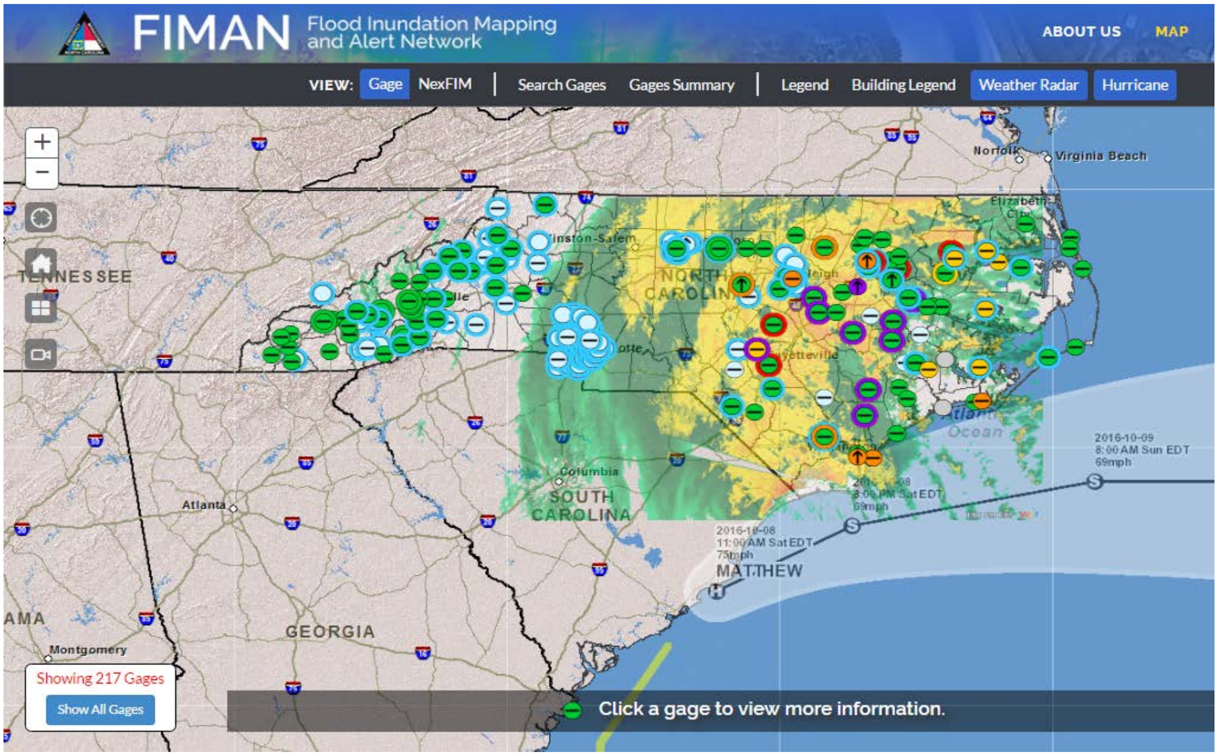


Flood Inundation Mapping and Alert Network (FIMAN)

The North Carolina Flood Inundation Mapping and Alert Network (FIMAN), managed through NCEM's Risk Management Office, provides actual storm-specific rainfall and stream/flood information based on a system of measurement stations (i.e., gages) located throughout the state. This system integrates gages of USGS and other agencies with State-owned gages, resulting in an overall network of approximately 550 gages. Data collected at the gages through sensors is transmitted by radios or satellite, retrieved and processed by special software, and then stored on an enterprise GIS database. The FIMAN web application uses responsive design and consistent modeling techniques to display real-time and forecasted flood information, which is accessible from any desktop, laptop, or mobile device. Gage readings are typically recorded and transmitted every 15 to 30 minutes. The goal of the FIMAN system is to reduce the loss of life and flood-related property damage by providing emergency managers and the public with more timely, detailed, and accurate information.

FIMAN has been successfully used to display real-time flooding scenarios across the state of North Carolina for different flooding events. This resource is helpful to emergency management officials as they plan for evacuation and rescue efforts before, during, and after a significant storm event. The alerting system of the FIMAN website responded in real-time to gage readings during Hurricane Matthew (see Figure 4-3) and has also been adopted by the media for use in weather reports.

Figure 4-3 Real-Time FIMAN Response During Hurricane Matthew



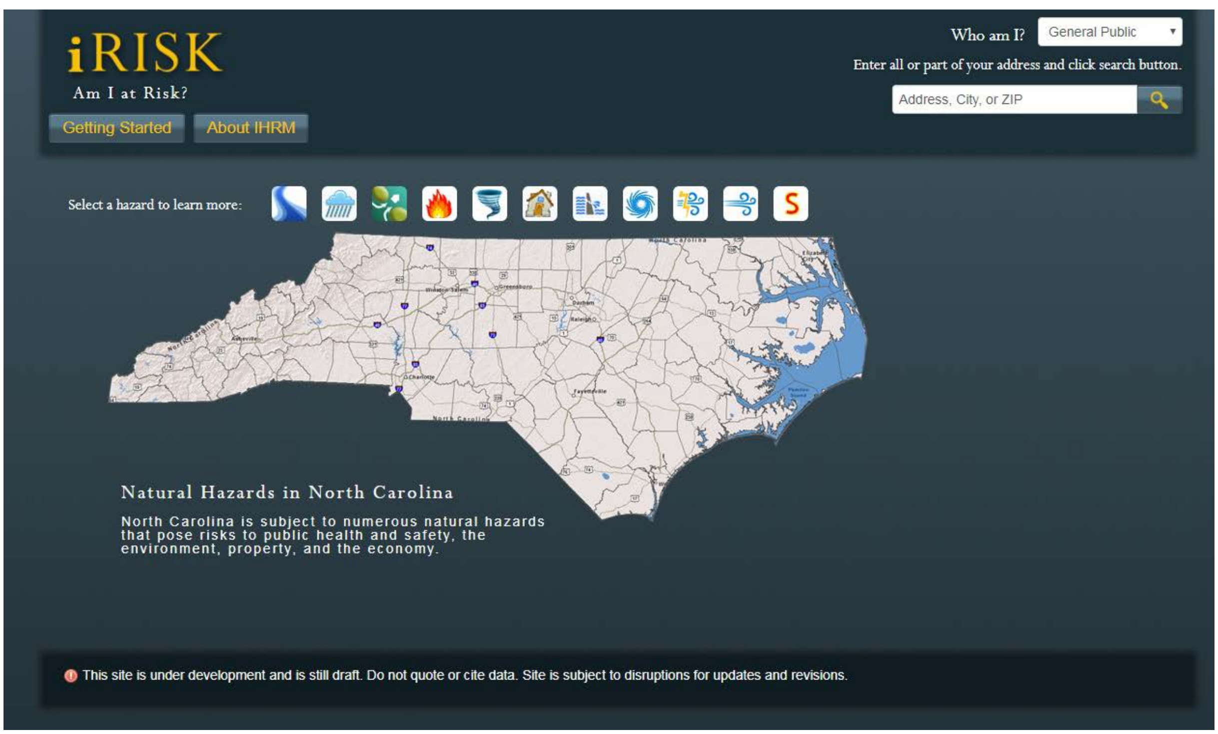
The NCFMP plans to expand the FIMAN system to densify the gage network in FIMAN and to build upon the network in order to provide alerts for a greater portion of the State. Approximately 100 riverine and 13 coastal gages have been identified for future installation and integration into the system.

iRisk

Risk is a tool that assesses the combination of the likelihood that a threat will occur and the consequences of its occurrence. North Carolina is subject to numerous natural hazards that pose risks to public health and safety, the environment, property, and the economy. Taking appropriate action can typically reduce these risks. The State of North Carolina, through the NCEM's Risk Management Section (NCEM-RM), received federal funding from FEMA to develop the Integrated Hazard Risk Management (IHRM) program to help the public, private sector, and governments (local, state, and federal) manage their risk from multiple natural hazards.

IHRM provides this information through the iRISK tool so that users can educate themselves about their risk and make informed decisions that will help save lives, decrease property damage, and improve resiliency to natural disasters. NCEM-RM developed the iRISK tool to help users evaluate and prioritize actions that are appropriate for reducing risk to an individual building from a specific hazard. The NCEM-RM also developed an improved hazard mitigation planning approach leveraging all the data and products of IHRM to be used by local governments in preparing hazard mitigation plans for state and FEMA approval. For local government's hazard mitigation planning, the iRISK tool supports the evaluation of risk-reducing actions applicable to both the neighborhood and community-wide scales.

Figure 4-4 North Carolina iRisk Tool



The results displayed in iRISK come from models and methods commonly used by government risk assessors. One of these methods is FEMA's Hazus-MH, a nationally applicable standardized set of models for estimating potential losses from earthquakes, floods, and hurricanes. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Another method used is FEMA's Benefit-Cost Analysis software that calculates how much benefit comes from reducing a risk in a particular way. IHRM focused on collecting information on specific buildings and other critical infrastructure such as public utilities so that losses from damages could be calculated for each building or piece of infrastructure. The results factor in overall risk and its components of probability, consequence, and vulnerability.

4.2.1.5 Emergency Management Program Grant (EMPG)

The EMPG Program provides states with federal funds to sustain and enhance all-hazards emergency management capabilities. North Carolina uses EMPG to enhance its ability and to help counties support emergency management activities while simultaneously addressing issues of national concern as identified in the National Priorities of the National Preparedness Guidelines. A statewide comprehensive emergency management program begins at the local level; that is why NCEM coordinates EMPG activities through its 100 counties and the Eastern Band of Cherokee Indians.

EMPG Program funding is dependent upon the federal availability of funds and the total funding varies from year to year. EMPG has a 50 percent federal and 50 percent state cost-share cash or in-kind match requirement. The in-kind match is also a requirement of the state's EMPG sub-grants to its counties and the Eastern Band of Cherokee Indians.

North Carolina's EMPG program provides its counties and the Eastern Band of Cherokee Indians an opportunity to apply for baseline and supplemental funding. To align efforts between the State and local emergency management, specific programmatic deliverables are identified and agreed to by both parties. To be eligible for baseline funding, applicants must agree to complete certain universal programmatic deliverables during a specified period of performance. To be eligible for EMPG supplemental funding, applicants must have applied for baseline funding and agreed to complete at least one optional program activity during the specified period of performance.

4.2.1.6 Public Assistance

For a description of how the Public Assistance Program is administered by the State of North Carolina, please see the *Mitigation Funding* Section of this Capability Assessment.

Section 406 of the Stafford Act authorizes the Public Assistance (PA) Program, which is administered by FEMA. This post-disaster program provides aid to help communities save lives and property in the immediate aftermath of a disaster and help a community rebuild damaged facilities. Grants cover eligible costs associated with the repair, replacement, and restoration of facilities owned by state or local governments and non-profit organizations.

Four categories of assistance are available after a major disaster declaration:

- Debris removal provides 75 percent of funds to state or local governments or private non-profit organizations to eliminate threats to life, public health, or property. Debris may be removed from private property when in the public interest.
- Emergency work or protective measures to eliminate threats to life, public safety, or property. This includes ensuring emergency access, removal of public health and safety hazards, demolition of structures, establishment of emergency communication links, and emergency public transportation.
- Repair, restoration, relocation, or replacement of damaged facilities to return public and non-profit facilities to their pre-disaster condition. Grantees must comply with certain insurance purchase requirements.
- Community disaster loans to units of local government that lose a substantial part of their tax base because of a disaster.

Minimum standards for all repairs and reconstruction done under the PA program may include hazard mitigation standards and can be in place at the time of the disaster or can be adopted prior to the approval of a particular reconstruction project. Thus, improved standards that are adopted by a state or local government prior to FEMA's approval of the repair or replacement of the damaged portion of a facility may become eligible for Federal funding under the PA program. Under the PA program, the cost of bringing a facility up to current codes, specifications, and standards is an eligible cost.

The Public Assistance program also authorizes funding for appropriate cost-effective hazard mitigation measures related to damaged public facilities. The Regional Director may authorize hazard mitigation measures that are not required by codes, specifications, and standards if the measures are in the public interest, fulfilling the following criteria:

- The mitigation measures must substantially alleviate or eliminate recurrence of the damage done to the facility by the disaster.
- The measures are feasible from the standpoint of sound engineering and construction practices.
- The measures are cost-effective in terms of the life of the structure, anticipated future damages, and other mitigation alternatives.
- Floodplain management and applicable environmental regulations are met.

Communities can use the hazard mitigation planning process to identify potential mitigation measures for funding under the Public Assistance Program. The Hazard Mitigation Survey Team or Interagency Hazard Mitigation Team can be particularly useful in this regard. In addition, the Damage Survey Reports used by inspectors to make site-specific recommendations for repairs following a disaster can also serve to identify mitigation opportunities.

4.2.1.7 Integration of the Plan with Federal Mitigation Programs and Initiatives

NCEM Risk Mitigation staff have worked during this update to ensure that the State Hazard Mitigation Plan is integrated to the extent practicable with Federal Mitigation programs and initiatives that provide guidance to State and regional agencies. This has been done through the following activities:

- NCEM administers all FEMA Hazard Mitigation grant programs and coordinates with local governments and other State agencies to promote and implement FEMA programs.
- Other agencies clearly support mitigation programs, including Department of Insurance (NFIP) and State Fire Marshall (Building Codes)
- NCEM maintains a program of comprehensive coordination and outreach to State and Federal partners through the RMCC. This ongoing committee and permanent working group is designated to evaluate, monitor and update the State Hazard Mitigation Plan on a regular basis.

4.2.2 Other Pre- and Post-Hazard Management Policies, Programs, Funding, and Capabilities

In addition to the programs described in Section 4.1.1, there are also additional key programs outside NCEM that are closely associated with advancing mitigation throughout the State which are discussed below.

4.2.2.1 CDBG-DR

The United States Department of Housing and Urban Development makes funding available for disaster recovery through a program called the Community Development Block Grant – Disaster Recovery program (CDBG-DR). The funding is intended to be used to address unmet needs for disaster relief in a post disaster environment and support long-term recovery, restoration of infrastructure, housing, and economic development. In recent events, the funding has been required to be spent in the counties most impacted by the event. Most recently, North Carolina received $236.5 million dollars in CDBG-DR funding for Hurricane Matthew.

CDBG-DR funding is being managed at the State level by North Carolina Emergency Management in close coordination with the North Carolina Department of Commerce.

4.2.2.2 Dam Safety

The Dam Safety Program is housed in the NC Department of Environmental Quality's Energy, Mineral and Land Resources Division, its mission is to prevent property damage, personal injury, and loss of life from the failure of dams by providing oversight of more than 3,000 dams statewide. A staff member of the Dam Safety Program serves on the Risk Management Coordinating Council (RMCC).

The Dam Safety Program administers the NC Dam Safety Law of 1967 as amended (N.C.G.S. 143-215.23 et seq.). The purpose of the Dam Safety Law is to provide for the certification and inspection of dams in the interest of public health, safety, and welfare in order to reduce the risk of failure of dams; to prevent injuries to persons, damage to downstream property, and loss of reservoir storage; and to ensure maintenance of minimum stream flows of adequate quantity and quality below dams. The Dam Safety program has the authority to levy fines against dam owners who violate permit conditions or who construct an unauthorized dam.

The Dam Safety Program makes use of state-of-the-art web-based and wireless inventory tools, which are increasing its mitigation capability and efficiency. While the Program receives some federal money to carry out permitting and inspections duties, funding from FEMA has been reduced over the past several years, impacting the frequency of dam inspections throughout the state.

There are more than 3,000 dams in North Carolina that are regulated through the inspection and certification requirements of the Dam Safety Program. Eighty to eighty-five percent of the regulated dams are privately owned and maintained. Under the administrative rules carried out by the Dam Safety Program, all dams are classified as High, Intermediate, or Low in terms of their hazard potential. A dam failure involving dams classified as “Low Hazard” would entail minimal interruption of road service on low volume roads and less than $30,000 in economic damage. A dam failure involving dams classified as “Intermediate Hazard” would entail damage to highways, interruption of service, and economic damage of $30,000 to $200,000. A “High Hazard” dam failure would involve the loss of one or more human lives or economic damage totaling more than $200,000. If the dam is a publicly-owned utility, such as a municipal water supply dam, the cost of dam repair and loss of services is included in the economic loss estimate.

About one in five of all dams in North Carolina is classified as high-hazard. Coal Ash Management Action of 2014 (Session Law 2014-122) requires that all owners of high and intermediate hazard dams in North Carolina submit a proposed Emergency Action Plan. These plans greatly facilitate response procedures for these dams.

One goal of the Dam Safety Program is to assess dam failure vulnerability and inundation areas for high hazard dams in North Carolina. Increased levels of coordination with the NC Floodplain Mapping Program would likely augment the accuracy and efficiency of this effort. Questions still remain as to the best methods to assess dam failure vulnerability and possible inundation areas. At this time, earthquake risk is not a component in the dam failure risk assessment, nor are earthquake design standards incorporated into the permitting process.

The majority of dams in North Carolina are privately owned. Many dam owners are farmers or other rural residents, some of whom have limited incomes. Others are owned by homeowners’ associations with limited assets. Neither state nor federal funding is available to assist private property owners, and some dams in the state are neglected because of the expense involved.

To a limited degree, the NC Dam Safety Program coordinates with local emergency management officials to communicate EM response protocols and flood warnings to local communities. However, local emergency management officials are often not trained in response to dam failure, and many local emergency offices lack the hardware and software needed to use the dam hazard data that is available from the State. Furthermore, local emergency action plans are not required for existing dams, and many community members and local officials are unaware of the damage potential that exists from local dams.

The Dam Safety Program has recently embarked on a cooperative venture with the National Weather Service (NWS). By integrating data received from the Dam Safety Program into the forecast system, the NWS has the capacity to overlay dam locations in ArcView with weather radar, precipitation, river gauge information, and other relevant data. This project holds great potential for predicting weather systems that could impact dams in specific locations around North Carolina.

Other new ventures for the Dam Safety office include the development and distribution of a "Dam Safety Manual" as well as a mitigation report, or "Dam Failure Manual," for the 100 counties in North Carolina, containing data specific for each county (pending funding). The Land Quality Section also proposes to send copies to the respective local government and County Emergency Manager of any "Notice of Deficiencies" sent to property owners of high hazard and intermediate dams.

4.2.2.3 North Carolina Forest Service

The North Carolina Forest Service (NCFS), a Division of the N.C. Department of Agriculture and Consumer Services (NCDA&CS), operates under a mandate to protect, manage, and develop the millions of acres of forestland throughout the state. The Division is directly involved with forest management assistance, reforestation services, forest fire prevention and suppression, insect and disease control, and emergency response along with a host of other services and programs. The programs under the Forest Protection section of the NCFS are aimed at private forest landowners, homeowners, volunteer fire departments, communities, and the public to increase their awareness of fire risk, to educate them about fire safety and preventative measures, and to suppress wildfires quickly and safely. The Division also encourages the involvement of the private sector including builders and developers as well as the insurance and forestry industries to engage in widespread wildfire mitigation efforts and information dissemination. The NCFS also coordinates with the National Weather Service to forecast fire weather around the state, but more refined collaboration would enhance the real-time risk assessment capabilities of the NCFS. Although the Division is a leader of wildfire response in the United States, increased funding would allow the Division to engage in more aggressive outreach and public education campaigns to communities at risk from wildfire.

4.2.2.4 Organizations Providing Local Government Support

In addition to support given to local governments for mitigation planning and project implementation from state and federal agencies, a wide variety of organizations provide local government support for all sorts of mitigation activities. Some of these organizations are non-profit or non-government organizations. Others are associations of professionals or officials that exist to assist their clients or to promote a specific agenda. Although not comprehensive, a sample of some of these organizations is listed below.

- Association of County Commissioners
- League of Municipalities
- North Carolina Emergency Management Agency
- North Carolina American Planning Association
- Councils of Government
- American Red Cross
- Americorps National Preparedness and Response Corps
- Habitat for Humanity
- North Carolina Association of Floodplain Managers
- North Carolina Smart Growth Alliance
- North Carolina Voluntary Organizations Active in Disaster
- Institute for Business and Home Safety
- North Carolina Rural Economic Development Center

4.3 MITIGATION FUNDING

4.3.1 State Funding for Mitigation

North Carolina General Statute 166A-19.42 established the State Emergency Response and Disaster Relief Fund as a reserve in the State's general fund. General Statute 166A-19.41 defines some of the ways that funding can be used and includes mitigation as an option.

The General Assembly also provides post-event appropriations as well. Most recently, this took the form of the Disaster Recovery Act of 2016 following Hurricane Matthew. This Act provided over $200,928,370 in state dollars for recovery efforts which included implementing mitigation projects. An additional $100 million in state funding was allocated for disaster relief through the Disaster Recovery Act of 2017.

Additionally, the State has traditionally provided funding to help local governments meet the 25% match for HMGP grants.

4.3.2 The State's Use of FEMA Funding Sources

The State integrates FEMA programs into its mitigation strategy and actions whenever possible and wherever practicable. NCEM is responsible for administering FEMA mitigation programs and initiatives as well as serving as the lead agency for the State in disaster mitigation efforts, affording the State the opportunity to better coordinate the mitigation grant application process for the programs listed in this section. NCEM has primary responsibility for FEMA grant programs, including those listed here:

- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance Program (FMA)
- Pre-Disaster Mitigation Grant Program (PDM)

- Public Assistance (PA) Program
- Public Assistance (“406”) Mitigation Program

The main objectives of FEMA’s various mitigation grant programs are:
- to prevent future losses of lives and property due to disasters.
- to implement state or local mitigation plans.
- to enable mitigation measures to be implemented during a state’s or community’s immediate recovery from a disaster.
- to provide funding for previously identified mitigation measures that benefit the disaster area.

4.3.2.1 UHMA

During FY2009, FEMA developed the Hazard Mitigation Assistance Unified Guidance Program (HMA) to consolidate all FEMA mitigation activity grant programs (formerly FMA, SRL, RFC, PDM, and HMGP) into one streamlined portfolio. The PDM and FMA programs now share guidance and application periods. The SRL and RFC programs were rolled under the FMA program. HMGP also falls under HMA, but it is activated post-disaster and application periods are dependent upon disaster declarations.

Flood Mitigation Assistance Program (FMA)

FEMA’s Flood Mitigation Assistance Program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FMA is a pre-disaster grant program.

The goals of FMA are to:
- reduce the number of repetitively damaged structures and the associated claims on the National Flood Insurance Program.
- encourage long-term, comprehensive mitigation planning.
- respond to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development review and permitting.
- complement other federal and state mitigation programs with similar long-term mitigation goals.

FMA is generally made available to states on an annual basis. This funding is only available for planning, projects, and other assistance related specifically to flooding. NCEM administers the FMA program and serves as the grantee, in turn providing the funds to local communities. NCEM sets mitigation priorities, provides technical assistance to communities applying for FMA funds, and evaluates grant applications based on minimum eligibility criteria. NCEM is responsible for selecting projects for funding from the applications submitted by all communities within the State and then forwards selected applications to FEMA for an eligibility and selection determination. NCEM enters into grant agreements with the local community after FEMA approval and ensures that all community recipients are aware of their grant management responsibilities.

FMA is a cost-share program in which FEMA may contribute from 75 to 100 percent of the total eligible costs. Any required match must be provided by a non-federal source. If a match is required, no more than one half of the match may be provided as an in-kind contribution from a third party.

Project grants are available for projects that reduce the risk of flood damage to structures insurable under the NFIP. Such activities include:

- elevation of insured structures.
- acquisition of insured structures and real property.
- relocation or demolition of insured structures.
- dry floodproofing of insured structures.
- minor, localized structural projects that are not fundable by state or federal programs.

Before a community or county can be considered for FMA Project Grant, it must meet the threshold criteria as determined by FEMA and the State of North Carolina.

To be eligible, a project must, at a minimum, meet the following:

- Be cost effective.
- Be cost beneficial to the National Flood Insurance Fund.
- Be technically feasible.
- Be physically located in a participating NFIP community or must reduce future flood damages in an NFIP community.
- Conform with the State's Flood Mitigation Plan.
- Does not encourage development in Special Flood Hazard Areas.
- Communities with mapped flood hazard areas that wish to submit a project for review must participate in good standing with the National Flood Insurance Program.
- Address a property currently covered by an in-force NFIP Policy
- The proposed project must conform to the community's comprehensive plan, Flood Mitigation Plan, or Community Rating System Plan where such plans exist.
- The project must conform to all Federal, State, and local regulations, including National Flood Insurance Program regulations, NC Coastal Area Management Act (CAMA) regulations, building codes, and local plans and ordinances. In addition, the community must enforce applicable regulations.

This funding stream remains valid as of this plan update, December 2017.

The Pre-Disaster Mitigation (PDM) Program

DMA 2000 established a national program for pre-disaster hazard mitigation (PDM) to reduce disaster losses through pre-disaster mitigation planning and pre-identified cost-effective mitigation. The PDM program, part of the HMA portfolio of mitigation grant programs, makes funding available to state, local, and Indian Tribal governments to implement cost-effective hazard mitigation activities (e.g., mitigation projects or planning) that complement a comprehensive mitigation program. NCEM Mitigation staff work with local jurisdictions to identify and develop eligible projects. NCEM will continue to work directly with local governments and FEMA Region IV to submit projects for future PDM funding.

Like FMA, applicants for flood-related mitigation projects must be participating in the NFIP in good standing (if they have been identified as having special flood hazard area) and all participants must have a FEMA-approved hazard mitigation plan that recognizes the proposed mitigation measure. Successful grantees receive 75 percent federal funding toward total estimated project costs, with a 25 percent non-federal share. The non-federal share may be in cash or in the form of in-kind services. Small impoverished communities may receive federal funding of 90 percent.

The PDM applications determined to be eligible are evaluated by a National Evaluation Panel in accordance with PDM Grant Guidance and Notice of Funds Availability.

The Hazard Mitigation Grant Program (HMGP)

The Section 404-Hazard Mitigation Grant Program (HMGP) is a critical component of the state's mitigation efforts. The program was created in November 1988 through the Robert T. Stafford Disaster Relief and Emergency Assistance Act that amended the Federal Disaster Relief Act of 1974. The Hazard Mitigation and Relocation Assistance Act that amended Section 404 of the Stafford Act on December 3, 1993 to set the proportion of federal funds allotted to the HMGP at 15 percent of the federal funds spent on the Individual and Public Assistance Programs for each disaster. The Disaster Mitigation Act of 2000 (DMA 2000), which amended the Stafford Act, was enacted in 2000 to establish a national pre-disaster mitigation program as well as better control federal costs of disaster assistance through streamlining the disaster relief administration. DMA 2000 also increased HMGP funding on a sliding scale (ranging from 7.5 percent to 15 percent) based on the overall disaster assistance funding for states with a standard plan and up to 20 percent for those states with an approved State Enhanced Hazard Mitigation Plan.

The HMGP is administered by NCEM, which makes grants available to state agencies, tribal governments, and local governments and to eligible private, non-profit organizations for the implementation of long-term mitigation measures following major disaster declarations. Eligible projects must independently mitigate risks and be environmentally sound as well as cost-effective. Eligible project costs are limited to 75 percent provided in federal funds through FEMA with a 25 percent non-federal match (which may be provided by the state or local government or some share of each). In order to receive HMGP funds, a community must be participating and in good standing with the NFIP for flood-related projects and also must have a FEMA-approved hazard mitigation plan.

NCEM mitigation staff solicits, reviews, evaluates, and ranks HMGP applications when they are submitted after an eligible disaster event. Based on these evaluations and funding recommendations, NCEM coordinates with FEMA for approval. Projects typically consist of acquisition/demolition, flood retrofit, wind retrofit, education and outreach, localized flood reduction measures such as stormwater management, utility protection, NOAA weather radios, and planning. HMGP is a major funding component for implementing mitigation actions identified in State and local hazard mitigation plans.

4.3.2.2 Public Assistance Categories C-G and Individual Assistance

Public Assistance provides grants to eligible State and local governments, and certain private non-profits (PNPs), to assist with the cost of responding to and recovering from disasters. There are four building blocks of eligibility of public assistance, COST as reasonable and necessary; WORK and FACILITY which is the legal responsibility of an applicant in the damaged area as a direct result of a declared disaster whether state or federal; and APPLICANT which includes State and local government, federally recognized Indian Tribes, and certain PNPs. There are two categories of work: Emergency Work to include debris removal and emergency protective work and Permanent Work to include repair/replacement projects for roads and bridges, water control facilities, buildings and equipment, utilities, parks, and recreation. Both of these types of work have different eligibility established start times from the onset of the declaration. All requests for public assistance should be submitted within 30 days of the declaration date and must have all required documentation.

4.3.2.3 Cooperating Technical Partner

The CTP Program is an innovative approach to creating partnerships between the Federal Emergency Management Agency (FEMA) and participating NFIP communities, regional agencies, state agencies, tribes and universities that have the interest and capability to become more active participants in the FEMA flood hazard mapping program.[2] North Carolina works through this program as a Cooperating Technical State with FEMA. As a Cooperating Technical State, NCEM receives funding from FEMA to develop and update floodplain maps. These flood maps are integral for advancing hazard mitigation in North Carolina as they provide the basis for regulating areas of high hazard risk to flooding and can help local floodplain administrators make informed decisions about future growth and development. As a Cooperating Technical State, North Carolina's responsibilities regarding flood map development are a key capability as state staff are well-integrated into the process of floodplain mapping, which gives them a greater base of knowledge and insight on the implications for local governments and citizens in the state.

4.3.2.4 EMPG

The State of North Carolina has used EMPG funding to support advancing the mitigation strategy in a number of ways. One of the primary ways has been the provision of funds to support staff positions in hazard mitigation. These positions at the state level have been integral at assisting local governments in project implementation, grant management, mitigation planning, and many other tasks that are critical to promoting mitigation in the state. In terms of tangible projects, EMPG funds have been used to purchase and install

[2] *Cooperating Technical Partners Program. FEMA. Retrieved on December 20, 2017 from: https://www.fema.gov/cooperating-technical-partners-program*

stream gauges in various locations throughout the state that support the State's flood warning system (FIMAN). This system is crucial to providing advance warning of impending flood events and inundation maps for local emergency managers and planners to use to try to reduce future risk.

4.3.2.5 CAP SSSE Funding

The State of North Carolina has used Community Assistance Program – State Supportive Services Element (CAP SSSE) funding to support advancing the mitigation strategy. This program provides funding to states to provide technical assistance to communities in the National Flood Insurance Program (NFIP) and to evaluate community performance in implementing NFIP floodplain management activities. In this way, CAP-SSSE helps to:

- ensure that the flood loss reduction goals of the NFIP are met.
- build state and community floodplain management expertise and capability.
- leverage state knowledge and expertise in working with their communities.

4.3.2.6 Wildfire Mitigation Grants

The State of North Carolina has used Wildfire Mitigation Grants to support advancing the mitigation strategy in a number of ways. A primary example of this is from the United States Department of Agriculture's Forest Service Community Grant Program. Through this program, the North Carolina Forest Service received funding to develop Community Protection Plans for each of the national forests in the state. This program is carried out in conjunction with local communities and other cooperators at the local and federal level and the plans list prevention, mitigation and community projects that can be carried out to reduce risk.

4.3.2.7 Earthquake Consortia Grant

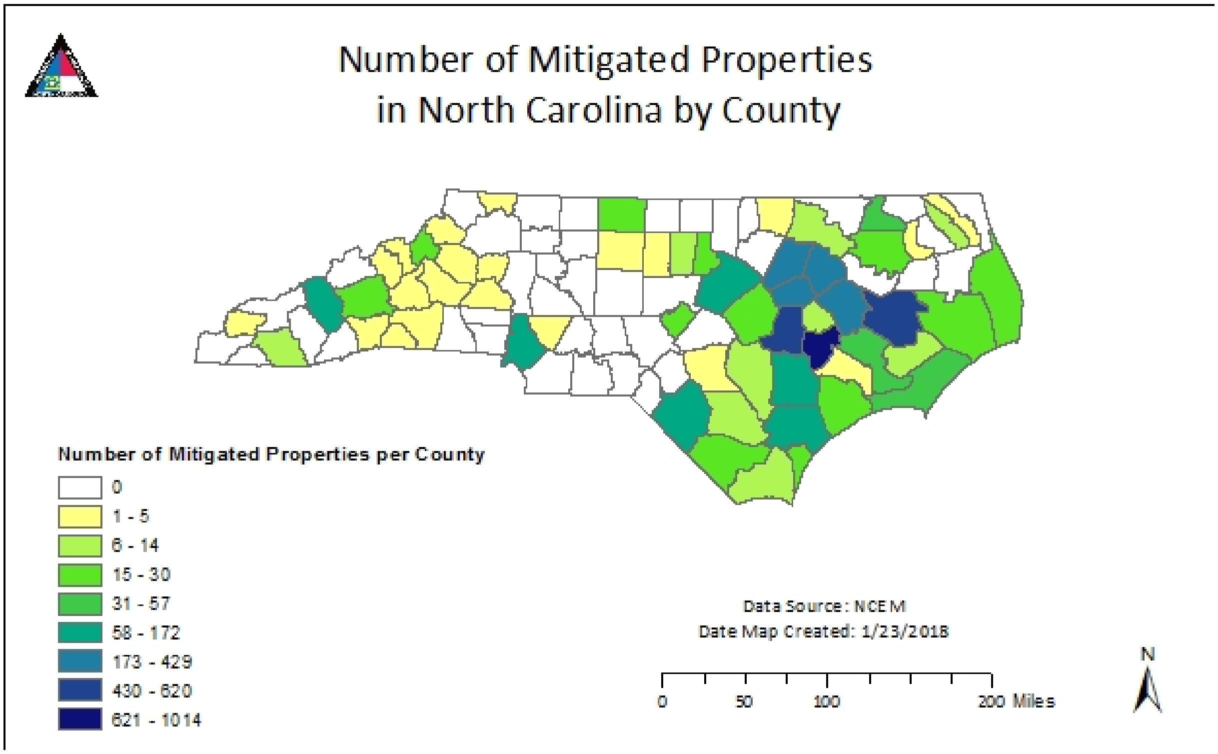
The State of North Carolina has used Earthquake Consortia Grants to support advancing the mitigation strategy. Examples include:

- Developing and demonstrating a non-structural EQ hazard and mitigation assessment
- Working in concert with the State Geologist to develop and deliver an earthquake awareness and earthquake science continuing education seminar offering continuing education credits for NC Science Teachers

4.3.2.8 Summary of Successes and Documented Losses Avoided

With over 20 years of implementing large-scale hazard mitigation projects, North Carolina has a rich history of mitigation success stories. As part of the 2018 plan update, the Hazard Mitigation Planning Branch within the North Carolina Division of Emergency Management worked to collect and establish a master list of mitigated properties in North Carolina. These properties are stored in an excel spreadsheet and have been uploaded into ArcGIS as a point layer. This point layer was then used to generate the map below. It is important to note that the properties included in the map were funded under grants that are now closed. Any projects that are funded under grants that have not been closed are not included in this map. Please find this map below which illustrates the number of mitigated properties by county.

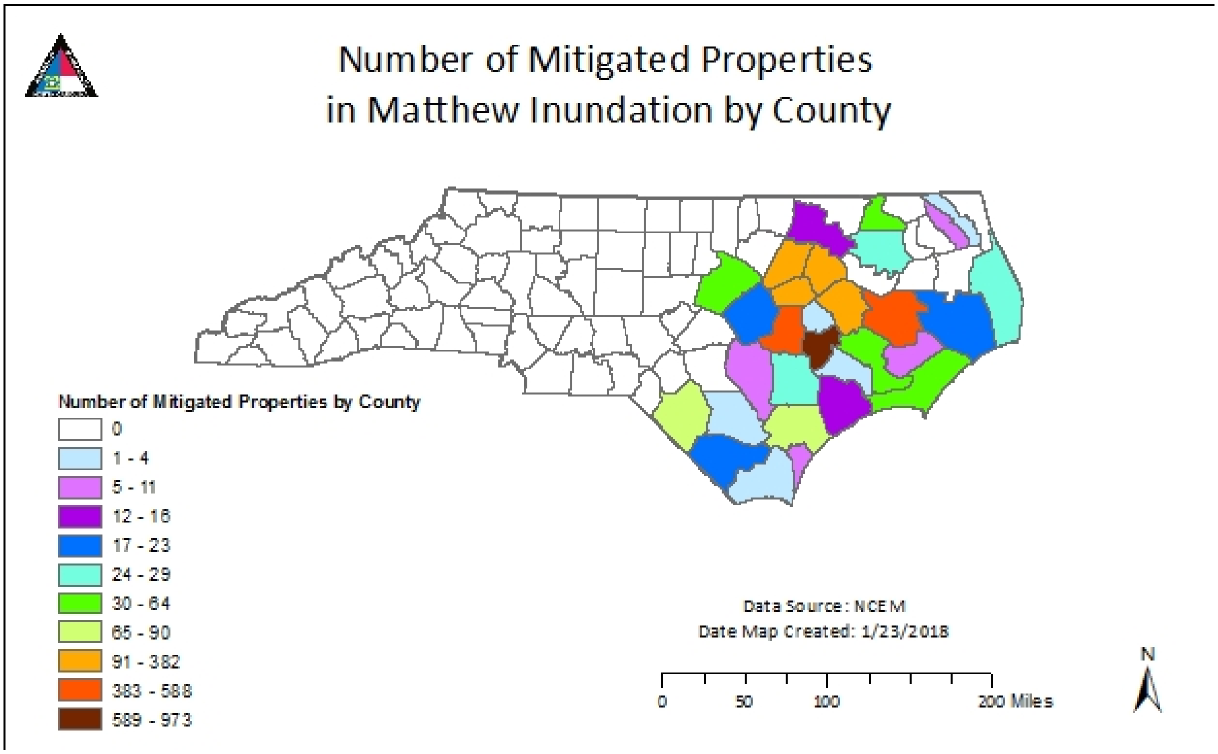
Figure 4-5 Summary Map of Mitigated Properties in North Carolina



In order to analyze the effectiveness of the Hazard Mitigation Program, NCEM conducted a "losses avoided" study and ran it against the Hurricane Matthew inundation area. In order to facilitate this process, NCEM ran an intersect in ArcGIS to see which of the properties from the previously mentioned mitigated properties layer fell within the inundation zone from the storm. Please find the map below illustrating the number of structures in which losses were avoided during Hurricane Matthew totaled by county.

In addition, NCEM HM Planning conducted a number of losses avoided assessments on individual properties as subsequent hazard impacts on the area have presented opportunities. These individual property assessments generally show a return (loss avoided) in excess of the 4:1 ratio frequently expressed in academic studies of the nationwide cost effectiveness of hazard mitigation projects.

Figure 4-6 Documented Losses Avoided from Hurricane Matthew



4.3.3 Prioritization of Mitigation Funds

Prioritizing Local Assistance for Planning Grants

As NC's local plans became due for update in 2005 and 2006, it was recognized that Federal and State grant funding for mitigation planning could be limited and, in some instances, may not be available. Therefore, it was determined at that time that approval of funds for mitigation plan updates would be based on the availability of funds and the determination as to whether the requesting jurisdiction has demonstrated the desire and ability to complete the plan update. NCEM (in conjunction with local governments) then successfully explored and implemented the option of consolidating some of the more than 120 approved and adopted local plans into regional plans based on similarities of hazard exposure, capability, and other factors. This section provides a description of the criteria by which the State prioritizes local jurisdictions to receive planning grants under the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, Pre-Disaster Mitigation (PDM) program, and other available funding programs.

In an effort to allow some flexibility in the distribution of mitigation planning funds, the following general guidelines have been developed. Unlike hazard mitigation project grants, planning grants do not require a formal Benefit-Cost Analysis prior to approval. These 11 guidelines are not all-inclusive and compliance with all of the issues listed below may not be required for approval of a planning update grant. These guidelines are not prioritized but instead will be viewed comprehensively when evaluating distribution of funding.

- NCEM/Risk Mitigation Branch will consider whether or not the community participates in the National Flood Insurance Program (NFIP).
- NCEM/Risk Mitigation Branch will consider the number of insured repetitive loss structures in the community (and actions taken to reduce the number of RL claims).
- The jurisdiction is experiencing significant growth, and development pressures may cause increases in vulnerability in undeveloped hazard areas.
- Results of the State and local risk assessment will be reviewed to determine if the level of susceptibility to natural hazards has increased in that jurisdiction.
- The jurisdiction must satisfy the criteria for the specific source of the funds.
- NCEM/Risk Mitigation Branch will consider its past experience with the community on other grants (such as disaster grants, mitigation projects, etc.).
- NCEM/Risk Mitigation Branch may contact the other State agencies/departments and/or the local regional Councils of Government (COG) to check on their past experiences with the requesting jurisdiction.
- NCEM/Risk Mitigation Branch will review previous presidential and State-declared disasters to determine the number of times the requesting jurisdiction has been impacted by declared disasters and the magnitude of damages resulting from those disasters. This review will consider impact on community infrastructure as well as families and businesses.
- NCEM/Risk Mitigation Branch will consider the community's status as a small-impoverished community and communities with special developmental pressures if applicable.
- NCEM will consider whether or not the jurisdiction has demonstrated the ability to form effective public-private natural disaster hazard mitigation partnerships.
- Jurisdictions willing to serve as the nexus for creation/consolidation of regional plans will receive priority for award of 7% planning funds set aside in the HMGP program.

Prioritizing Local Assistance for Project Grants

At the time of the 2018 update, nearly 100 percent of jurisdictions in the state have approved and adopted mitigation plans. As a result, nearly every jurisdiction is eligible to apply for and, ultimately, receive federal/state dollars to implement mitigation projects. Therefore, the state has had to implement a process for the prioritization of these dollars and it has been an extremely successful process that will continue to be implemented in the future as disasters affect the state.

NCEM's Hazard Mitigation Branch currently participates in all UHMA programs—the disaster-based HMGP as well as the non-disaster based PDM and FMA programs. From Hurricanes Fran through Ophelia (2005), the majority of UHMA funding was made up of the HMGP. As the Branch completed projects in these disasters in the years that followed, the large majority of funding between FY08 and FY11 switched to non-disaster grant funding streams as well as small disasters including Tropical Storm Hanna, the 2008 Winter Storm, and Tropical Storm Nicole. This included the start of the RFC and SRL FEMA funding streams in FY08. In 2011, North Carolina received two major disaster declarations—the April 2011 tornadoes and Hurricane Irene. With these funding streams, NCEM's funding emphasis has once again started coming primarily through the HMGP program. This has more or less continued with several other federally declared disasters in the last 5 years including severe storms and flooding in 2013, severe winter weather in 2014, and perhaps most notably, Hurricane Matthew in 2016. Table 4-1 shows the UHMA funding sources that have been used since the last plan update was approved in 2013,

Table 4-1 Summary Table of UHMA Funding in North Carolina Since 2013

Program	Year	Number of Projects	Amount Obligated ($)	Amount Expended to Date ($)
PDM	2013	4	$190,633.32	$178,144.72
PDM	2014	9	$656,522.91	$506,900.15
PDM	2015	7	$824,679.05	$313,975.93
PDM	2016	Not reported	Not Reported	Not reported
FMA	2013	6	$4,344,696.40	$2,757,710.09
FMA	2014	9	$10,187,670.56	$5,219,283.16
FMA	2015	14	$5,151,830.47	$0
FMA	2016	14	$4,237,686.42	$0
HMGP 4146	2013	3	$1,150,774.00	$125,000.00
HMGP 4153	2013	4	$579,806.00	$500,483.91
HMGP 4167	2014	13	$6,457,245.00	$1,122,995.06

To begin the process of prioritization, outreach is conducted through a Letter of Interest process with local governments. The Letter of Interest is essentially a Request for Proposals from local governments citing requested project types and identifying the properties or projects requesting mitigation. The LOI process is supported through field visits, Mitigation Opportunities Assessments, and public outreach meetings. The LOI, an official document signed by the local government, is the basis for conducting Benefit Cost Analysis, prioritization and other activities related to project development.

From 2007-2017 (project development for non-disaster funding streams and small disasters), the HM Branch also used a Letter of Interest process. For the SRL and RFC programs, NCEM aggressively targeted Repetitive Loss and Severe Repetitive Loss properties based upon the Rep Loss (RL) and Greatest Savings to the Fund (GSTF) lists provided by FEMA.

During the 2010-2013 period, the Mitigation Branch pursued intensive outreach to communities through the SRL and RFC programs. This included field visits, face-to-face meetings, public meetings, letters, and phone calls to discuss properties on the RL and GSTF lists. Despite a concentrated effort to address over 200 SRL properties statewide, only a small fraction of these projects ended up being cost effective—even with the GSTF methodology. During this time Benefit Cost Ratio was the ultimate driver of project development, rather than number of repetitive flood claims. While Repetitive Loss factored into project prioritization and dictated NCEM's participation in the FMA, RFC, and SRL programs, it was the benefit cost ratio of all structures which was the biggest driver, not the end number of claims. This made it extremely difficult for the state to implement these programs.

Therefore, during the 2010-2013 period (DR-1969, DR-4019, and non-disaster programs), the balance of the work flow shifted back to the HMGP, with non-disaster grant programs “filling in the gaps” of other program types (i.e., NC will only pursue tornado safe rooms under the PDM program) or “overflows” of cost effective properties, should the HMGP funding streams run out of funding. For the HMGP, please note that, per the 404 Admin Plan for Hurricane Irene, priority for mitigation is framed in terms of repetitive loss among the six cascading priorities for residential acquisition and elevation (Hurricane Irene 404 Admin Plan, p. 13, “Priorities.”)

In the 2013-2017 period, there has been a continual use of Benefit-Cost Analysis when evaluating projects at the state level. However, in August of 2013, FEMA issued guidance allowing for projects to forego the standard BCA rules for project eligibility if they met certain criteria. Namely, that if a structure could be acquired for less than $275,000 or elevated for less than $175,000, the BCA requirement on that property would be waived. That is to say, the structure would not have to exceed a BCR of 1.0 in order to be eligible. This has had a major impact in that meeting BCA is no longer the greatest hurdle to implementing projects. This has opened up many more properties to eligibility under the UHMA programs, which has caused a different sort of challenge. Because so many more structures are eligible under these new rules, there have been more properties than funding available to carry out these buyouts and elevations. As such, the greatest challenge changed from meeting BCA to lack of funding availability.

One additional factor that has recently played a part in project prioritization is based on the state’s recent experiences in Hurricane Irene and Hurricane Matthew. In the aftermath of these events, many homeowners whose homes were destroyed by these hurricanes were forced into temporary housing after the storms. After Irene, many took up residence in FEMA’s Temporary Housing Units (THUs) located on their own property, while after Matthew many had to relocate to other forms of temporary or transitional housing. Staff at NCEM recognized that if properties owned by these affected homeowners were eventually going to be bought out through the voluntary acquisition program, it would make sense to implement this buyout as quickly as possible to reduce the time citizens would have to spend in temporary housing and the cost the federal government would incur from paying for temporary living space. Since acquisition of high risk properties is one of the Mitigation Branch’s highest priorities, the strategy of acquiring these properties was given additional emphasis and a high prioritization in the wake of these events.

Another notable addition to the prioritization criteria came from the federal level where FEMA’s evaluation criteria during the FY17 cycle was, among other changes, much less focused on acquisition, elevation, and reconstruction projects than in past years. FEMA’s criteria in this funding cycle tended to emphasize prioritizing stormwater projects under FMA and non-flood related projects under PDM. These changes caused NCEM to evaluate projects that were submitted through its Letter of Interest process in a new light and adjust its submission package to these competitive programs accordingly.

4.3.3.1 Repetitive Loss and Severe Repetitive Loss Properties Prioritization

Analysis of the repetitive loss communities and properties with the greatest financial losses will be utilized to identify and prioritize areas for mitigation projects. Eighty-eight (88) counties in the state have repetitive loss properties and are regularly identified during funding cycles to assist with the prioritization of areas for mitigation projects. Project Managers on the Grants team will work closely with these communities to determine the potential for project development. SRL program and individual project development criteria will adhere to the SRL guidance released by FEMA on October 1, 2017, or as amended.

Areas identified as high priority are selected based in part on whether there are repetitive or severe repetitive loss properties in the area. The Repetitive Loss Mitigation Strategy for North Carolina is geared to encourage local communities to prioritize mitigation of Repetitive Loss and Severe Repetitive Loss properties and remove the financial strain imposed upon the National Flood Insurance Program (NFIP) for claims that compensate homeowners who have suffered repeatedly from flood losses.

The North Carolina Repetitive Loss and Severe Repetitive Loss strategy meets the directives of the US Congress as outlined in the Federal Register and reflects FEMA's guidelines for the RL and SRL programs. The RL/SRL strategy for the state is as follows:

- The state will include the presence of severe repetitive loss structures and repetitive loss structures and the extent to which they are mitigated as an evaluation criterion in the review process for applications for disaster and other hazard related assistance. Localities will be encouraged to include these properties in their proposals and applications.
- The state will require that local mitigation plan update identify severe repetitive loss properties and repetitive loss properties and include appropriate mitigation actions.
- The state will require that local mitigation plan updates identify undeveloped areas in the floodplain and appropriate mitigation actions to help avoid repetitive losses in the future.
- The state will require that each local mitigation plan update consider mitigation actions such as prevention, property protection, and natural resource protection to address existing repetitive loss properties. These actions will assist with avoiding recurring losses from natural hazards in the future.

Project Eligibility

NCEM will review any eligible project proposal that demonstrates cost-effectiveness in the mitigation of RL or SRL properties with an emphasis on the following:

- RL or SRL identified properties with the greatest dollar value of claims.
- RL or SRL identified properties with the greatest number of claims.

- All properties evaluated for a proposed project will be ranked from highest to lowest based on the FEMA Benefit-Cost Analysis (BCA) module. Cost effective properties with the highest Benefit Cost Ratio (BCR) will become priority projects.
- Acquisition (includes the worst of the worst residential properties) (requires a high benefit to cost ratio).
- Relocation (residential properties) (requires a high benefit to cost ratio).
- Elevation (residential properties) (requires a high benefit to cost ratio).
- Mitigation reconstruction (if traditional elevation cannot be implemented).
- Minor physical localized flood reduction projects (requires a high benefit to cost ratio).
- Dry Flood proofing (commercial or historic properties only) (requires a high benefit to cost ratio).

Project Selection Criteria

The State's priorities are a major consideration in the selection of projects for funding. Projects will be selected according to how well they satisfy all FEMA eligibility criteria and their support of the NCHMP RL and SRL mitigation strategy.

- Upon receipt of Notice of Funds Availability, NCEM will forward the notice to local governments with an overview of funding criteria and priorities and will also offer to provide, upon receipt of written request from the jurisdiction, a copy of the most recent NFIP RL and SRL information. NCEM has access to RL and SRL information via Bureau Net, and generally twice per year requests a spreadsheet containing all RL and SRL data for NC from FEMA.
- The Hazard Mitigation Branch, which is responsible for project development, will work closely with the community to develop a RL and SRL Plan of Action to prioritize and mitigate the most vulnerable structures.
- The selection of a priority RL or SRL property will be determined by ranking the houses/structures in the state based on the greatest losses and claims to the NFIP. Cost effective properties with the highest Benefit Cost Ratio (BCR) will become priority projects. Mitigation action type (Acquisition, Elevation, etc.) will also play a role in the ranking process.
- The RL and SRL program will include eligible priority projects for Elevation, Acquisition, and Relocation and Retrofitting of facilities.
- RL and SRL properties identified in the priority ranking may be identified for funding from several NCEM-administered disaster and non-disaster programs. The HMGP, PDM, and FMA programs are potential funding sources to mitigate flood hazard properties. In general, NCEM will determine which project requests get submitted to which funding stream based on programmatic and state priorities.
- Other programs that provide funding for mitigation activities include:
  - 406 mitigation under FEMA's Public Assistance program.
  - HUD Disaster Assistance grants, including CDBG-DR.
  - SBA Loans following disaster declarations.
  - local government incentives.

- homeowner insurance-based products to include ICC funds that are administered at the local level.

NCEM provides technical assistance to ensure the structures that are substantially damaged and are in the Special Flood Hazard Area are repaired in accordance with current NFIP regulations.

4.4 LOCAL AND TRIBAL MITIGATION CAPABILITIES

4.4.1 Summary and Evaluation of Local and Tribal Mitigation Capabilities

Governments In North Carolina: Building Capacity

Building the capacity of local governments to mitigate the impacts of natural hazards is a major focus of North Carolina's goal to reduce vulnerability. This is critical in the state given the fact that there is no statewide land use, growth management, or development planning, nor is planning mandated at the local level (with the notable exception of local governments in the coastal zone where County-level CAMA Plans including a Land Use Plan are required). Decisions of where to locate infrastructure, when and where to allow subdivisions to occur, and even whether or not to enact zoning and other land use regulations are largely left to the discretion of local government in North Carolina. These are fundamental decisions that can profoundly impact a community's level of risk.

For purposes of the State Hazard Mitigation Plan, the term "local government" refers to those legal subdivisions of the state that are defined by political boundaries. There are 100 counties and approximately 640 incorporated jurisdictions in North Carolina. North Carolina is home to eight Native American tribes located throughout the State, although only one—the Eastern Band of the Cherokee Indians—is federally recognized as a Sovereign Indian Nation at this time. North Carolina also has 18 active Councils of Government (COGs) that were established by the NC General Assembly in 1972 as voluntary organizations of county and municipal governments within a region. Although the COGs have no regulatory powers, they provide many valuable services to the communities in their region.

While North Carolina remains committed to maintaining the independence of local governments to manage their own affairs, North Carolina is not a "Home Rule" state. Instead, North Carolina follows "Dillon's Rule," whereby local governments are only allowed to exercise powers that have been expressly granted to them in the state constitution or by other state laws. This means that in order to enact any type of regulation that is not among the usual panoply of powers granted by the State, a local government must petition for special dispensation from the General Assembly.

Many local governments in North Carolina are exceedingly proactive when it comes to planning to mitigate the impacts of natural hazards. Largely through the Hazard Mitigation Planning Initiative (HMPI) conducted by NCEM, local communities throughout the State have embraced the principles of mitigation to reduce losses and increase resiliency to natural hazards.

While the State provides ample guidance and technical assistance to prepare hazard mitigation plans, each community is encouraged to write and implement a plan that is locally tailored and meets the specific hazard conditions and mitigation needs and capabilities of that locality. NCEM recognizes that there is no one-size-fits-all solution to every community's hazard exposure. The state has a wide variety of communities in terms of demographics, topography, climate, economics, natural resources, hazard exposure, and political and cultural milieu. North Carolina has large affluent metropolitan areas that are experiencing growing pains and unchecked sprawl. There are also isolated rural communities whose agricultural or manufacturing economic base is declining and whose populations are shrinking. There are mountain communities that must deal with the constraints of a steep terrain and coastal communities that experience frequent violent storms. Some communities are progressive and promote a liberal agenda, while others are more conservative and espouse traditional values related to zoning and land use planning. Some local governments aggressively regulate land uses within their jurisdiction, and others vehemently oppose government interference with private property rights. While this diversity contributes to the richness of the State's social fabric, it also means that HMPI coordinators must tailor their approach to help all communities meet their individual mitigation needs.

Fiscal Capability

Because each community is so unique, it is impossible to make accurate generalizations about the fiscal capability of local governments in North Carolina to carry out mitigation objectives. Financial resources and technical resources are critical for planning and implementing most mitigation projects. Large metropolitan areas such as Charlotte-Mecklenburg (the largest urban area in the State), the Raleigh-Durham-Chapel Hill Triangle area, and the Winston Salem-Greensboro-High Point Triad have sizable resources and a vast array of technical and financial opportunities. These areas also have a larger and typically more affluent tax base. Many of the larger coastal communities also demonstrate highly functional planning, funding and implementation capabilities. At the other extreme, many smaller rural communities in North Carolina have very limited fiscal and personnel resources that reduce the ability to engage in complex hazard mitigation activities without significant assistance from the State and Federal government.

The North Carolina Department of Commerce classifies all 100 counties in the state into one of three tiers, with Tier 1 representing the most economically disadvantaged and Tier 3 the most prosperous. Tiers 1, 2, and 3 may be deemed "distressed" based on various economic and demographic characteristics. Counties that are designated as distressed gain easier access to certain funds from the federal and State governments and waivers of some of the local matching fund requirements that accompany many federal and State grants. For counties that fall outside the lower tiers, but which nonetheless are struggling to meet service needs, fiscal capability is often quite limited.

Local elected officials must balance many competing interests when allocating limited local resources. Highly visible problems, such as roads, schools, housing, and health services, often grab the immediate attention of constituents. Many communities in North Carolina, like the rest of the nation, are currently experiencing an economic downturn and relatively high unemployment, factors which strain local government coffers as the need for government services increases. However, many local governing boards throughout North Carolina have come to realize that money invested in hazard mitigation activities can save millions of dollars in property damage by reducing losses from inevitable natural hazards. Keeping businesses open, residents in their homes, and basic services operating following an emergency results in economic security and social stability for local communities. Residents in many North Carolina localities have seen the devastation that can occur from hurricanes and hurricane-related flooding first hand as well as from other natural hazards, including severe winter storms, drought, forest fires, flash flooding, and other recurring hazards. Because of their experiences, many North Carolinians have learned that mitigation efforts can help prevent future devastation.

State and Federal aid is a large part of many local governments' revenue stream, especially at the county level. Grants and other aid programs help local governments meet specific needs, including disaster recovery and hazard mitigation. Usually, conditions are attached to grants. For example, North Carolina requires that all local governments with identified flood hazards must participate in the National Flood Insurance Program (NFIP) in order to receive Hazard Mitigation Grant Program (HMGP) funds for flood related projects.

Many government grant programs require a nonfederal match in order to receive the funds. This is true of many hazard mitigation grants. Local, state or any non-federal funds can be used to meet the match. Community Development Block Grant (CDBG) funds can also be applied as a match (CDBG funds, although they are issued by the U.S. Department of Commerce, lose their federal status when allocated to the state level).

Local government applicants can also meet the nonfederal match with in-kind contributions instead of cash outlays. In-kind resources can be labor or salaries paid to staff to carry out the approved mitigation activities of the grant recipient (including project managers, attorneys, appraisers, planners, engineers, public works crews, etc). In-kind contributions from third parties can constitute some of the nonfederal share and may include donated services, supplies, equipment, and space in buildings. Communities have quite a bit of leeway in developing sources of in-kind matches. The State Hazard Mitigation Branch encourages local governments to incorporate specific mitigation actions into their Hazard Mitigation Plans.

While outside sources of funding pay for the bulk of many current local mitigation programs and projects in North Carolina—especially expensive large-scale projects such as massive buy-outs of flood-prone properties—many creative local governments are becoming more self-reliant when it comes to financing mitigation activities. As described more fully later in this section, some of the powers and authorities that enhance the fiscal capability of many North Carolina jurisdictions include:

- capital improvement funding (including withholding spending in hazard-prone areas).
- authority to levy taxes and special assessments.
- fees for utilities (water, sewer, gas, electricity).
- stormwater management fees
- impact fees for homebuyers or developers of new housing subdivisions.
- incurring debt through general obligation bonds or other bonds.
- regulatory fees.

Some of the most effective mitigation strategies may require no additional money at all, just a shift in thinking. There are many practical activities that can improve community resilience to natural hazards, including mitigation policies and retrofitting programs that local governments can initiate without the benefit of state or federal aid. There are also many useful budgeting practices for leveraging local mitigation funding to avoid losses attributable to non-action.

A large part of creating and updating a plan is process-oriented. When the state has been advising local governments on updating their plans, there has been a focus on process improvement. If there are many stakeholders from different departments involved in the plan update (the process of updating the plan), hazard mitigation strategies can be better integrated into other planning and regulatory mechanisms, such as Capital Improvement Plans and Land Use Plans.

Technical Capability

In order to develop mitigation plans and to carry out mitigation activities, local governments must have adequate technical capability, including competent personnel and administrative support. As with other types of capability, there is a wide range of technical ability throughout North Carolina. Some urban areas have very large planning departments and have the staff, budget, and equipment to engage in sophisticated growth management, floodplain regulation, stormwater management, and comprehensive planning. Other communities have less experience with land use regulation and development management and take a more laissez faire approach to land use. Coastal counties have been required by the North Carolina Coastal Area Management Act to engage in planning for over forty years, and most coastal counties have institutionalized the concept of land use planning to a degree that otherwise might not have occurred.

Most local communities in North Carolina, except the very smallest of villages or unincorporated areas, do have a planning department, with staffs educated in land development and land management practices. There is a wide range in the level of expertise of professionals trained in engineering and construction practices related to buildings and infrastructure. In some rural areas, several jurisdictions may share personnel to fulfill roles of building inspectors, engineers, and planners; these positions are often filled at the county level. Regional Councils of Government often assist local governments with planning issues and grants writing and management (see discussion on COGs below). All counties in North

Carolina are required to have an Emergency Management Office, which have been the point of central contact for the State's Hazard Mitigation Planning Initiative.

Technological Capability

The technological capability of local governments in North Carolina to predict, analyze, map, and mitigate against natural hazards also varies widely throughout the state. The majority of local communities have digital systems, primary and secondary phone systems, and access to the Internet, although this is by no means universal.

In many areas of rural North Carolina there is less computer use and internet connectivity than in some of the more urban areas. The kind of infrastructure necessary for widespread technological growth and development has been lacking in rural areas. As with other utilities and services, rural areas are often the last to be served because of the higher price of doing business. However, great efforts have been made to increase access, and this increase throughout North Carolina is beginning to greatly enhance the technological capacity of local governments to engage in more sophisticated hazard analysis and mitigation planning.

Among local governments that have computerized systems, many also make use of geographic information systems (GIS), although these systems may not always be devoted to planning or regulatory purposes. For instance, many 911 emergency contact services and county tax information may be contained in a GIS system, but other local departments and services within that same jurisdiction may not have access to the data or a means of using it for other applications.

While some rural communities are still coming up to speed and lack comprehensive GIS capability, many other jurisdictions in North Carolina are using GIS as a tool for managing natural hazards. This is important because the more information concerning hazard analysis that becomes available, the greater the capability of local governments to guide development in a way that minimizes the threats to people and property. NCEM will continue to update and promote tools available through the Risk Management section such as the Integrated Hazard Risk Management and Communications tool. This tool will provide risk assessments for local and state governments and will help to identify potentially cost-effective mitigation measures. The communications tool will be an invaluable asset for plan updates because it will provide a number of ways to analyze and display information on hazard risks.

State Support for Local Plan Development and Implementation

This section details a few of the support programs that the State of North Carolina has made available to local governments to assist them in preparing a local Hazard Mitigation Plan that will meet the planning criteria set by FEMA and NCEM. Many of the same support mechanisms are available for plan implementation. Local governments are highly encouraged to seek out additional resources (monetary and otherwise) to augment the support made available by the State. The State also encourages local governments to look to existing sources of revenue, including annual budget reviews, to identify surpluses that can be directed to either one-time or ongoing mitigation activities.

Prioritizing Local Assistance

It is the policy of the State of North Carolina to assist as many local governments as possible to prepare and implement high quality mitigation plans. NCEM has advertised the planning requirements, plan criteria, funding availability, and the State deadline for plan completion through a variety of means, including posting the information on the NCEM website; by direct mailings to local government planners, managers, emergency management personnel, and local government elected officials; professional associations, and during HMPI workshops.

The League of Municipalities, the North Carolina Association of County Commissioners, the North Carolina Association of Emergency Managers, and the North Carolina Chapter of the American Planning Association have also disseminated information on behalf of the Division to their respective members and clientele. Division leaders are confident that that all eligible local governments have been made aware of the availability of funding and other assistance for plan development.

4.4.2 Effectiveness of Local Mitigation Capabilities

North Carolina demonstrates a wide disparity in local capabilities across the State. Typically, jurisdictions with the largest populations and revenues have the most capabilities. In contrast to the larger cities and counties, some county and municipal jurisdictions in North Carolina have rural populations and very limited revenue resources. Consequently, capabilities in rural counties are typically very low, but there are some notable exceptions. Many rural North Carolina towns have little or declining growth and might have a staff of two or three housed in a small town hall, with no plans, building codes, zoning, or other regulatory means to implement mitigation measures. These small communities depend on support from their county governments, which generally have greater means to lend support to local government in pursuit of hazard mitigation.

The overall state of local capabilities in North Carolina points to the need for a strong State program to support and increase the capabilities of rural communities and sustain and strengthen the capabilities of larger jurisdictions. NCEM fully recognizes these needs for continuing mitigation planning support and has been actively taking steps to expand its technical support and work with local governments to identify funding opportunities. The State intends to increase support for localities to receive professional planning and engineering services for hazard mitigation. This can be accomplished through continuing coordination with county EMAs and working to obtain planning funds (e.g., PDM, CDBG, HMGP, etc) available to improve and expand local mitigation activities. As part of the State's Enhanced Plan initiatives, technical and funding support programs will be examined and new programs will be developed to improve local capabilities among all levels and types of jurisdictions throughout the State.

Table 4-2 provides a summary of the various capabilities that local governments can utilize to implement mitigation techniques. The table provides descriptions of capabilities in the categories of regulatory powers, land use regulations, taxation, spending, and services and planning. Following each capability description is a brief discussion on the effectiveness of the capability for local governments in North Carolina. Finally, there is an indication of whether or not the capability is helpful in facilitating reduction of repetitive loss and severe repetitive loss properties.

Table 4-2 Summary Table of Local Capabilities including Descriptions and Evaluation of Effectiveness

Category: **Regulatory Powers**		
Local Capability	**General Police Power**	
Description	Because local governments have broad regulatory powers, statutes allow police power to enact and enforce ordinances to structure public health, safety, and welfare. Ordinances are adopted and regulated to ensure that counties are creatures of Legislature. This legislation must be up to par with State rules.	
Effectiveness	In North Carolina, the ultimate authority in all regulation is the NC General Assembly, which has the power to strip zoning and other local regulatory powers from local governments if necessary.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Building Code Enforcement and Building Inspection**	
Description	Building codes ensure that buildings and facilities are resilient to impacts from natural hazards. Strict adherence to these codes, along with proper and regular inspections, creates safer buildings that save lives and properties during disasters.	
Effectiveness	North Carolina generally adheres to state building codes; however, some counties are known to be less rigorous in carrying out routine inspections. Until recently, a partnership in NC called Project Blue Sky created one of the first model homes to research hurricane-resilient construction practices and promoted voluntary standards that exceeded code specifications in Southern Shores. In some towns, such as Nags Head on the Outer Banks, have building moratoria that are activated following a disaster.	
Helps Facilitate Reduction of RL and SRL Properties?		✓

Category: **Land Use Regulations**		
Local Capability	**Land Use Regulations**	
Description	The State grants local governments regulatory powers, which serve as the most basic manner in controlling land use. Local governments regulate the use of property to protect the physical environment, to encourage economic development, and to protect the public's health and safety.	
Effectiveness	While land controls are not required by the State, two-third of all counties have some sort of policy in motion.	
Helps Facilitate Reduction of RL and SRL Properties?		✓
Local Capability	**Zoning**	
Description	Zoning is the traditional method of controlling land use that includes type of use, as well as minimum specifications for use. Zoning can be used to keep inappropriate building out of hazard-prone areas, to control construction, and to designate certain areas for low-intensity use.	
Effectiveness	All of North Carolina's larger cities and towns have zoning regulations that the city council has adopted by ordinance, and 80 counties have implemented at least partial zoning, making zoning an effective hazard mitigation strategy in the state.	
Helps Facilitate Reduction of RL and SRL Properties?		✓
Local Capability	**Flood Hazard Regulation**	
Description	The Flood Hazard Prevention Act authorizes local governments to prohibit landfills, hazardous waste and chemical storage facilities, and junkyards in the 100-year floodplain.	

	This process relies heavily on up-to-date floodplain mapping, which is being updated by the NC Flood Mapping Program.	
Effectiveness	Many local governments in North Carolina have stringent flood damage prevention ordinances. However, regulating flood hazard areas is dependent on precise mapping, which is not as readily available or up-to-date in some of the smaller rural communities.	
Helps Facilitate Reduction of RL and SRL Properties?		✓
Local Capability	**Subdivision Regulation**	
Description	Subdivision regulation intends to prevent developing land that cannot support development to ensure adequate streets and drainage. They typically contain standards for stormwater management and erosion control.	
Effectiveness	About two thirds of North Carolina counties have enacted subdivision regulations, especially in more conservative areas of the state.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Stormwater Management**	
Description	The National Pollutant Discharge Elimination System Program was established in 1972 to regulate stormwater management practices. Ordinances regulate existing development, future developments, and construction activities to prevent careless pollution of surface waters.	
Effectiveness	In North Carolina, there are six Phase 1 communities that require permit coverage for municipalities that have populations of 100,000 or more. Obtaining this permit has shown to be costly and challenging.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Acquisition**	
Description	Often the most effective method of “hazard proofing” property is for the government to acquire the land to eliminate or reduce inappropriate development. These projects consist of purchasing a home from the owner, demolishing or removing the structure, and reverting the land back to an open or non-intensive use area.	
Effectiveness	In North Carolina, the use of eminent domain is infrequently used for acquisition of hazard-prone areas. After many severe hurricanes, many communities have made use of Hazard Mitigation Grant Program funds for major buyouts in flooded areas. Local NC governments have also used Pre-Disaster Mitigation program funds from FEMA to acquire hazard-prone property. NCEM monitors the reuse of acquired property to ensure that the space remains undeveloped once the land is taken over by local governments. NC acquisition projects have been considered model projects and have accomplished the goal of removing thousands of peoples and buildings out of harm’s way.	
Helps Facilitate Reduction of RL and SRL Properties?		✓

Category: **Taxation**		
Local Capability	**Taxation**	
Description	Taxation extends beyond the mere collection of revenue and can give government power to influence which lands are affordable, while providing disincentives for developing on hazardous lands. Tax abatements can also encourage landowners to integrate proper mitigation measures into new developments.	
Effectiveness		
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Property Tax**	
Description	Property taxes are often the largest single source of revenue for local governments and are based on property value assessments. Preferential taxation can be used for mitigation purposes to reduce development on hazardous areas. There are some restrictions on the use of property tax funds.	

Effectiveness	In North Carolina, more than 95% of all property owners pay their taxes, making property taxes an effective way of generating local revenue. Because of the state's agricultural capabilities, North Carolina allows preferential taxation of farm and forestland. Historic properties are also eligible for preferred tax rates.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Land Transfer Tax**	
Description	Transfer taxes are assessed against sellers of land devoted to certain designated uses. They can discourage conversion to higher density, slow rapid growth rates, and discourage speculation, but may be ineffective in long term protection.	
Effectiveness	A few local governments in North Carolina have the authority to impose transfer taxes as determined by a local act passed by the General Assembly. This tax has potential to be effective in acquiring open space and preventing development in high-hazard areas.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Occupancy Taxes**	
Description	Some local governments are authorized to levy taxes on hotel and motel room occupancies. Most often, these proceeds are used only for tourist or visitor-related purposes, such as in coastal communities.	
Effectiveness	In North Carolina, issues of adequate protection of tourist visitors, including dissemination of public information concerning hurricane awareness, issuance of storm warnings, and evacuation can be addressed with funds derived from occupancy taxes.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Gas Tax (Powell Bill)**	
Description	NC has a separate tax on the sale of gasoline. Part of this tax, called Powell Bill Funds, can be used to construct or maintain city streets in municipalities.	
Effectiveness	Since its beginning in 1951, the Powell Bill has allocated $4,372,331,765[3] to 508 municipalities in North Carolina.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**User Fee**	
Description	Local governments can charge user fees to use services, such as public water and sewer systems, or trash collection. After property taxes, this is the largest source of local government revenue.	
Effectiveness	The City of Charlotte has raised millions of dollars for mitigation purposes by charging a stormwater management fee on local residents. This has been effective in enabling the city to afford GIS applications and state-of-the-art flood damage reduction strategies.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Special Assessments**	
Description	Assessments may be levied against owners who directly benefit from a specific public improvement, which shifts financial burden for improvement of the general public to those who directly benefit. Examples include improving water and sewer systems, streets, watersheds, and water resource projects.	
Effectiveness	Assessments may be used in temporary projects to raise revenue for specific improvements, to fund indefinite projects. Charges may or may not discourage development in the assessment district, but they do transfer some cost of living or doing business in a hazard-prone area to those who chose to do so.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Impact Fees**	
Description	Impact fees require new developments to share in the financial burden that their arrival imposes on a community. They are usually a one-time charge and can be linked to environmental impact analyses.	

[3] *https://connect.ncdot.gov/municipalities/State-Street-Aid/Powell%20Bill/2017%20State%20Street-Aid%20to%20Municipalities%20October.pdf*

Effectiveness	Studies have shown that communities prefer to insure against losses than to assess hazard-prone impact fees and pass cost of service along to developers.	
Helps Facilitate Reduction of RL and SRL Properties?		

Category: **Spending and Service**		
Local Capability	**Local Government Services**	
Description	All local governments have power to make expenditures in the public interest. County governments are responsible for providing social, public health, mental health, and emergency services. In addition to the mandated services they must provide, counties are also responsible for improving their services.	
Effectiveness	As of 2017, almost all cities and towns in North Carolina have public water and sewer systems, paved streets, and police and fire protection. In North Carolina, most services are available to all county residents, whether they live inside or outside a city or town.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Public Schools**	
Description	Public schools are both a state and local responsibility, but local entities are responsible for adopting budgets and capital costs. Major decisions regarding location and construction of schools are made at the county level, and schools often serve as shelters in the event of emergencies.	
Effectiveness	There are 114 school systems within North Carolina. Careful site selection and construction of public schools are important; after Hurricane Floyd, many schools in eastern North Carolina were closed for months due to severe flooding.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Emergency Management Services**	
Description	Each county is mandated to form a local emergency management office that is responsible for providing emergency management planning, administration, coordination, training and support for local governments. Personnel cooperate with other governmental agencies, volunteer organizations, and private sector organizations to maintain emergency management capabilities at the local level.	
Effectiveness	Local emergency management personnel attend NCEM planning workshops to increase local knowledge and coordination.	
Helps Facilitate Reduction of RL and SRL Properties?		✓
Local Capability	**Emergency Shelters**	
Description	Local governments must make facilities available to protect or reduce exposure to hazards that must be designed to withstand impacts of most types of hazards in that area. Most shelters serve another purpose during non-disaster times.	
Effectiveness	Presently, each county in North Carolina has the capacity to provide some type of mass care support and shelter 23,000 citizens. The Information and Planning branch of NCEM is conducting a three-year shelter retrofit project to develop new shelters and retrofit existing shelters.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Mutual Aid Agreement**	
Description	The NC General Assembly allows cities and towns to enter inter-local agreements. This allows one local government to offer and another receive assistance cooperatively in times of disaster. The idea behind the agreement is to efficiently provide assistance by having conditions worked out in advance.	
Effectiveness	Mutual Aid Agreement has been effective in local government coordination since Hurricane Fran struck North Carolina in September 1996. Approximately 40% of towns, cities, and counties in the state have executed the agreement, and NCEM maintains a current listing of all participating local governments.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Capital Improvement Programming**	

Description	Hazard mitigation principles can be a routine part of local government spending decisions when programmed into a time table of providing municipal services. Capital improvement plans have been used to secure hazard-prone areas for low risk uses and can effectively direct growth away from hazardous areas.	
Effectiveness	North Carolina does not prohibit local governments from providing capital improvements in hazardous areas, nor from withholding spending for infrastructure in hazardous areas.	
Helps Facilitate Reduction of RL and SRL Properties?		
Local Capability	**Economic Development**	
Description	Many counties have formed economic development commissions to improve local economies by keeping businesses in their communities. Continuing development is especially important in touristic areas.	
Effectiveness	There are more than 60 counties in North Carolina with economic development commissions. Since tourism is a big economic draw in the mountains and the coast, economic development allows local decision-makers to consider efforts to make their communities more attractive to tourists in the safest way.	
Helps Facilitate Reduction of RL and SRL Properties?		

Category: **Planning**		
Local Capability	**Land Use/Comprehensive Plans**	
Description	Land use plans serve as the basis for much of the regulation of property use. Plans prepare maps that show how various areas may be developed or used in the future, and approved plans become part of the community's Comprehensive Plan. Plans do not set regulation, but local officials can use the plans to guide decisions of future construction.	
Effectiveness	Comprehensive plans are effective as a hazard planning tool because they guide other local measures, including capital improvement plans, and zoning or subdivision ordinances. In North Carolina, all but the smallest cities and towns have land use plans and 80 Counties enforce at least partial land use restrictions.	
Helps Facilitate Reduction of RL and SRL Properties?		✓
Local Capability	**Hazard Mitigation Plans**	
Description	Local governments can create their own plans strictly regarding hazard mitigation as part of the Hazard Mitigation Planning Initiative (HMPI).	
Effectiveness	Since 1996, North Carolina has been one of the leading states of promoting and strengthening hazard mitigation planning at the local level. HMPI has provided funding, outreach, education, and training that have greatly enhanced local government capabilities.	
Helps Facilitate Reduction of RL and SRL Properties?		✓

4.4.3 Tribal Capabilities

The Eastern Band of Cherokee Indians (EBCI) is the only federally-recognized Native American tribal government in North Carolina. The EBCI participates in a regional local hazard mitigation plan called the Smoky Mountain Regional Hazard Mitigation Plan which was last updated in 2017. The EBCI's portion of that plan meets FEMA requirements for Tribal plans and includes an assessment of Tribal capabilities. Detailed information on the EBCI's capabilities can be found in that plan, but in general, the plan indicates that the EBCI has fairly extensive administrative, technical, and fiscal capabilities in place for implementing hazard mitigation. The EBCI is the only Tribal Nation to have received a direct-to-tribe Disaster Declaration (DR 4013 in March of 2013).

4.5 MITIGATION PLANNING

4.5.1 Description

Much of the impetus for the strong local hazard mitigation movement in North Carolina can be attributed to the combination of State and Federal requirements pertaining to mitigation planning. In June 2001, the North Carolina General Assembly passed Senate Bill 300 (SB 300): An Act to Amend the Laws Regarding Emergency Management as Recommended by the Legislative Disaster Response and Recovery Commission. Among other provisions, Senate Bill 300 requires that local governments have an approved hazard mitigation plan in place in order to receive State Public Assistance funding. In order to be eligible for federal mitigation assistance, local governments must have a completed, approved, and adopted hazard mitigation plan that meets the requirements of the federal Disaster Mitigation Act of 2000 (DMA 2000).

The Hazard Mitigation Planning Initiative (HMPI) started by the North Carolina Division of Emergency Management in 1996 placed North Carolina squarely on the leading edge of promoting and strengthening hazard mitigation planning at the local level. Since its inception following Hurricane Fran, and the subsequent expansion of HMPI after other declared disasters, the outreach, education, training, and funding provided through HMPI has greatly enhanced the capability of local governments throughout the state to engage in hazard mitigation planning.

Since 2005, it has been recognized by state and local personnel that the original goal of pushing plans and planning activities as far down to the community level resulted in certain inefficiencies and placed undue burdens on certain communities with smaller EM or Planning staffs or other reduced capabilities. In addition, NCEM noted that only a small percentage of the communities with mitigation plans were applying for mitigation funding through the various programs. As a result of these observations, NCEM began a concerted effort to assist with the process of rolling up many single-jurisdictional plans into county-level plans and started to explore the possibility of combining several contiguous county-level plans into regional hazard mitigation plans.

From 2005 until 2013, intense efforts have been made to begin to roll up municipal-level plans in to county-level plans and to subsequently (or simultaneously) roll up those county-level plans into regional plans that consist of multiple counties working together to develop a plan. The intent of this effort has been to allow local governments to pool their resources and develop higher quality plans that are more effective. Through the end of 2017, this effort has been very successful as 23 regional plans have been approved and adopted by local governments. There are no municipal/single jurisdiction plans remaining and only 8 county-level multi-jurisdictional plans remaining. It is likely that during the 2018-2021 update period that at least two of these county-level plans will join a contiguous regional plan during update. This effort will allow NCEM staff to focus more of its technical assistance efforts on fewer plans, thereby enhancing the quality of hazard mitigation plans.

The SHMO recognizes both the authority of local governments to create and maintain individual plans and some benefits of specialization but suggests the benefits in efficiency and uniformity in a more regional approach should not be overlooked. In all cases, the state has provided technical assistance to local governments throughout the state in a number of ways that are outlined below:

- NCEM provides mitigation planning guidebooks/publications/research information, risk assessment data, links to other mitigation partners websites, etc. on the NCEM Hazard Mitigation website. Local governments, sister State agencies, and other mitigation partners can view relevant legislation, learn about new funding options, develop Unified Hazard Mitigation Grant Program project and planning grant applications, learn how to join the National Flood Insurance Program, link to model ordinances and regulations, and much more through the mitigation pages of North Carolina Emergency Management's website.
- NCEM assists with identifying risk assessment planners and grants project managers from NCEM staff to act as the primary points of contact and providers of technical assistance for each county. Examples of technical assistance include attending local mitigation planning meetings, consultations with local staff responsible for developing the local plans, reviewing sections of plans during development and project grant applications and providing feedback, relaying information from FEMA on current interpretations and policies, identifying information sources at State and national levels, interpreting State and Federal guidelines, and distributing model ordinances and approved plans.
- NCEM provides planning grants through the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, and Flood Mitigation Assistance (FMA) program. The money that had, in the past, been targeted towards individual planning grants is now being targeted to encourage local governments to develop regional plans. HMGP Planning funding has now been prioritized as an incentive for counties and their municipalities to work together to develop regional plans. In 2016, NCEM began to pursue a strategy of serving as grantee/subgrantee on all mitigation planning grants and as such entered into a prime contract with three consulting firms that provide planning services across the state. Participants in Mitigation Planning Grants are offered a choice of which particular firm serves as their consultant, and if a firm they wish to us is not among the prime contractors, they may choose to have their consultant of record or choice enter into a sub-contractor agreement with one of the Prime firms to complete a plan update. The advantage of this approach is that it gives the state a supervisory relationship with contractors working on updates and allows the state to provide guidance and instruction directly to contractors when required.
- The Risk Mitigation Branch has a well-established working relationship with the North Carolina Division of Coastal Management, the agency that oversees development and implementation of local land use plans for the 20 coastal counties as mandated by the North Carolina Coastal Area Management Act (CAMA). These two agencies continue to work together to integrate requirements imposed by CAMA for hazard mitigation elements of the coastal land use plans with the requirements for hazard

mitigation plans imposed by the State and FEMA. Although greater integration needs to occur, these two agencies strive to ensure consistency and avoid redundancy for local hazard mitigation planning.

- The Hazard Mitigation Branch of NCEM serves as a technical advisor to the development of an Integrated Hazard Risk Management and Communications tool and the Risk Management Tool that have been previously discussed.

4.5.2 Training

Since the last plan update, NCEM has been providing outreach to communities and conducting seminars and presentations on local plan development based on the current guidance released by FEMA in October 2011. NCEM has also been conducting stand-alone seminars, providing local training sessions on request, and also participating in twice-annual meetings of the North Carolina Emergency Management Association to provide plan update seminars. All of these trainings and outreach have led to very successful local plan updates over the past five years in which most communities had few major challenges as they went through the plan update process.

4.5.3 Technical Assistance

NCEM continues to provide guidance and leadership in the quest to improve the quality and utility of state and local hazard mitigation plans and projects through participation in conferences and seminars and on FEMA workgroups and discussion panels. While many communities in NC are capable of developing, maintaining, and implementing high quality plans and projects, a number of communities are experiencing difficulties due to constraints on time and public resources. The Risk Mitigation Branch provides technical assistance to local governments with Hazard Analysis, Mitigation Opportunities Assessment, Mitigation Plan Development, Project Development, Benefit Cost Analysis, and Project Implementation as well as outreach and technical assistance for completion of local hazard mitigation plans and projects. It is an NCEM goal to continue to be an active participant in the national dialogue concerning hazard mitigation plans and projects.

4.5.4 Review of Local Plans

NCEM Risk Mitigation Planning Branch uses a database to track the status of all hazard mitigation plans in the state down to the municipal level. The Risk Mitigation Planning Branch reviews upcoming funding needs at every funding opportunity including all programs under Unified Hazard Mitigation Assistance. Due to the unpredictability of the annual UHMA programs local governments are encouraged to begin applying for funding to update their plan in years two and three of their approval status. Therefore, when plans cross the one-year mark of plan approval Risk Mitigation Planning staff begin to reach out to the local governments about funding opportunities.

Risk Mitigation Planning staff work with the local government to inform them of the preferred timeline for updating hazard mitigation plans. This is generally accomplished during training classes, EM forums, through regular emails and is also pushed down through the field staff.

The timeline used is as follows: apply for plan update funding in years two and three, six to eight months from close of the application period to receive award letters from FEMA, three to four months for the local procurement process to hire a contractor to assist in the update, twelve months to update the plan through the planning process and six months for NCEM and FEMA review period. The process is generally thirty months from the time the funding application is submitted to FEMA.

The review process for NCEM is accomplished by electronic submittal of the plan to NCEM. The plan is assigned to a planner to review against the FEMA Local Plan Review Tool. This process generally takes two to three weeks to accomplish. If the plan has met all of the requirements it is then mailed to FEMA on a Compact Disc (CD). However, if it does not meet the requirements the deficiencies are clearly and concisely identified in the plan review tool. The planner will also clearly and concisely identify how to correct the deficiencies to meet the requirements. Usually the contractor will have the corrections made within a couple of days and sometimes even within a couple of hours. The key to keeping the NCEM review process to a minimal time is how the planners identify the deficiencies in the plan review tool and clearly explaining what needs to be changed or added to meet the requirement.

The FEMA review process is usually the longer of the two reviews. As per the 44 CFR §201.6, FEMA has 45 days when possible to review the plan. When they have reviewed the plan the review tool is sent back to NCEM with either an “Approval Letter”, “Approvable Pending Adoption Letter”, or “Needs Revisions Letter”. If the plan needs revisions NCEM will review all FEMA comments and the plan. If NCEM concurs with the comments the planners will work with the contractor to identify how to meet the requirement. If NCEM finds the comments to be in error the planners will work with FEMA to resolve the issue. The FEMA review timeframe is very fluid in nature and has taken up to 90 days. Risk Mitigation Planning Branch also tracks the time the plan is mailed to FEMA to receipt of a letter back. If plans have been at FEMA for review for longer than thirty days the Risk Mitigation Supervisor makes contact with the state planning lead about the status of the plan.

Upon either “Approval or Approvable Pending Adoption” the plan review tool and letter is sent back to the contractor for distribution to the local governments and the local adoption process is initiated. This process can take several months due to the meeting schedule and priorities of the local governments. This is particularly the case between the months of April through August when local governments are focused on budgets for the new fiscal year (1 July through 30 June of the following year) and in NC some local elected officials do not meet during the months of July and August. Once the resolution is approved and signed by the local government it is then forwarded to the Risk Mitigation Planning Branch. Risk Mitigation Planning staff will hold resolutions until several are collected unless the community is at risk of expiring. They are then sent to FEMA for processing. FEMA will in turn send an “Approval Letter” to NCEM who distributes it accordingly.

4.6 MITIGATION GRANTS MANAGEMENT

The goal of the Grants Management Team is:
To provide extensive assistance to local governments in all phases of the grants management cycle across all FEMA-funded UHMA programs and to conduct outstanding grants management and fiscal stewardship operations to support the mission of the Branch, Section, and Division.

Services which the Grants Management Team provides include technical assistance for:

1. **Project Development**
   - Eligibility determinations
   - Data collection
   - Benefit cost analysis
   - Project site visits
   - Environmental review
   - Public meetings
   - Town/city council meetings
   - Grant writing and editing

2. **Project Implementation**
   - Coordinating of multiple/complimentary funding source
   - Public meetings
   - Grants management
   - Compliance with all federal reporting requirements
   - Grant closeout

3. **Project Closeout**
   - Effective administration closeout within FEMA periods of performance and post-implementation liquidation periods
   - Sound fiscal stewardship

4.7 SUMMARY

The capability of North Carolina's State Government to implement mitigation project, policies, and procedures has long been one of the strongest in the country. This capability has continued to improve over the years as stronger ties are made between hazard mitigation and the day-to-day activities of multiple State agencies as described in this section.

Areas to Target Improvements

The capability of local governments in North Carolina varies. Some communities and counties have high capabilities and some have very low capabilities. NCEM will continue to promote increasing local capabilities to the extent practicable through training, funding, and technical assistance.

Through continued implementation of the State's Mitigation Strategy, both state and local capabilities should improve as more mitigation projects, policies, and procedures are implemented.

Section 5. MITIGATION STRATEGY

44 CFR Reference

(3) A Mitigation Strategy that provides the State's blueprint for reducing the losses identified in the risk assessment. This section shall include:

(i) A description of State goals to guide the selection of activities to mitigate and reduce potential losses.

(ii) A discussion of the State's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas; a discussion of State funding capabilities for hazard mitigation projects; and a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

(iii) An identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified.

(iv) Identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.

(v) A State may request the reduced cost share authorized under § 79.4(c)(2) of this chapter for the FMA and SRL programs, if it has an approved State Mitigation Plan meeting the requirements of this section that also identifies specific actions the State has taken to reduce the number of repetitive loss properties (which must include severe repetitive loss properties), and specifies how the State intends to reduce the number of such repetitive loss properties. In addition, the plan must describe the strategy the State has to ensure that local jurisdictions with severe repetitive loss properties take actions to reduce the number of these properties, including the development of local mitigation plans.

5.1 MITIGATION STRATEGY OVERVIEW

The Mitigation Strategy Section is made up of goals, objectives, and actions/activities that the State of North Carolina’s agencies will strive to achieve in order to make North Carolina the most resilient state in the United States and reduce risk to both natural and technological/man-made hazards. Overall these goals, objectives, and actions make up the state’s Mitigation Strategy. When viewed holistically, this structure can be viewed as a combination of broad and specific aims of the state, which in turn form both interim- (less than 5 years to completion) and long-term (more than 5 years to completion) strategies that are meant to achieve the state’s vision for mitigation.

During the 2018 update of the North Plan Carolina Enhanced Hazard Mitigation Plan, NCEM Risk Mitigation staff determine the need to revise the format of the Mitigation Strategy. Revisions included:

- Changing the section number of the Mitigation Strategy Section of the plan to Section 5,
- Adding additional goals to the plan,
- Changing the objectives of the plan to be the milestones of the goals,
- Reviewing actions for cost effectiveness, overall feasibility, availability of potential funding, political will, and to meet the SMART action criteria. SMART is an acronym for Specific, Measurable, Achievable, Relevant, and Time-Bound. This is a new concept to the North Carolina Enhanced Hazard Mitigation Plan for this update. Each action must meet all of the aforementioned criteria, either as it is or through revision, otherwise it was identified for deletion.

Risk Mitigation Planning staff reviewed the mitigation actions and made recommendations for revisions to the primary responsible agency through the RMCC members, various subject matter experts, and other stakeholders. After discussion with the responsible agencies, some actions have been identified for deletion and some new actions have been added. The deleted actions have been removed from the "Active" actions and put below in a new sub-section specifically for deleted actions.

5.2 MITIGATION GOALS

5.2.1 Aligning State Goals and Changes Since Last Update

In an effort to integrate other planning functions and bring the North Carolina Enhanced State Hazard Mitigation Plan into alignment with the overall goals and strategies of the North Carolina Department of Public Safety and the Division of Emergency Management, some of the goals of the NCHMP have changed. The updated goals will directly coincide with the overarching goals of the Department of Public Safety, the North Carolina Emergency Management Division, and the North Carolina State Homeland Security Strategy. The goals are based on six of the seven core capabilities in the mitigation mission area of the National Preparedness Goals. These core capabilities have been identified as the priorities of the Secretary of North Carolina Department of Public Safety, the State Emergency Response Commission, and the Director of North Carolina Emergency Management.

The overarching goals of the North Carolina Department of Public Safety, the North Carolina Emergency Management Division, and the North Carolina State Homeland Security Strategy are as follows:

1. **Prevent** - We are the model for preventing and reducing crime.
2. **Protect** - North Carolina is safe for living, working and visiting.
3. **Prepare** - We are leaders in public safety readiness, communication and coordination.

4. **Perform** - We excel in every facet of our work – Law Enforcement, Emergency Management, National Guard, Adult Correction and Juvenile Justice and Administrative Services.
5. **People** - We will value each other like family.
6. **Vision** - To provide the finest safety and security services for all North Carolinians

The six priority core capabilities in the mitigation mission area of the National Preparedness Goals are:

1. Mitigation Planning
2. Public Information and Warning
3. Community Resilience
4. Long-Term Vulnerability Reduction
5. Threats and Hazard Identification
6. Risk and Disaster Resilience Assessment

During the review process of the latest state planning guidance, dated March 2016, and the current NCEHMP it was determined that the current single goal would not meet the requirements of the guide. Therefore, additional goals have been added to meet the requirement of having more than one goal.

Another key component of developing this strategy is the Risk Mitigation Branch's outreach to local communities. Through this outreach, the state describes our various grant funding programs and asks that communities send in "Letters of Interest" which describe mitigation activities that they would like to pursue within specific funding streams. Each year, once FEMA Hazard Mitigation Assistance Guidance has been published for that year, the Hazard Mitigation Branch, in coordination with the Risk Mitigation Branch, sends out a mass mailing to all local Emergency Management, Planning, and Storm Water services staff across the state describing programmatic goals and priorities and announcing the beginning of that year's non-disaster assistance grant cycle.

State staff may travel to communities to meet in person with public officials and municipal or county staff to explain grant guidance and eligibility requirements and discuss potential mitigation projects for that grant cycle. Communities typically have ideas as to what specific mitigation actions they would like to pursue, so the Hazard Mitigation Branch requests communities provide "Letters of Interest" and offers them technical assistance in areas such as cost-benefit analysis, interpretation of FEMA guidance, and Environmental Review, as they develop their projects.

The Hazard Mitigation Branch and the Risk Mitigation Branch use the Letters of Interest and feedback from technical assistance provided to ensure the goals and objectives in the local plans align with the goals and objectives in the state's plan. When they do not, appropriate steps are taken to evaluate both plans and make amendments where necessary as part of the plan maintenance process. This process also helps state officials understand local needs and shapes the overall statewide mitigation strategy.

Finally, the goals, objectives, and actions that make up this mitigation strategy are also based on the findings of the statewide risk assessment which is laid out in Section 3. During the 2018 update, after completing the risk assessment portion of the plan, the planning team evaluated what areas of concern (e.g. hazards, geographic areas, etc.) were most pertinent to mitigate in the state. Encompassed within this review, major changes in development that occurred between the 2013 and 2018 were identified and analyzed. The mitigation strategy was then updated according to these areas of concern and changes in development, and was therefore influenced heavily by the risk assessment.

5.2.2 Goals

Through a process of aligning the NCDPS goals and core capabilities, the NCHMP goals have been established as follows:

1. Support mitigation planning at all levels of government, including all Tribal Nations, in North Carolina to ensure every community has the opportunity to participate in a systematic mitigation planning process and has an approved and adopted hazard mitigation plan.
2. Provide the public with proper risk information and availability of early warning systems for events to the extent possible.
3. Ensure community level resilience through empowering individuals and communities to make informed decisions to facilitate actions as necessary to adapt to, withstand, and quickly recover from future incidents.
4. Achieve a measurable decrease in the long-term vulnerability of North Carolina against all hazards.
5. Identify all threats and hazards most likely to impact North Carolina based on sound science and through coordination and collaboration with local, state, and federal agencies.
6. Complete risk and disaster resilience assessments at the local level, defining localized vulnerabilities and consequences associated with potential hazards.

Overall, when viewed jointly, these new goals continue to address the intent of the single, original goal of the original North Carolina State Hazard Mitigation Plan: “To reduce the State’s vulnerability and increase resilience to natural hazards, in order to protect people, property and natural resources.” However, the new goals provide a more distinct vision for the state to follow as it attempts to further reduce risk for the public.

5.2.2.1 Repetitive Loss and Severe Repetitive Loss Specific Goals

Although many of the goals above apply to repetitive loss and severe repetitive loss properties, the planning team felt that it was also important to identify some goals that were specifically aimed at addressing repetitive and severe repetitive loss properties. In short, the state will adhere to two primary goals when addressing repetitive loss properties:

1. Reduce the overall number of repetitive loss and severe repetitive loss properties by utilizing available mitigation funding and prioritizing funds to address repetitive loss properties when appropriate.
2. Minimize the number of additional properties that may become repetitive loss properties through the implementation of proactive mitigation action.

5.3 MITIGATION OBJECTIVES

While the FEMA Guidance does not contain a requirement to have objectives, it is a requirement of the Emergency Management Accreditation Program. The updated goals and objectives have been designed to align with other plans maintained by NCEM as well as the overarching goals of NCDPS and NCEM. The plan's goals will be pursued through the identification of more specific, but still necessarily broad Objectives that apply collectively to the identified hazards. These objectives outline in greater detail how the state will achieve its goals and also provide some organization for the state's mitigation actions (see below). These objectives are focused on creating measurable outcomes and milestones for the state as it attempts to address the goals laid out in the plan. The following objectives have been identified:

- Hazards: Continuously identify new hazards and address each of the hazards identified in this plan through at least two actions.
- Data: Collect spatial data on each of the hazards outlined in this plan and collect exposure data concerning people, property, and other features likely to be impacted by all identified hazards.
- Applications: Develop new, and maintain/enhance existing applications and software to assist local officials, state officials, and other stakeholders in reducing risk.
- Risk Assessments: Carry out risk assessments for each of the hazards identified in this plan and help local governments use this information to mitigate these hazards.
- Training/Outreach: Provide technical assistance and training to local governments and other state agencies to help utilize state tools and information and conduct outreach to receive feedback from these stakeholders.
- Technology: Emphasize the use of technology to identify risk, advance mitigation goals, and improve the implementation of mitigation actions.

5.4 MITIGATION ACTIONS

5.4.1 Identification of Potential Mitigation Actions

The plan's objectives will be achieved through the implementation of individual Actions that will describe specific and measurable activities to be undertaken in pursuit of the overall Objectives and Goals. The Mitigation Action Tables are the primary tool that will be used by the state to implement and monitor the actions that have been identified to reduce the impact of hazards across the state. In these tables, the planning team has identified a number of actions that it intends to take or support in the coming years.

Progress toward actions is noted in each table and any action items that have been completed are marked "completed" and will be removed in the next plan update. Similarly, actions that are no longer applicable or were combined with other actions have been marked "deleted" and will be removed in the next plan update. All other existing actions have been updated with an explanation of progress towards completion.

5.4.1.1 Identification Process

As alluded to above, many of the existing actions from previous plan updates have not been fully completed. To identify which actions would remain in place during the 2018 update, the planning team carried out a thorough review of each of the existing actions from the 2013 update. Each action was marked as completed, deleted, or incomplete/deferred. Any actions that fell into the latter designation were identified as actions that would remain in the 2018 update of the plan.

In addition to completing a thorough review of existing actions, the planning team also worked in conjunction with the RMCC to identify new actions. This process was made up of two parts. First, the planning team worked within the Risk Mitigation Branch and the NCEM organization overall to identify actions that were important priorities for mitigation in the state that were not already included in the plan. A number of these were connected to actions being undertaken by other groups within NCEM, but many were also new ideas for projects that had been developed within the Risk Mitigation Branch over the past five years.

The second part of the process of identifying new actions involved getting feedback from members of the RMCC on any priorities that they wanted to include in the plan. Feedback from these stakeholders was received through the RMCC meetings that were held during the process and by directly contacting designated representatives from other stakeholder groups who may not have been able to attend RMCC meetings.

Through this process of evaluating existing actions and identifying new actions, a comprehensive set of mitigation actions was developed to support risk reduction statewide.

5.4.1.2 Assessment of Effectiveness of Actions

During the 2018 plan update, it became clear that many of the existing actions in the plan had remained in the plan over the course of several updates. A number of these actions had either been completed during this time or were never carried out due to various challenges that impeded implementation. Therefore, during the 2018 update, the planning team determined that it was critical to carry out an in-depth evaluation of the effectiveness of existing actions. Encompassed in this evaluation, the team drastically reduced the number of existing actions that had been carried over from past plan updates by marking actions completed or deleted.

In addition, the actions that were kept in place were systematically evaluated in terms of their effectiveness as well. Through this process, the planning team was able to get a sense of what actions were working to reduce risk and mitigate hazards most effectively and use that knowledge as a guide to develop additional actions and to prioritize actions. While all of the existing actions that were kept in the plan have the effect of mitigating risk to hazards, some of these actions do so more effectively than others. This evaluation of effectiveness was critically important because it helped the planning team determine where to focus future funding and effort to maximize risk reduction across the state.

5.4.2 Prioritization, Changes in Priorities, and Funding of Actions

5.4.2.1 Prioritization of Actions

Prioritization of actions in the plan can be challenging, as various interests may have differing views on what criteria should be given the most weight and which actions should be prioritized. For instance, cost may be a major concern for some stakeholders, while ease of implementation may be the primary concern for others. The planning team took into account a number of different factors when prioritizing and based prioritization of the proposed mitigation actions on the following six factors:

- Effect on overall risk to life and property
- Ease of implementation
- Political and community support
- A general economic cost/benefit review[1]
- Funding availability
- Continued compliance with the NFIP

The planning team coordinated the prioritization process by reviewing each action and working with the lead agency/organization responsible to determine a priority for each action using the six factors listed above. Using these criteria, actions were classified as high, moderate, or low priority.

5.4.2.2 Changes in Priorities

Overall, the general intent of the plan and its priorities remains the same as during the last plan update, which in short is to protect the life, safety, and welfare of the citizens of North Carolina, their property, and the state's natural resources by reducing vulnerability to hazards. However, given the major overhaul of the mitigation strategy, including reshaping goals and objectives and efforts to re-focus actions on areas that can have the greatest positive impact, it is clear that priorities have changed to some degree. Although there are a number of priorities for the state, the planning team elected to emphasize several that seemed to be major priorities going forward.

One of the major areas of focus going forward is on maximizing technology and producing high quality data in the area of risk and vulnerability assessments. The state has identified this as a primary priority since it is critical to have accurate and useful information before real mitigation efforts can be implemented. The most substantive mitigation actions take place at the local level, but most local governments do not have the resources available to produce high quality data that can inform them of their risk. Therefore, the state views itself as a key resource for local governments in this regard and plans to emphasize its

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1 Only a general economic cost/benefit review was considered through the process of selecting and prioritizing mitigation actions. Mitigation actions with "high" priority were determined to be the most cost effective and most compatible with the state's unique needs. Actions with a "moderate" priority were determined to be cost-effective and compatible with state needs, but may be more challenging to complete administratively or fiscally than "high" priority actions. Actions with a "low" priority were determined to be important needs, but several potential challenges were identified in terms of implementation (e.g. lack of funding, technical obstacles). A more detailed cost/benefit analysis may be applied to particular projects prior to the application for or obligation of funding, as appropriate.

development of new data and technology to provide local governments with the best available information and to support their use of that information to implement actions that reduce risk.

Another major area of focus for the state going forward will be in training and outreach to local governments. As mentioned, the state views local governments as the most effective conduit for the implementation of mitigation actions, so open communication and outreach to the local level is key. Although training and outreach has always been identified as a component of the state's mitigation strategy, the 2018 update of the plan has brought into focus the prominent role the state needs to play in ensuring local governments are well-supported in their efforts to implement mitigation action.

5.4.2.3 Potential Funding Sources of Actions

Funding of mitigation actions is often a challenge due to the limited resources that are available broadly. However, there are a number of sources of funding that are aimed specifically towards mitigation actions and projects, primarily through the federal government. These are described below and represent the most commonly used sources of funding for mitigation projects in the state.

Hazard Mitigation Grant Program (HMGP):

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local government's overall mitigation strategy and comply with program guidelines. Eligibility for funding under HMGP is limited to state and local governments, certain private nonprofit organizations, institutions that serve a public function, and authorized tribal organizations. These organizations must apply for HMGP project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding, administering the program, and assuring that local projects are consistent with the state's mitigation plan.

After a presidential disaster declaration, local governments conduct community outreach meetings. At these meetings, federal and state officials provide information and answer questions about state and federal assistance. Property owners interested in acquisition, elevation, or reconstruction projects must submit a completed owner interest form to the local government. Local governments may also request guidance and information on submission of proposals for other mitigation project types such as protection of critical public facilities. Based on the outcome of these meetings and proposals, the Risk Mitigation Branch establishes priorities for the allocation of disaster-related mitigation funds. The outcome of this process is reported in the State Administrative Plan.

Once this process is complete, NCEM solicits or completes project applications for selected projects. NCEM reviews applications for congruence with local mitigation plans, examines any environmental issues that may be encountered in association with NEPA, and also conducts a benefit-cost analysis for each submitted project, if applicable.

Non-Disaster Mitigation Programs

As per FEMA's 2015 unified hazard mitigation assistance guidance, NCEM also annually solicits letters of interest from local governments for two non-disaster HMA programs: Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA). Local governments have responded in a positive manner to this approach. Since they now know when to expect solicitations, they can do a better job of planning for participation and a better job of providing NCEM with accurate and appropriate documentation for application development.

For purposes of selecting and prioritizing proposals for non-disaster related projects, NCEM uses either program-specific guidance (which may change somewhat from year to year) and/or relies on a traditional prioritization of cost effective projects.

Availability of funds is made known to NCEM's local mitigation partners including local emergency management coordinators, local elected officials, and local planning community development staff upon receipt of FEMA guidance. Project proposals are solicited and technical assistance is provided in development of applications for funding of eligible projects.

Generally, emphasis is also placed on identifying and addressing properties that meet the repetitive loss and severe repetitive loss designations of FEMA's non-disaster funding sources. Special outreach is usually conducted when each funding opportunity is made available to encourage participation in projects by property owners and local governments. Outreach may include direct contact, special mailings, public meetings and public service announcements published by the North Carolina Division of Emergency Management, the Department of Public Safety, and other partners in North Carolina's mitigation effort.

Other Factors Pertaining to Mitigation Funding

It should be noted that for prioritization of cost effective projects across all UHMA funding streams, the State integrates specific criteria into its analysis. This includes, but is not limited to, an assessment of the impacts of development pressures (i.e. geographic areas experiencing significant growth) and the increased potential beneficial impact the mitigation project may have on its community.

Furthermore, all of our grant programs require an environmental review as mandated by the National Environmental Policy Act (NEPA). This environmental assessment is conducted during the application process for any grant application and includes NCEM coordination with other state and federal agencies to notify them of potential projects. Other agencies have the opportunity to comment on these projects and notify NCEM if there is an area of concern which might require further action in order to make it an environmentally sound project.

Repetitive Loss and Severe Repetitive Loss Funding

All of the aforementioned funding sources (HMGP, PDM, FMA) have been used by the state to address repetitive loss properties. Historically, FMA has been targeted most directly at addressing repetitive loss and severe repetitive loss properties since federal priorities have often emphasized that purpose. However, the state also utilizes both HMGP and PDM to address these types of properties. These programs will continue to serve as the primary funding source for addressing repetitive loss and severe repetitive loss properties in the future.

5.4.2.4 Repetitive and Severe Repetitive Loss Specific Priorities

The repetitive loss and severe repetitive loss strategy for North Carolina is geared towards encouraging local communities to prioritize mitigation of repetitive loss and severe repetitive loss properties and removing the financial strain imposed upon the National Flood Insurance Program (NFIP) for claims that compensate homeowners who have suffered repeatedly from flood losses.

The North Carolina strategy meets the directives of the United States Congress as outlined in the Federal Register and reflects FEMA's guidelines for the program. To this end:

- In the review process for applications for disaster assistance, the state will review the number of repetitive loss and severe repetitive loss structures in a community and the extent to which they are mitigated. Local governments will be encouraged to include these properties in their proposals and applications for mitigation projects.
- The state will require that local mitigation plan updates identify the number of severe repetitive loss properties and repetitive loss properties in each community covered by the plan.
- The state will require that each local mitigation plan update consider mitigation actions to address existing repetitive loss properties. These actions will assist with avoiding recurring losses from natural hazards in the future.
- The state will require that local mitigation plan updates identify undeveloped areas in the flood plain and appropriate mitigation actions to help avoid building structures that will become repetitive loss properties in the future.

Project Eligibility

NCEM will review any eligible project proposal that demonstrates cost-effectiveness in the mitigation of repetitive loss and severe repetitive loss properties, with an emphasis on the following:

- Severe repetitive loss and repetitive loss properties with the greatest dollar value of claims
- Severe repetitive loss and repetitive loss properties with the greatest number of claims
- Properties will be evaluated for a proposed project based on the FEMA Benefit-Cost Analysis (BCA) module. Cost effective properties with the highest Benefit Cost Ratio (BCR) will become priority projects.
- These properties may be mitigated through a number of techniques including, but not limited to:
- Acquisition
- Elevation
- Mitigation Reconstruction
- Minor physical localized flood reduction projects
- Dry Floodproofing (historic/commercial properties only)

Project Selection Criteria

The State's priorities are a major consideration in the selection of projects for funding. Projects will be selected according to how well they satisfy FEMA eligibility criteria and their support of the state's overall mitigation strategy.

The Grants Section which is responsible for project development will work closely with the community to develop a severe repetitive loss and repetitive loss plan of action to prioritize and mitigate the most vulnerable structures. The selection of properties will be determined by ranking the structures in the state based on the greatest losses and claims to the NFIP.

As mentioned above, properties with the highest Benefit Cost Ratio (BCR) will also be prioritized. Projects will be examined and the state will work with local governments to determine the most appropriate type of mitigation action to implement (elevation, acquisition, etc.). After this, applications will be submitted in the program that is determined to give the project the best chance of funding success.

5.4.3 Mitigation Actions

As explained previously, the state's mitigation actions provide a functional plan that is designed to achieve the mitigation goals and objectives outlined above. Each proposed mitigation action has been identified as an effective means of reducing hazard risk, and these actions will be reviewed on a regular basis according to the plan's maintenance procedures.

Each action is listed in conjunction with information detailing the action such as hazard(s) addressed, relative priority, and potential funding sources to implement the action. Most importantly, implementation mechanisms are provided for each action, including the designation of a lead agency or department responsible for carrying the action out, as well as a timeframe for its completion. These implementation mechanisms ensure that the plan remains a functional document that can be monitored for progress over time. These mitigation actions are laid out on the following pages.

Action Number	NC-1
Action Number in Previous Plan	NC-1, NC-2, NC-5, NC-26, NC-35
Action Description	Develop a robust network of tools and systems throughout the state to help local and state officials better prepare for and respond to flooding events. This would include: • Increase the number of USGS stream-flow gauges statewide • Collect stream gauge data, rainfall data, and high water mark data regularly • Provide information to communities on real time flood inundation • Develop flood warning and alert system
How Action Contributes to Risk Reduction	Improving data collection, real time flood information, and flood warnings will allow more preparation for and better response to flood events, reducing potential loss of life and property damage.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	Flooding
Priority	High
Goal	2, 3
Objective Addressed	2, 3, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	National Weather Service
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	North Carolina Flood Inundation Mapping and Alert Network (FIMAN) produces maps in real-time that depict areas of inundation as well as flood forecast maps that show areas that are expected to become inundated hours and days into the future. As of 2018, the FIMAN has expanded to serve additional areas of the state and has improved its overall functionality. It is now faster and available on multiple platforms, including on mobile devices. There are more than 550 gauges across the state that are connected through FIMAN. Local and state level officials have begun using the network during major events such as Hurricane Matthew in 2016 to help communities identify key facilities or areas that may be flooded during the event.
Anticipated Future Progress	Currently there are many areas of the state where there are no stream gauges or the number and location of gauges makes it challenging to produce data for some localities. The state would like to increase the number of gauges and further expand the data available to local governments using this program.

Action Number	NC-2
Action Number in Previous Plan	NC-3, NC-8, NC-18, NC-53, NC-64, NC-71, NC-93, NC-94, NC-95, NC-96, NC-97
Action Description	Carry out projects that qualify under the most current version of Unified Hazard Mitigation Assistance program to protect/mitigate risk to people and personal property such as residences and businesses. Where possible, a primary focus of these programs will be on repetitive loss and severe repetitive loss properties. Project types that fall under this action could include, but are not limited to: Acquire properties that are located in areas vulnerable to hazards. Elevate properties that are located in areas vulnerable to flooding. Structural retrofits for structures that are vulnerable to wind events. Non-structural retrofits for structures that are vulnerable to earthquakes/geological events. Analyze building stock to identify potential structures that could be mitigated. Provide funds for purchase of conservation easements or purchase of land within floodplain. Identify properties to be acquired that will support mitigation by coordinating with other entities (such as the Clean Water Task Force) to leverage other funding sources for acquisition to support additional state mandated goals. Develop funding source (with hazard funds) targeted to areas most vulnerable to earthquakes, sinkholes, and landslide/geochemistry for acquisition and/or conservation easements. Promote safe room construction and help provide safe havens/rooms in areas with extremely vulnerable populations.
How Action Contributes to Risk Reduction	Completing mitigation projects, such as acquisition, elevation, retrofits, etc., will reduce the number of people and properties located in vulnerable areas, improve structures' ability to withstand damage from future hazard events, and increase safety for vulnerable populations, reducing potential loss of life and property damage.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	3, 4, RL-1, RL-2
Objective Addressed	2, 3, 6
NPG Core Capability	Community Resilience, Long-Term Vulnerability Reduction, Housing, Economic Recovery
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM- Hazard Mitigation
Other Contributing Agencies	NC DEQ, Local governments
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	The state has remained active in all of the UHMA related funding streams, annually applying for funding from non-disaster programs such as FMA and PDM, and utilizing HMGP to the greatest extent possible. The state has especially been active at acquiring and elevating properties through these grant programs, but has also begun to diversify and submit applications for some of the other projects listed above. Leveraging these programs and funding sources will continue to be a major priority for the state's mitigation program going forward.
Anticipated Future Progress	There are still a large number of projects across the state that may be eligible for funding through the UHMA programs so the state will continue to work with local governments and other stakeholders to ensure these projects are implemented through UHMA when possible.

Action Number	NC-3
Action Number in Previous Plan	NC-9, NC-19, NC-28, NC-32, NC-33, NC-34, NC-46, NC-56, NC-63, NC-65, NC-67, NC-68, NC-74, NC-85, NC-87, NC-88, NC-89, NC-90, NC-92
Action Description	The state will provide training and publications to local governments, state agencies, and other organizations on emergency management and mitigation. Encompassed in this, the state will develop and implement an outreach program to receive feedback on mitigation programs and policies. These efforts may include: • Train local emergency managers on various mitigation activities and funding opportunities. • Educate public and private organizations on the theory and practice of hazard mitigation, and help them to identify how mitigation can become incorporated into their own routine functions or activities. • Conduct interactive "Mitigation Planning Workshops" to local governments including use of GIS in Hazard Mitigation Planning. Potentially partner with Institute of Government to develop. • Develop and conduct county-wide educational programs for local officials on wildfire programs such as Firewise Communities, Ready, Set, Go!, and Fire Adapted Communities, and on flood risk including flood mapping, new DFIRMs, flood insurance, etc. • Develop and maintain a variety of widely-adaptable mitigation PowerPoints, brochures, publications, newsletters, and other information. • Promote Wildfire Risk Reduction through the National Fire Plan and other funding sources to create landscape-level change across North Carolina (prescribed fire and hazard fuel reduction projects). • Gain insights from local public officials on what additional products or services could assist them in developing local mitigation plans. • Develop, publicize, and provide a wide variety of risk assessment products and planning services to assist local officials in their planning and risk reduction activities. • Promote 406 mitigation through discussion and presentations with various state and federal partners. • Participate in expositions and symposiums such as the North Carolina Aquariums Earth Day Expo, host booth(s) at county and state fairs, coordinate with county Cooperative Extension Services on events. • Develop Bi-lingual mitigation messages. • Conduct direct outreach on non-structural mitigation measures at Local, Tribal, and State agencies as well as with citizens.
How Action Contributes to Risk Reduction	Improving training, education, and outreach on emergency management and mitigation for local governments, state agencies, and other organizations will increase the implementation of mitigation activities, resulting in overall risk reduction.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 2, 3, RL-1, RL-2
Objective Addressed	1, 2, 3, 4, 5, 6

NPG Core Capability	Public Information and Warning, Community Resilience
Funding Source(s)	Federal and State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM- Risk Management
Other Contributing Agencies	NC DEQ, NC FS
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	NCEM has provided a number of workshops and opportunities for local governments related to mitigation and has maintained a wide array of outreach materials on mitigation. Additionally, other state agencies have also been active in mitigation outreach over the past several years. For example, the NC Forest Service is currently conducting 300+ presentations/programs per year on these various programs. There is a statewide Firewise exhibit at the state fairgrounds that engages thousands of visitors throughout the 10-day event. NCFS receives federal pass through USFS funding for Fire Adapted Communities work to be completed in 4 NC Resource Conservation and Development Districts, the Appalachian RC&D FAC Coalition. These support funds will allow the RC&D's to assist in expanding the FAC Concept across multiple States along the Appalachian Mountain range initially from Georgia into North Carolina and Virginia. Each of the North Carolina RC&Ds (4) received $32,000 of funding to encourage a grassroots effort for Fire Adapted Communities. This effort began in January 2017 in Western NC. There are 24 Nationally-recognized Firewise Communities in NC that are scattered throughout the state (see map of current communities in good standing: http://nfpa.maps.arcgis.com/apps/Viewer/index.html?appid=c4a788340df748f18d98d8363145bb67).
Anticipated Future Progress	Training and outreach will continue to be a critical task for the state to carry out in terms of mitigation. NCEM will lead efforts to help local governments with grant funding opportunities and planning, as well as maintaining a public face to help inform citizens about the benefits of mitigation.

Action Number	NC-4
Action Number in Previous Plan	NC-11
Action Description	Evaluate emerging technologies and upgrade through hardware/software acquisition and training where appropriate and feasible.
How Action Contributes to Risk Reduction	Developing new technologies and software will improve the ability to evaluate risk and make better risk reduction decisions, minimizing potential loss of life and property damage.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 5, 6
Objective Addressed	3, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM- Risk Management
Other Contributing Agencies	NCGS, Forest Resources, NC Dam Safety, Local Governments, State Climate Office
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	NCEM is one of the leading developers of new technology and software in the country in terms of risk and vulnerability assessment. NCEM- Risk Management holds bi-annual meetings on the risk management plan which are often focused on new technologies. Indeed, one of the primary objectives of the RMCC is to focus on leveraging new technology to evaluate risk in the state. As new technologies have been developed within the state, staff have been trained to integrate these technologies into existing programs to ensure the most advanced and up to date information and data is being used. In addition, state staff keep up to date on using other technologies that have been developed outside of the state.
Anticipated Future Progress	The state will continue to leverage technology going forward in an attempt to make the best possible decisions on risk reduction and minimizing damage to people and property across the state. As new technologies are constantly emerging, this is an area where there will often be quick developments and a need for constant vigilance to ensure the best available information is being used.

Action Number	NC-5
Action Number in Previous Plan	NC-12
Action Description	Standardize technology between partners, determine software compatibility, linear referencing, inventory of DOT facilities.
How Action Contributes to Risk Reduction	Standardizing technology will ensure the most up to date information is available to support risk reduction decision making.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 5, 6
Objective Addressed	3, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	None
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	Over the past several years, there have been great efforts made by NCEM to standardize technology with partners across other state and federal agencies by working to determine software capabilities and create common inventories of assets and features.
Anticipated Future Progress	This is a process that requires frequent updating to ensure the most up to date information is included in databases and so the focus of this action going forward will be to regularly evaluate the information within these databases and integrate new information where possible. This process may also necessitate new systems for organizing the data and these will be implemented when identified.

Action Number	NC-6
Action Number in Previous Plan	NC-13, NC-14, NC-37, NC-39, NC-40, NC-41, NC-42, NC-54, NC-55
Action Description	Work with local communities to promote changes in local policies, regulations, and activities such as: • Re-assess tree trimming policies of municipalities and power companies • Ensure that tree trimming policies of local governments have been reassessed to comply with industry standards • Promote updating Building Codes in hazard-prone areas • Update Building Code to reflect hazard mitigation building techniques. • Encourage local governments to use their risk and historical hazard data for purposes of modifying regulations, standards, ordinance to minimize their vulnerability. • Promote river basin wide planning of flood hazard • Promote consideration of future build-out conditions when establishing land use and floodplain management regulations. • Promote and support recognition programs, such as the Community Rating System • Promote improvement of storm drainage systems.
How Action Contributes to Risk Reduction	Promoting change and improvements in local policies, regulations, and activities, such as tree trimming policies, building codes, land use and floodplain management regulations, etc., will protect infrastructure, critical facilities, and other buildings, reducing potential vulnerability and property damage.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 3, 4, 6
Objective Addressed	1, 2, 3, 4, 5
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing, Natural and Cultural Resources
Funding Source(s)	State and Local resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	Local Governments
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	Since the last update of the plan, the state has taken a fairly proactive approach and has even implemented stronger language related to freeboard standards into the state building code. Many local governments have likewise implemented stricter standards, regulations, and policies aimed at mitigating risk over the past several years and state officials have worked to help craft these policies and regulations when asked.
Anticipated Future Progress	Where feasible, the state will continue to work with local governments going forward on improving these regulations and policies at the local level as new ideas are implemented and successful policies are identified.

Action Number	NC-7
Action Number in Previous Plan	NC-15
Action Description	Develop and present series of seminars on NC's earthquake hazard and risk for various audiences.
How Action Contributes to Risk Reduction	Improving outreach and education on the earthquake hazard will increase awareness and knowledge of risk and actions that can be taken to reduce vulnerability.
Years of Action Establishment	5+ years
Current Status of Action	In progress
Hazard Addressed	Earthquake
Priority	Moderate
Goal	1, 4
Objective Addressed	4, 5
NPG Core Capability	Public Information and Warning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	NEHRP Grants, Earthquake Consortia Grants
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Mitigation
Other Contributing Agencies	NCGS, NC-DEQ
Completion Date	2020 (Interim Strategy)
Current Progress	NCEM has been working to develop seminars on the state's earthquake risk and staff members have gone on the road to present these seminars to local governments and other key stakeholders. This information has been critical to present and has been updated along the way several times using the funding made available through the NEHRP grant that was received.
Anticipated Future Progress	During the 2017 NEHRP grant cycle, the state has applied for another earthquake grant which will help continue its outreach and education program and ensure that the latest information on earthquake risk reaches the appropriate stakeholder groups at the local level.

Action Number	NC-8
Action Number in Previous Plan	NC-16, NC-36
Action Description	Look into new USGS mapping of geologic indicators and use this information to inform local and state level risk assessments
How Action Contributes to Risk Reduction	Utilizing new and updated information and data on geologic hazards will improve risk assessments and understanding of existing geologic risks.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Earthquake, Geological
Priority	Low
Goal	1, 3, 5, 6
Objective Addressed	1, 4, 5, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NC-DEQ
Other Contributing Agencies	NCEM- Risk Management
Completion Date	2020 (Interim Strategy)
Current Progress	USGS and NC DEQ are frequently gathering and analyzing additional data and producing maps that contain risk-related information. As of 2018, there are a number of new or updated sources of information that can be integrated into state and local level risk assessments. The state has integrated this data to some degree, but further evaluation of this data needs to take place.
Anticipated Future Progress	State officials will analyze the many sources of information that the USGS provides through its mapping to determine the most effective means of mitigating geologic hazards. As new data becomes available over the coming years, this data will also be used when possible to improve risk management.

Action Number	NC-9
Action Number in Previous Plan	NC-21
Action Description	Provide wildfire mitigation funds to identified communities at risk to implement wildfire mitigation projects after they have been identified by the Southern Wildfire Risk Assessment Portal (SouthWRAP), Community Wildfire Risk Assessments, and Community Wildfire Protection Plans.
How Action Contributes to Risk Reduction	Increasing wildfire mitigation funding for at risk communities will allow those communities to develop CWPPs and identify areas of concern and mitigation measures to reduce vulnerability to wildfire.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	Wildfire
Priority	Low
Goal	3, 4, 6
Objective Addressed	2, 4, 5
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	US Forest Service
Primary State Agency	NC Forest Service
Other Contributing Agencies	NCEM
Completion Date	2020 (Interim Strategy)
Current Progress	Over 760 CWPPs have been completed and more are in some stage of development (CWPPs are completed at the fire district level). County Emergency Management, Fire Departments, and (where applicable) Federal partners have been part of the team that has worked on these CWPPs. The CWPP identifies areas of concerns and mitigation measures are recommended to improve communities understanding of the risk of wildfire and to reduce hazardous fuels conditions. Over 70,000 acres of prescribed fire was applied to state and private lands in the last year
Anticipated Future Progress	As noted, CWPPs have been completed in many fire districts across the state, but since there are still many districts that are in the process of developing plans, this action will remain in place.

Action Number	NC-10
Action Number in Previous Plan	NC-22, NC-31
Action Description	Develop and distribute custom Dam Safety Manual for the 100 counties in North Carolina, with data specific for each county and enhance the "Workbook" for local planning officials to include more information on dam failure mitigation activities and recommendations from local planners.
How Action Contributes to Risk Reduction	Distributing county-specific Dam Safety Manuals will improve awareness of local dam failure risk and mitigation activities that can be implemented to reduce vulnerability.
Years of Action Establishment	5+ years
Current Status of Action	In progress
Hazard Addressed	Dam Failure
Priority	Low
Goal	1, 2, 3, 5
Objective Addressed	1, 2, 4, 5, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	US ACE
Primary State Agency	NC DEQ
Other Contributing Agencies	NCEM
Completion Date	2020 (Interim Strategy)
Current Progress	Dam Safety officials have been working on updating Dam Safety Manuals and given the issues caused by dam failures during Hurricane Matthew in 2016, there is an increased awareness among state officials that it is critical to work with local officials and dam owners to ensure they are well-educated about dam safety and measures that can be implemented to mitigate future risk of failures.
Anticipated Future Progress	Dam Safety plans to continue to work on developing educational materials that increase awareness of the risks of dam failure throughout the state. Although a manual is certainly one of those tools and will continue to be going forward, the state also plans to work on developing other outreach and education techniques in the future.

Action Number	NC-11
Action Number in Previous Plan	NC-23, NC-38, NC-49, NC-50
Action Description	As part of its role in mitigation, the state would like to emphasize advocating for additional funding for important mitigation-related programming including: • Find a source of funds targeted for repairs to high hazard dams. • Promote full funding of NC Flood Mapping Program to complete new Flood Insurance Studies for entire state. • Provide state funding to the State Climate Office; funding not currently coming from Legislative Sources. (MH) (-60% from UNC System and remainder from grants) • Present the American Society of Dam Safety Officials (ASDSO) report on reductions in FEMA funding, and ask for assistance/supplemental funding into The Dam Safety Fund to keep Dam Safety Program viable.
How Action Contributes to Risk Reduction	Increasing funding for mitigation-related programming will advance mitigation efforts and implementation, reducing overall risk and vulnerability.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 2, 3, 4, 5, 6
Objective Addressed	1, 2, 3, 4, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing, Natural and Cultural Resources
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	NC-DEQ
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	One of the state's primary roles in mitigation has been as an advocate for programs across the state that advance mitigation efforts. The state has been a strong advocate for the allocation of funding to a number of programs that are related to mitigation and, in many cases, has been a major contributor to those programs.
Anticipated Future Progress	In the future, the state will continue to act as an advocate for mitigation-related programs from the state legislature, federal government, and numerous other agencies and organizations. The need for funding to implement mitigation projects and programs will likely continue to exist and so this action will continue to be a priority for the state.

Action Number	NC-12
Action Number in Previous Plan	NC-24
Action Description	Calculate dam failure flood inundation areas for all high hazard dams.
How Action Contributes to Risk Reduction	Determining dam failure flood inundation areas will improve dam failure risk assessments and understanding of existing risk.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Dam Failure
Priority	High
Goal	1, 3, 4, 5
Objective Addressed	1, 2, 4, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing, Natural and Cultural Resources
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA, US ACE
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NC DEQ
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	Dam inundation areas have not been completed for all high hazard dams in the state. Some counties have all high hazard dam inundation areas mapped while others have few or none. This is a priority for the state going forward, especially in the wake of Hurricane Matthew where dam failures were a significant issue for many communities.
Anticipated Future Progress	As noted above, dam failure inundation mapping is a major priority for the state going forward and funding and effort will be targeted at implementing this mapping and analysis for as many dams as possible in the coming years.

Action Number	NC-13
Action Number in Previous Plan	NC-25, NC-27, NC-51, NC-81
Action Description	The state and localities need to improve the existing system for assessing drought risk and understanding drought impacts. There are a number of ways to advance this system overall including: • Conduct a study on developing drought frequency data to provide to local governments. • Increase monitoring of precipitation and ground/surface water supplies. • Perform a drought economic impact study analyzing drought through surveys to local communities, state agencies, and industry farmers and other affected parties. • Coordinate all drought mitigation activities with the Drought Management Advisory Council.
How Action Contributes to Risk Reduction	Improving the ability to assess drought risk will increase understanding of impacts and vulnerability, making it possible to identify necessary mitigation and reduce future loss.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Drought
Priority	High
Goal	1, 2, 3, 4, 5, 6
Objective Addressed	1, 2, 4, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Health and Social Services, Natural and Cultural Resources
Funding Source(s)	State and Federal resources
Primary Federal Agency	US Department of Agriculture
Primary State Agency	NCEM
Other Contributing Agencies	State Climate Office
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	Dam inundation areas have not been completed for all high hazard dams in the state. Some counties have all high hazard dam inundation areas mapped while others have few or none. This is a priority for the state going forward, especially in the wake of Hurricane Matthew where dam failures were a significant issue for many communities.
Anticipated Future Progress	As noted above, dam failure inundation mapping is a major priority for the state going forward and funding and effort will be targeted at implementing this mapping and analysis for as many dams as possible in the coming years.

Action Number	NC-14
Action Number in Previous Plan	NC-30, NC-98
Action Description	One of the state's primary goals in mitigation is to provide useful data, studies and other products that can help local communities better understand their risks. To achieve this, the state will: • Continually upgrade statewide spatial data maintained in-house through multiple data sources. • Develop studies, collect, and analyze data on areas of risk to various hazards.
How Action Contributes to Risk Reduction	Enhancing available data and products will enable local communities to conduct better risk assessments and improve understanding of hazards and risk.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 2, 5
Objective Addressed	1, 2, 3, 4, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	CGIA, NCGS
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	NCEM's Risk Management has worked with a number of other state agencies to ensure the widespread availability of spatial data, especially in terms of data that can help assess and analyze risk. North Carolina has been one of the leading state's when it comes to spatial risk data production and this is still the case in 2018.
Anticipated Future Progress	In the coming years, the state hopes to further expand its warehouse of spatial data and to produce more user-friendly tools for visualization of this data both to government officials and the public. In this way, the data will be used to better inform users of areas of high risk and allow them to make the best possible decisions regarding mitigation action to reduce those risks.

Action Number	NC-15
Action Number in Previous Plan	NC-47
Action Description	Engage Federal, State, and Local fire service resources to collaborate on Wildfire Risk and proposed mitigation solutions.
How Action Contributes to Risk Reduction	Collaborating on wildfire risk and mitigation efforts will increase implementation success and goal achievement, minimizing existing wildfire vulnerability.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Wildfire
Priority	Low
Goal	1, 5, 6
Objective Addressed	1, 4, 5
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Fire Management and Suppression
Funding Source(s)	State and Local resources
Primary Federal Agency	US Forest Service
Primary State Agency	NC Forest Service
Other Contributing Agencies	NCEM
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	A Community Mitigation Assistance Team was brought in by the Pisgah Ranger district in September 2017 to encourage the formation of a McDowell County Partnership among community members and cooperators. An active partnership (Fire Safe Cherokee County) has been in place since 2010 among Federal, State, and County personnel, and local stakeholders in Cherokee County. Wildland Fire Suppression for Fire Departments and Ready, Set, Go! Train-the-Trainer courses are planned throughout the year, as well as other interagency training for risk reduction. Biennially, there is a cooperators meeting between state and federal agencies about wildland fire. The NCFS will host 3 Assessing Structure Ignition Potential from Wildfire (NFPA) in early 2018.
Anticipated Future Progress	The state will continue to work with officials at both the local and federal level to ensure the best possible outcomes in terms of wildfire mitigation. The state intends to leverage existing relationships with local, federal, and other state agencies to collaborate and achieve common goals going forward in mitigation.

Action Number	NC-16
Action Number in Previous Plan	NC-66
Action Description	Produce future volumes of NC measuring success publications documenting losses avoided – quantitatively and qualitatively.
How Action Contributes to Risk Reduction	Documenting losses avoided will improve the public's perception of mitigation, increasing support for future mitigation projects to further reduce vulnerability.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Low
Goal	4, 6
Objective Addressed	2, 5
NPG Core Capability	Planning, Public Information and Warning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	None
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	During a number of past disaster events, the state has worked in conjunction with FEMA to develop losses avoided studies. This has been carried out both through quantitative and qualitative means. As the state continues to recover from Hurricane Matthew and the damages associated with that storm, it is likely that future analysis of losses avoided will take place.
Anticipated Future Progress	Losses avoided studies are one of the primary means of producing evidence of the effectiveness of past mitigation projects. As a result, these studies are critical to both the public's perception of mitigation projects as well as the basis for demonstrating that similar future projects should be implemented. The state will continue to carry out these analyses whenever possible to ensure that projects that are being implemented have merit and are a worthwhile investment.

Action Number	NC-17
Action Number in Previous Plan	NC-73
Action Description	Work with the NC DEQ Division of Coastal Management in developing the hazard mitigation portion of the revised planning guidelines under the Coastal Area Management Act (CAMA).
How Action Contributes to Risk Reduction	Integrating land use planning and hazard mitigation planning efforts will result in better coordination and consistency and improve overall resilience through regulation.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Hurricanes and Coastal Hazards, Flooding
Priority	Low
Goal	1, 3, 4, 6, RL-2
Objective Addressed	2, 4, 5
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NC DEQ-Coastal Management
Completion Date	2020 (Interim Strategy)
Current Progress	NC DEQ did update of the planning guidelines for CAMA and unfortunately there was no coordination with NCEM. But based on conversations during this update cycle, NC DEQ and NCEM are going to try to work together on additional projects in the future, such as integrating CAMA planning with the mitigation planning cycle to promote consistencies across planning documents.
Anticipated Future Progress	As mentioned above, one of the biggest areas of focus going forward on this action is to try to improve coordination between NCEM and NC DEQ so that CAMA land use planning and hazard mitigation planning are not developed in separate silos, but instead are integrated processes that coordinate together. The main goal will be to try to line up the timing of these processes at the local level to facilitate integration and reduce inconsistencies across plans.

Action Number	NC-18
Action Number in Previous Plan	NC-76
Action Description	Assist all counties and stakeholders in developing their fuel plans for back-up fuel statewide.
How Action Contributes to Risk Reduction	Developing and maintaining up to date fuel plans will ensure back-up fuel is available when necessary, increasing resilience during disaster events.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 3
Objective Addressed	5
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Logistics and Supply Chain Management, Economic Recovery
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Logistics
Other Contributing Agencies	NC DEQ- State Energy Program
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	The state has worked with local counties on a continual basis to help them prepare their fuel plans and these have been completed for many of the communities in the state.
Anticipated Future Progress	These fuel plans require consistent updating, so the state will need to keep this action in place and continue to communicate with the counties to ensure fuel plans are up to date and accurate.

Action Number	NC-19
Action Number in Previous Plan	NC-77, NC-84
Action Description	Hold annual meetings with locals and utility entities on ice buildup, measurements, and related issues.
How Action Contributes to Risk Reduction	Holding annual meetings on issues related to severe winter weather will improve coordination and response during such events.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Severe Winter Weather
Priority	Moderate
Goal	1, 3
Objective Addressed	1, 2, 5
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM-Public Assistance
Other Contributing Agencies	NC Utilities Commission, Utility Companies, Local Governments
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	As of 2018, the state has had some meetings with utility entities and local governments on addressing issues related to severe winter weather. These meetings often take place at the local level and state officials attend when possible.
Anticipated Future Progress	The state would like to improve its attendance at these meetings going forward as there are often many coordination meetings at the local level that the state does not attend. These are critical opportunities for coordination on issues such as maintaining power during major events, so the state will re-focus on attending these meetings in the future when possible.

Action Number	NC-20
Action Number in Previous Plan	NC-79
Action Description	Enhance the NC ECO-Net through the State Climate Office to provide comprehensive weather and environmental monitoring in each of NC's 100 counties.
How Action Contributes to Risk Reduction	Improving comprehensive weather and environmental monitoring will allow more preparation for and better response to hazard events, reducing potential loss of life and property damage.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 2, 5, 6
Objective Addressed	1, 2, 3, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification,
Funding Source(s)	State resources
Primary Federal Agency	National Oceanic and Atmospheric Administration
Primary State Agency	State Climate Office
Other Contributing Agencies	NCEM
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	There is infrastructure for ECO-Net in place and it is all functioning correctly and at full capacity. However, the one shortfall is that there are not 100 stations up and functioning yet for all of the counties.
Anticipated Future Progress	As mentioned above, the ECO-Net system is fully in place and functioning, but the remaining work that needs to be done entails setting up and integrating a station in each of North Carolina’s 100 counties. The plan is to try to get all of the 100 planned stations set up and integrated by 2023.

Action Number	NC-21
Action Number in Previous Plan	NC-99
Action Description	Implement projects that help provide early warning, data, and/or reduce functional downtime to the emergency management community and public.
How Action Contributes to Risk Reduction	Improving early warnings and reducing functional downtime will allow better and faster response to hazard events, reducing potential loss of life and property damage.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	2
Objective Addressed	1, 3, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Local Governments
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	The state has a number of mechanisms in place to provide early warning information for local governments including the FIMAN and the Emergency Alert System (EAS). The state has also worked with local governments to provide early warning sirens and other alert systems to help reduce functional downtime for the public and local governments.
Anticipated Future Progress	In the future, the state will continually aim to improve the implementation of its early warning systems such as the EAS, so that citizens and local governments can respond to emergencies as quickly and effectively as possible. This may include integrating new technologies where possible and/or expanding systems in ways that help early warning messages reach additional people.

Action Number	NC-22
Action Number in Previous Plan	NC-101
Action Description	Develop and maintain an Enhanced State Hazard Mitigation Plan to increase HMGP funding subsequent to a flood disaster.
How Action Contributes to Risk Reduction	Developing and maintain an Enhanced State Hazard Mitigation Plan will increase funding and implementation of the plan, reducing vulnerability and minimizing risk.
Years of Action Establishment	5+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 2, 3, 4, 5, 6, RL-1, RL-2
Objective Addressed	1, 2, 3, 4, 5, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Economic Recovery, Health and Social Services, Housing, Natural and Cultural Resources
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	All State Agencies
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	The state has worked to maintain all aspects of its Enhanced Plan over the past five years and, during the 2018 update, has attempted to improve on several of the gaps that existed during previous versions of the plan with regard to Enhanced Plan status. This update includes a major overhaul of the plan structure and content and one of the primary intents of this overhaul was to more explicitly address many weaknesses in past versions.
Anticipated Future Progress	In future updates, the state will continue to maintain the Enhanced Plan status that it has achieved and will ensure that the components of the mitigation plan are integrated into the state's overall mitigation program to achieve implementation of the plan whenever possible.

Action Number	NC-23
Action Number in Previous Plan	NC-102
Action Description	Develop and conduct exercise models/exercises to continually update prevention measures, biosecurity recommendations and early response strategies to ensure that disease mitigation and response remain effective and efficient.
How Action Contributes to Risk Reduction	Developing and conducting exercise models/exercises will ensure disease transmission prevention and response are implemented effectively and new strategies are developed to reduce the spread of disease.
Years of Action Establishment	5+ years
Current Status of Action	In progress
Hazard Addressed	Infectious Disease
Priority	Low
Goal	1, 5
Objective Addressed	1, 2, 5, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Health and Social Services
Funding Source(s)	State resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	The NC Department of Health and Human Services has conducted a number of exercises over the past several years which have been integral in helping the department identify prevention measures that could be implemented to reduce risk to infectious diseases and also to develop new strategies for early response. These exercises have included representatives from multiple partner state agencies, but were primarily led by NC DHHS.
Anticipated Future Progress	Going forward, NC DHHS plans to continue to conduct exercises and models to ensure ongoing vigilance regarding disease transmission prevention activities. Continuing to carry out these activities will allow state officials to interact and coordinate in scenarios that can help them understand potential real-world conditions and develop strategies to improve prevention practices. NC DHHS will work to include more stakeholders from other state agencies in future activities and generally broaden the number of officials who are trained in these activities.

Action Number	NC-24
Action Number in Previous Plan	NC-105
Action Description	Increase State Lab capabilities to include ability to test for Foreign Animal Diseases (FADs) and Infectious Diseases (IDs) that most threaten North Carolina's citizens and animals.
How Action Contributes to Risk Reduction	Increasing capabilities to test for diseases will improve awareness of new threats and enable preventative measures to be implemented as necessary.
Years of Action Establishment	5+ years
Current Status of Action	In progress
Hazard Addressed	Infectious Disease
Priority	Low
Goal	1, 3, 5
Objective Addressed	1, 5, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Health and Social Services
Funding Source(s)	State resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	As new technology and systems have been developed, they have been integrated into the State Lab's capabilities to test for diseases with a focus on those diseases that are most likely to affect citizens in North Carolina. Many improvements have been made over the past 5 years, especially as new threats have emerged in the state.
Anticipated Future Progress	In the constantly evolving environment of disease transmission, testing for diseases is a critical activity that the State Lab will continue to carry out on a regular basis. A major focus of this action is to stay aware of new threats as they emerge over the coming years and to ensure that these new threats are identified quickly and that preventative action can be taken by health officials at all levels. The State Lab will continue to be a key player in this activity and will continue to integrate new testing technologies and strategies when available.

Action Number	NC-25
Action Number in Previous Plan	New Action
Action Description	Meet annually with NC Housing Finance Agency to identify available funding that could be used for mitigation and discuss opportunities to collaborate.
How Action Contributes to Risk Reduction	Identifying available funding and opportunities for collaboration annually will increase implementation of mitigation activities, reducing vulnerability and minimizing risk.
Years of Action Establishment	New Action
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 4, RL-1, RL-2
Objective Addressed	1, 2, 4
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment,
Funding Source(s)	State resources
Primary Federal Agency	N/A
Primary State Agency	NCEM
Other Contributing Agencies	NC Housing Finance Agency
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	New Action
Anticipated Future Progress	The NC Housing Finance Agency may be a source of funding for many project types that overlap with mitigation, including elevation of residential structures. NCEM hopes to meet with the agency on an annual basis to discuss joint ventures that may be undertaken to reduce risk and improve the lives of citizens through these funding sources.

Action Number	NC-26
Action Number in Previous Plan	New Action
Action Description	Directly integrate mitigation actions from state hazard mitigation plan into RiskMAP program to ensure progress is being tracked and recognized.
How Action Contributes to Risk Reduction	Ensuring that mitigation progress is tracked and recognized will help identify obstacles for implementation and increase the likelihood of successfully completion of mitigation efforts.
Years of Action Establishment	New Action
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 4, 5
Objective Addressed	2, 4, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	All State Agencies
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	New Action
Anticipated Future Progress	In the past NCEM has tracked progress of action via RiskMAP, but this has not been consistent or coordinated with the mitigation plan's actions, so going forward the state would like to develop a more formalized process for tracking progress in RiskMap that coincides with the annual review of the state hazard mitigation plan.

Action Number	NC-27
Action Number in Previous Plan	New Action
Action Description	Encourage use of PA 406 Mitigation program after disasters to rebuild public infrastructure by identifying potential projects prior to storm events so they are ready to implement when structures/facilities are damaged.
How Action Contributes to Risk Reduction	Identifying potential projects for PA 406 Mitigation funding prior to storm events will ensure that infrastructure can be rebuilt with less risk following a disaster event.
Years of Action Establishment	New Action
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	3, 4, 5, 6
Objective Addressed	1, 2, 4
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Critical Transportation, Infrastructure Systems, Economic Recovery
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	NC DOT, All State Agencies
Completion Date	2023 (Interim and Long-Term Strategy)
Current Progress	New Action
Anticipated Future Progress	NCEM and other state agencies have only infrequently used 406 Mitigation funding to help rebuild after disaster events because there is often pressure to rebuild quickly and identified measures to integrate mitigation techniques into the rebuilding process have not been defined ahead of time. As a result, the state would like to continue to work on improving the number of projects that use this funding so that infrastructure is not built back after a disaster with the same level of risk that it had prior to the disaster.

5.4.4 Actions that were identified as combined, deleted, or completed during 2018 plan update

Action Number	NC-28
Action Number in Previous Plan	NC-2
Action Description	Collect stream gauge data, rainfall data, and high-water mark data regularly
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-1
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	USGS
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	National Weather Service
Completion Date	Combined into NC-1
Current Progress	Combined into NC-1
Anticipated Future Progress	

Action Number	NC-29
Action Number in Previous Plan	NC-4
Action Description	Identify source of funds to assist owners of agricultural business/low-income households/small business owners to purchase flood insurance.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	Resources to be determined
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	Dept. of Commerce, Dept. of Agriculture
Completion Date	Deleted
Current Progress	Since no progress has been made on this action and it seems somewhat unrealistic that it will be achieved going forward, the planning team determined that it should be deleted.
Anticipated Future Progress	

Action Number	NC-30
Action Number in Previous Plan	NC-5
Action Description	Develop flood warning and alert system (NCFPM)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-1
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-1
Current Progress	Combined into NC-1
Anticipated Future Progress	

Action Number	NC-31
Action Number in Previous Plan	NC-6
Action Description	Develop and Implement Integrated Hazard Risk Management and Communications Tool
How Action Contributes to Risk Reduction	Implementing the Integrated Hazard Risk Management and Communications Tools enables improved risk management.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Completed
Current Progress	We have completed development of this tool so this action is considered complete.
Anticipated Future Progress	

Action Number	NC-32
Action Number in Previous Plan	NC-7
Action Description	Develop working relationship with state and federal agencies with interests related to emergency management and hazard mitigation, with technologies from which we can benefit.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Hurricanes, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards,
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	State Climate Office,USGS/NCGS, NC DEQ/Coastal Management, US Corps of Engineers, FEMA, NWS
Completion Date	Deleted
Current Progress	This action was evaluated and considered to be an inherent part of our programming as we are always working to build relationships with other agencies and interests related to emergency management and hazard mitigation. Therefore, it will be deleted.
Anticipated Future Progress	

Action Number	NC-33
Action Number in Previous Plan	NC-8
Action Description	Identify properties to be acquired that will support mitigation. Coordinate with other entities to leverage other fund sources for acquisition to support addition state mandated goals.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Hurricanes, Flooding, Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Clean Water Trust Fund, NC DEQ/Coastal Management, FEMA, Disaster Housing
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-34
Action Number in Previous Plan	NC-10
Action Description	Utilize the National Weather Service Forecast and Warning (FWF, RFW) with support from State and Federal sources.
How Action Contributes to Risk Reduction	Utilizing the National Weather Service Forecast and Warning allows more and better preparation for hazard events.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Severe Winter Weather, Dam Failure, Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	
Other Contributing Agencies	NCEM/National Weather Service, NCGS Land Quality, NC Dam Safety, State Climate Office
Completion Date	Completed
Current Progress	This action was evaluated and determined to be so integrated into our programs and operations that it no longer needs to be defined as an action and has been marked complete.
Anticipated Future Progress	

Action Number	NC-35
Action Number in Previous Plan	NC-14
Action Description	Promote updating Building Codes in hazard-prone areas.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Earthquake
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NC-DOI
Other Contributing Agencies	NCEM, IBC (find out who regulates)
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-36
Action Number in Previous Plan	NC-17
Action Description	Link data on vulnerability through HAZUS (MH) (3)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Earthquake
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Deleted
Current Progress	Upon further analysis, this task has proven too much of a challenge and has been determined to not really be feasible given the lack of existing data and the fact that any data that does exist is not really compatible in Hazus. As such, this action was identified for deletion.
Anticipated Future Progress	

Action Number	NC-37
Action Number in Previous Plan	NC-18
Action Description	Develop funding source (with hazard funds) targeted to areas most vulnerable to earthquakes, sinkholes, and landslide/geochemistry for acquisition and/or conservation easements.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Earthquake, Geological Hazards
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NC-DEQ
Other Contributing Agencies	NCEM
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-38
Action Number in Previous Plan	NC-19
Action Description	Develop and conduct county-wide educational programs for county and municipal officials on general aspects of Firewise Communities.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources, possibly mitigation grant funds
Primary Federal Agency	
Primary State Agency	NC-DEQ-Forest Resources
Other Contributing Agencies	NCEM
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-39
Action Number in Previous Plan	NC-20
Action Description	Have state capable to support less advantaged jurisdictions to seek, apply for and implement grants.
How Action Contributes to Risk Reduction	Supporting less advantaged jurisdictions increases mitigation action implementation, reducing vulnerability and risk.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	Forest Resources, Dept. of Commerce/Division of Community Assistance
Completion Date	Completed
Current Progress	This action has been in place for several cycles of plan updates and the state has remained capable of providing support to less advantaged jurisdictions throughout. Therefore, it was determined that this should be marked complete during this update cycle as this action is more of a capability at this point.
Anticipated Future Progress	

Action Number	NC-40
Action Number in Previous Plan	NC-26
Action Description	Increase the number of USGS stream-flow gauges statewide. (MH)(2)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-1
Hazard Addressed	Drought
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NC-DEQ
Completion Date	Combined into NC-1
Current Progress	Combined into NC-1
Anticipated Future Progress	

Action Number	NC-41
Action Number in Previous Plan	NC-27
Action Description	Increase monitoring of precipitation and ground/surface water supplies. (3)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-13
Hazard Addressed	Drought
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NC-DEQ
Other Contributing Agencies	NCEM
Completion Date	Combined into NC-13
Current Progress	Combined into NC-13
Anticipated Future Progress	

Action Number	NC-42
Action Number in Previous Plan	NC-28
Action Description	Develop and maintain a variety of widely-adaptable mitigation PowerPoints.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Drought
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-43
Action Number in Previous Plan	NC-29
Action Description	Encourage attendance at the Drought Management Advisory Council annual meetings.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Drought
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	State Climate Office
Other Contributing Agencies	
Completion Date	Deleted
Current Progress	This action has been included in the last several updates of the hazard mitigation plan and has been carried out to the degree that it is now considered a capability, so it will be deleted.
Anticipated Future Progress	

Action Number	NC-44
Action Number in Previous Plan	NC-31
Action Description	Enhance the “Workbook” for local planning officials to include more information on dam failure mitigation activities and recommendations from local planners
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-10
Hazard Addressed	Dam Failure
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NC-DEQ-Dam Safety
Other Contributing Agencies	NCEM
Completion Date	Combined into NC-10
Current Progress	Combined into NC-10
Anticipated Future Progress	

Action Number	NC-45
Action Number in Previous Plan	NC-32
Action Description	Gain insights from local public officials (through survey instruments and other means) on what additional products or services could assist them in developing local mitigation plans.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-46
Action Number in Previous Plan	NC-33
Action Description	Develop, publicize and provide a wide variety of risk assessment products and planning services to assist local officials throughout the local mitigation planning process
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-47
Action Number in Previous Plan	NC-34
Action Description	Design a two-day workshop for local officials on “Utilizing GIS for Hazard Mitigation Planning”
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-48
Action Number in Previous Plan	NC-35
Action Description	Increase the number of USGS stream gauges Statewide.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-1
Hazard Addressed	Flooding, Hurricanes, Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	Federal resources
Primary Federal Agency	USGS
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-1
Current Progress	Combined into NC-1
Anticipated Future Progress	

Action Number	NC-49
Action Number in Previous Plan	NC-36
Action Description	Look into USGS mapping for geologic indicators to support Risk Assessment capabilities for the state.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-8
Hazard Addressed	Geological Hazards
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NC-DEQ-Geological Survey
Other Contributing Agencies	NCEM-Risk Management
Completion Date	Combined into NC-8
Current Progress	Combined into NC-8
Anticipated Future Progress	

Action Number	NC-50
Action Number in Previous Plan	NC-37
Action Description	Update Building Code to reflect hazard mitigation building techniques. (4)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	1
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NC-DOI
Other Contributing Agencies	
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-51
Action Number in Previous Plan	NC-38
Action Description	Promote full funding of NC Flood Mapping Program to complete new Flood Insurance Studies for entire state.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-11
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NC-General Assembly
Other Contributing Agencies	NCEM-Risk Management
Completion Date	Combined into NC-11
Current Progress	Combined into NC-11
Anticipated Future Progress	

Action Number	NC-52
Action Number in Previous Plan	NC-39
Action Description	Promote river basin wide planning of flood hazard Promote consideration of future build-out conditions when establishing land use and floodplain management regulations.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NC-DEQ-Water Quality
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-53
Action Number in Previous Plan	NC-40
Action Description	Promote consideration of future build-out conditions when establishing land use and floodplain management regulations.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	Dept. of Commerce/Division of Community Assistance, NC League of Municipalities, NC Home Builders Association
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-54
Action Number in Previous Plan	NC-41
Action Description	Promote improvement of storm drainage systems. (4)*This action was edited b/c maintenance is not mitigation. We think drainage systems cover stream channels.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	Dept. of Commerce, Dept. of Agriculture, Dept. of Administration/Environmental Clearinghouse, NCDOT
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-55
Action Number in Previous Plan	NC-42
Action Description	Ensure that tree trimming policies of local governments have been reassessed to comply with industry standards (MH) (4)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Severe Winter Weather
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NCEM-Public Assistance
Other Contributing Agencies	NC League of Municipalities, County Commissioners Association, NC Utilities Commission
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-56
Action Number in Previous Plan	NC-43
Action Description	Establish a State Weather Support Service to coordinate the weather information needs and tailor the weather forecasts for State Agencies (DOT, Forestry, DEQ, Corrections, etc.)
How Action Contributes to Risk Reduction	Establishing a State Weather Support service to coordinate weather information needs and tailor weather forecasts enables earlier warnings and better preparation for hazard events.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Severe Winter Weather
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NCDOT, State Climate Office
Completion Date	Completed
Current Progress	State agencies have worked together to develop a weather support service that helps each of those agencies to make decisions in weather-related emergencies. This action has been well-integrated and is now considered complete.
Anticipated Future Progress	

Action Number	NC-57
Action Number in Previous Plan	NC-44
Action Description	Provide corporate incentives to businesses that encourage employees to not come in during severe winter weather. (MH) (5)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Severe Winter Weather
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NC-DOC
Other Contributing Agencies	NC-General Assembly
Completion Date	Deleted
Current Progress	This action was re-assessed and determined to be overly ambitious and likely not something that is readily achievable so it was deleted from this update.
Anticipated Future Progress	

Action Number	NC-58
Action Number in Previous Plan	NC-45
Action Description	Assess incentives and disincentives in the insurance framework that affect mitigation; consider following the NFIP model for Firewise Communities.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NC-DOI
Other Contributing Agencies	NCEM, NC-DEQ-Forest Resources
Completion Date	Deleted
Current Progress	After evaluating this action during this update, it was determined that this action would be challenging to fund and is not necessarily a high priority in the upcoming update cycle, so this action will be deleted.
Anticipated Future Progress	

Action Number	NC-59
Action Number in Previous Plan	NC-46
Action Description	Promote the National Fire Plan as a source for Wildfire Mitigation Funding.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NC-DEQ-Forest Resources
Other Contributing Agencies	NCEM
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-60
Action Number in Previous Plan	NC-48
Action Description	Advocate inclusion of mitigation strategies in relevant public policy. (MH) (1)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	Governor's Office
Other Contributing Agencies	NCEM, NC-DEQ-Forest Resources
Completion Date	Deleted
Current Progress	This action was evaluated during this update and it was determined that this action was generic and was considered an inherent part of the state’s mitigation program. Therefore, this action was deleted.
Anticipated Future Progress	

Action Number	NC-61
Action Number in Previous Plan	NC-49
Action Description	Provide state funding to the State Climate Office; funding not currently coming from Legislative Sources. (-60% from UNC System and remainder from grants)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-11
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	Resources to be determined
Primary Federal Agency	
Primary State Agency	Governor's Office
Other Contributing Agencies	NCEM, NC-DEQ-Forest Resources
Completion Date	Combined into NC-11
Current Progress	Combined into NC-11
Anticipated Future Progress	

Action Number	NC-62
Action Number in Previous Plan	NC-50
Action Description	Present the American Society of Dam Safety Officials (ASDSO) report on reductions in FEMA funding, and ask for assistance/supplemental funding into The Dam Safety Fund to keep Dam Safety Program viable.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-11
Hazard Addressed	Dam Failure
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NC-DEQ-Geological Survey
Other Contributing Agencies	NC-DEQ-Dam Safety
Completion Date	Combined into NC-11
Current Progress	Combined into NC-11
Anticipated Future Progress	

Action Number	NC-63
Action Number in Previous Plan	NC-51
Action Description	Fund the NC Department of Commerce to conduct a drought economic impact study analyzing the 2002 drought that surveys local communities, state agencies, business and industry farmers and other affected parties. (5)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-13
Hazard Addressed	Drought
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NC-DOC
Other Contributing Agencies	
Completion Date	Combined into NC-13
Current Progress	Combined into NC-13
Anticipated Future Progress	

Action Number	NC-64
Action Number in Previous Plan	NC-52
Action Description	Develop proposal to allow market forces to have rate differentials for Wind/lightning mitigation features safe rooms fortified homes. (MH)(2)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	IBHS, NCDOI
Completion Date	Deleted
Current Progress	This action was evaluated during this update and it was determined that this was not feasible economically, so it was deleted.
Anticipated Future Progress	

Action Number	NC-65
Action Number in Previous Plan	NC-53
Action Description	Provide safe havens/rooms for Mobile Home Parks.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NCDOI, Manufactured Housing Institute
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-66
Action Number in Previous Plan	NC-54
Action Description	Encourage local governments to use their risk and historical hazard data for purposes of modifying regulations, standards, ordinance to minimize their vulnerability.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NCGS, League of Municipalities, County Commissioners Association
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-67
Action Number in Previous Plan	NC-55
Action Description	Promote and support recognition programs, such as the Community Rating System (CRS)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-6
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	Local Governments
Completion Date	Combined into NC-6
Current Progress	Combined into NC-6
Anticipated Future Progress	

Action Number	NC-68
Action Number in Previous Plan	NC-56
Action Description	Promote 406 mitigation through discussion and presentations with various state and federal partners.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-69
Action Number in Previous Plan	NC-57
Action Description	Discuss with the Insurance Industry the ability of applying market force incentives to insurance premiums.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NC-DOI
Other Contributing Agencies	NCEM-Risk Management
Completion Date	Deleted
Current Progress	This action was evaluated during this update and it was determined that this was not feasible economically, so it was deleted.
Anticipated Future Progress	

Action Number	NC-70
Action Number in Previous Plan	NC-58
Action Description	Identify planning activities of state agencies, select those most relevant to natural hazard mitigation, and work with the responsible agency to integrate mitigation into those activities.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	
Completion Date	Deleted
Current Progress	This action was evaluated during this update and it was determined that this action was generic and was considered an inherent part of the state's mitigation program. Therefore, this action was deleted.
Anticipated Future Progress	

Action Number	NC-71
Action Number in Previous Plan	NC-59
Action Description	Formulate a proposal to the General Assembly that will require all major development projects to develop a natural hazard vulnerability impact assessment during the project planning process, to disclose the extent to which the proposed development will affect the vulnerability of the area to the impact of natural hazards.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Deleted
Current Progress	This action was evaluated during this update and it was determined that this action was too ambitious and would likely not be accomplished as it would take a great deal of political support. Therefore, this action was deleted.
Anticipated Future Progress	

Action Number	NC-72
Action Number in Previous Plan	NC-62
Action Description	Incorporate hazards risk maps and hazard mitigation strategies into local land use plans.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	Local Governments
Completion Date	Deleted
Current Progress	This action was evaluated during this update and it was determined that this is a local level action that the state has no control over. Therefore, it was deleted.
Anticipated Future Progress	

Action Number	NC-73
Action Number in Previous Plan	NC-63
Action Description	Develop with the Institute of Government a training module for training county and municipal administration course on Hazard Mitigation.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	NCLM, FEMA
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-74
Action Number in Previous Plan	NC-64
Action Description	Promote safe room construction.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Hurricane, Severe Winter Weather, Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-75
Action Number in Previous Plan	NC-65
Action Description	Train local emergency managers on various mitigation activities and funding opportunities.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-76
Action Number in Previous Plan	NC-67
Action Description	Develop and distribute Hazard Mitigation brochures.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-77
Action Number in Previous Plan	NC-68
Action Description	Distribute publications, information, and newsletters/updates electronically via the Internet, and removable data mediums (CDs, USB flash drives, etc.).
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-78
Action Number in Previous Plan	NC-69
Action Description	Research, analyze and document missed opportunities for mitigation measures. (4)
How Action Contributes to Risk Reduction	Determining missed opportunities for mitigation improves future mitigation measure evaluation and implementation.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	2
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	
Completion Date	Completed
Current Progress	This has been carried out continually as part of all pre- and post-disaster programming and is now considered an inherent part of the state's mitigation program overall. Therefore, this action is considered a capability and is completed.
Anticipated Future Progress	

Action Number	NC-79
Action Number in Previous Plan	NC-70
Action Description	Establish key contacts in various departments to facilitate exchange of information post-disaster.
How Action Contributes to Risk Reduction	Facilitating exchange of information post-disaster increases awareness and knowledge, promoting future mitigation efforts to reduce vulnerability.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	
Other Contributing Agencies	NCEM, NCDOT, NCDOI, NC Public Health, NC Dept. of Agriculture, NC Dept. of Corrections, SERT agencies, Office of Governor, FEMA
Completion Date	Completed
Current Progress	This has been carried out continually and is now considered an inherent part of the state's mitigation program overall. Therefore this action is considered a capability and is completed.
Anticipated Future Progress	

Action Number	NC-80
Action Number in Previous Plan	NC-71
Action Description	Coordinate with Clean Water Task Force and other entities to leverage other fund sources for acquisition to support additional state mandated goals such as clean water.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	NCEM, Clean Water Trust Fund, DEQ/Water Quality, DEQ/Coastal Management, Million Acre Initiative
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-81
Action Number in Previous Plan	NC-72
Action Description	Identify public, private, non-profit and special interest agencies or organizations with which collaboration would be beneficial for furthering flood hazard mitigation.
How Action Contributes to Risk Reduction	Improving collaboration supports the implementation of flood hazard mitigation efforts.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	
Other Contributing Agencies	NCEM, Governor's Office, Dept. of Commerce, Red Cross, Americorps
Completion Date	Completed
Current Progress	This has been carried out continually and is now considered an inherent part of the state's mitigation program overall. Therefore, this action is considered a capability and is completed.
Anticipated Future Progress	

Action Number	NC-82
Action Number in Previous Plan	NC-74
Action Description	Educate organizations on the theory and practice of hazard mitigation, and help them to identify how mitigation can become incorporated into their own routine functions or activities.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Hurricanes, Severe Winter Weather
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	DOC-Community Assistance, US Corps of Engineers
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-83
Action Number in Previous Plan	NC-75
Action Description	Inventory all agencies involved in Hazard Mitigation Planning and coordinate to avoid duplication.
How Action Contributes to Risk Reduction	Coordinating all agencies involved in Hazard Mitigation Planning will ensure efficiency and promote successful mitigation.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Hurricanes
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Completed
Current Progress	This has been completed as an inventory of all agencies involved in hazard mitigation planning exists and is used regularly for coordination. Therefore, this action is considered completed.
Anticipated Future Progress	

Action Number	NC-84
Action Number in Previous Plan	NC-78
Action Description	Develop a way for DOT's TIMS to not only be in text, but in graphics also.
How Action Contributes to Risk Reduction	Converting NC DOT TIMS to map format makes the information more accessible and improves awareness.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Severe Winter Weather
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	
Primary State Agency	NC-DOT
Other Contributing Agencies	
Completion Date	Completed
Current Progress	The NC DOT TIMS system has been converted to map format, so this action is now complete.
Anticipated Future Progress	

Action Number	NC-85
Action Number in Previous Plan	NC-80
Action Description	Make CGIA services free to state agencies.
How Action Contributes to Risk Reduction	Making CGIA services available to all agencies increases awareness.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Wildfire
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	Governor's Office
Other Contributing Agencies	NCEM, NC-DEQ, NC-DOC
Completion Date	Completed
Current Progress	CGIA services are available to all agencies and have been for some time so this action is considered complete and is a capability now.
Anticipated Future Progress	

Action Number	NC-86
Action Number in Previous Plan	NC-81
Action Description	Coordinate all drought mitigation activities through the Drought Management Advisory Council.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-13
Hazard Addressed	Drought
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State and Local resources
Primary Federal Agency	
Primary State Agency	NC-DEQ
Other Contributing Agencies	
Completion Date	Combined into NC-13
Current Progress	Combined into NC-13
Anticipated Future Progress	

Action Number	NC-87
Action Number in Previous Plan	NC-83
Action Description	Develop relationship between DOI and NCGS to uncover potential linkages of geological risk data into the Building Code, and Market Based Insurance Rates.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Geological Hazards
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	
Primary State Agency	NC-DEQ-Geological Survey
Other Contributing Agencies	NC-DOI
Completion Date	Deleted
Current Progress	During the last several update cycles, this funding has not been available and it does not appear that it will be in the future so this action will be deleted.
Anticipated Future Progress	

Action Number	NC-88
Action Number in Previous Plan	NC-84
Action Description	Have utilities share the ice buildup measurement data from their data stations with National Weather Service and Climate Office.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-19
Hazard Addressed	Severe Winter Weather
Priority	
Goal	
Objective Addressed	3
NPG Core Capability	
Funding Source(s)	NWS, utility companies
Primary Federal Agency	
Primary State Agency	State Climate Office
Other Contributing Agencies	
Completion Date	Combined into NC-19
Current Progress	Combined into NC-19
Anticipated Future Progress	

Action Number	NC-89
Action Number in Previous Plan	NC-85
Action Description	Develop and conduct county-wide educational programs for the general public on general aspects of the North Carolina DFIRMs highlighting the benefits of flood mapping, feature of new DFIRMs, flood insurance implications, etc.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	4
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-90
Action Number in Previous Plan	NC-87
Action Description	Participate in the North Carolina Aquariums Earth Day Expo.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	4
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-91
Action Number in Previous Plan	NC-88
Action Description	Host booth(s) at county and state fairs. (4)
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	4
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-92
Action Number in Previous Plan	NC-89
Action Description	Coordinate with County Cooperative Extension Services for Symposiums/events to include information on natural hazard risks and mitigation.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	4
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	
Primary State Agency	NCEM
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-93
Action Number in Previous Plan	NC-90
Action Description	Develop Bi-lingual mitigation messages.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	4
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-94
Action Number in Previous Plan	NC-92
Action Description	Conduct direct outreach on non-structural mitigation measures at Local, Tribal, and State agencies as well as citizens.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-3
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	4
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	
Completion Date	Combined into NC-3
Current Progress	Combined into NC-3
Anticipated Future Progress	

Action Number	NC-95
Action Number in Previous Plan	NC-93
Action Description	Acquire properties that are located in areas vulnerable to hazards.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	UHMA, State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Local Governments
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-96
Action Number in Previous Plan	NC-94
Action Description	Elevate properties that are located in areas vulnerable to flooding.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Flooding
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	UHMA, State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Local Governments
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-97
Action Number in Previous Plan	NC-95
Action Description	Action Item: Structural retrofits for structures that are vulnerable to wind events.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Hurricane, Severe Winter Weather, Tornado/Thunderstorm
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	UHMA, State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Local Governments
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-98
Action Number in Previous Plan	NC-96
Action Description	Action Item: Non-structural retrofits for structures that are vulnerable to earthquakes/geological events.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Earthquake, Geological Hazards
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	UHMA, State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Local Governments
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-99
Action Number in Previous Plan	NC-97
Action Description	Analyze building stock to identify potential structures that could be mitigated.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-2
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	UHMA, State resources
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	
Completion Date	Combined into NC-2
Current Progress	Combined into NC-2
Anticipated Future Progress	

Action Number	NC-100
Action Number in Previous Plan	NC-98
Action Description	Develop studies, collect and analyze data on areas of risk to various hazards.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Combined into NC-14
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	UHMA, State resources, EMPG
Primary Federal Agency	
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NC-DEQ, NC-DHHS
Completion Date	Combined into NC-14
Current Progress	Combined into NC-14
Anticipated Future Progress	

Action Number	NC-101
Action Number in Previous Plan	NC-100
Action Description	Implement projects that help local governments develop and maintain their local mitigation plans.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Flooding, Hurricane, Severe Winter Weather, Earthquake, Wildfire, Dam Failure, Drought, Tornado/Thunderstorm, Geological Hazards
Priority	
Goal	
Objective Addressed	5
NPG Core Capability	
Funding Source(s)	State resources HMGP (7% projects), PDM
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	Local Governments
Completion Date	Deleted
Current Progress	Upon further evaluation, this action is considered too generic as it is an inherent component of the mitigation program. Therefore, this action will be deleted.
Anticipated Future Progress	

Action Number	NC-102
Action Number in Previous Plan	NC-103
Action Description	Develop system to upgrade statewide spatial and surveillance data maintained in-house through multiple data sources.
How Action Contributes to Risk Reduction	Upgrading spatial and surveillance data improves risk assessment and management.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Infectious Disease
Priority	
Goal	
Objective Addressed	
NPG Core Capability	
Funding Source(s)	State or Federal resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	Completed
Current Progress	In 2016, NC DHHS established the NC Electronic Disease Surveillance System (NC EDSS), so this action is considered complete.
Anticipated Future Progress	

Action Number	NC-103
Action Number in Previous Plan	NC-104
Action Description	Develop system to upgrade statewide ID data maintained in-house through multiple data sources.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Infectious Disease
Priority	
Goal	
Objective Addressed	
NPG Core Capability	
Funding Source(s)	State or Federal resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	Deleted
Current Progress	During the 2018 update of this plan, this action was evaluated and it was determined that it is no longer a top priority and should be removed from the plan.
Anticipated Future Progress	

Action Number	NC-104
Action Number in Previous Plan	NC-106
Action Description	Develop and implement a syndrome based surveillance system that incorporates human and animal health.
How Action Contributes to Risk Reduction	Implementing a syndrome based surveillance system improves the ability to identify disease, implement preventative actions, and manage risk.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Infectious Disease
Priority	
Goal	
Objective Addressed	
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	Completed
Current Progress	A new syndrome-based system, called NC Detect, that incorporates both animal and human health has been developed and implemented so this action is considered complete.
Anticipated Future Progress	

Action Number	NC-105
Action Number in Previous Plan	NC-107
Action Description	Create ID and GIS staff positions and maintain them with capable personnel using competitive salary increases as needed.
How Action Contributes to Risk Reduction	
Years of Action Establishment	
Current Status of Action	Deleted
Hazard Addressed	Infectious Disease
Priority	
Goal	
Objective Addressed	
NPG Core Capability	
Funding Source(s)	State resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	Deleted
Current Progress	Since the state budget has not allocated funding for additional positions during the past two updates and it does not appear that it will be available in the near future, this action was deleted.
Anticipated Future Progress	

Action Number	NC-106
Action Number in Previous Plan	NC-108
Action Description	Build and maintain a real-time ID webpage that communicates prevention measures, biosecurity practices, warnings, disease recognition, reporting information and actual incidents.
How Action Contributes to Risk Reduction	Maintaining a real-time ID webpage increases awareness and improves risk management of infectious diseases.
Years of Action Establishment	
Current Status of Action	Completed
Hazard Addressed	Infectious Disease
Priority	
Goal	
Objective Addressed	
NPG Core Capability	
Funding Source(s)	State and Federal resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	Completed
Current Progress	A real-time infectious disease webpage has been developed and achieves all of the activities outlined above. This is the epi.publichealth.nc.gov website. As such, this action is considered complete.
Anticipated Future Progress	

Section 6. PLAN MAINTENANCE, MONITORING AND IMPLEMENTATION

44 CFR Requirement

Requirement §201.4(c)(5) [The Standard State Plan Maintenance Process must include]

(i) An established method and schedule for monitoring, evaluating, and updating the plan.

(ii) A system for monitoring implementation of mitigation measures and project closeouts.

(iii) A system for reviewing progress on achieving goals as well as activities and projects identified in the Mitigation Strategy

This section of the plan provides an overview of the procedures that define how the State of North Carolina will monitor, evaluate and update this plan over time. This includes defining implementation procedures to be followed and ways that the plan can be enhanced in the future. This sections also provides an overview of the system used to monitor implementation of mitigation measures and project closeouts. And finally, this section provides a summary of the system for reviewing progress made towards achieving goals, activities and projects identified in the Mitigation Strategy.

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

6.1.1 Effectiveness of the Past Process

As part of the 2018 plan update process, NCEM Risk Mitigation staff reviewed the defined method for monitoring, evaluating, and updating the plan and decided that a completely new format for presenting those procedures was needed for the 2018 plan. This decision was made for a multitude of reasons but the major factors were the organizational structure changes that have been made in the last five years, the integration of the Floodplain Mapping Discovery process and the State Mitigation Advisory Group into the Risk Management Coordinating Council and the need for a better defined process based off of realistic expectation and needs. This revised section represents the revised layout for plan maintenance, monitoring and implementation procedures.

6.1.2 Agency and Section Responsible

As provided for in the North Carolina Emergency Management Act of 1977 (NCGS 166A-5 (3) (b)), the responsibility for preparation and maintenance of State Plans for technological or natural disasters resides within the North Carolina Division of Emergency Management (NCEM). The Risk Mitigation Branch of NCEM will be responsible for developing and maintaining the State Hazard Mitigation Plan. The State Hazard Mitigation Officer is the individual responsible for overseeing this work.

6.1.3 Schedule

Monitoring the Plan

Regular monitoring of this Plan is essential for the document to be a true working document and is primarily accomplished through NCEM's efforts to track the implementation and relevance of the plan. NCEM's method for monitoring includes tracking implementation of actions found in the Mitigation Strategy. This helps ensure that the plan is being implemented over time. The mitigation actions listed within the Mitigation Strategy are measurable and time-bounded, and tracking implementation and progress is built-in to each action.

Other ways that NCEM monitors the relevance of the plan is through meetings with the RMCC and other stakeholders to ensure that the data and methodologies that go toward developing the capability and risk assessments remain current. This helps ensure that the plan itself contributes to remain current and reflects changes to the statewide mitigation program.

The Risk Mitigation Branch is responsible for conducting an ongoing monitoring progress made toward implementing the Plan.

Evaluating the Plan

In addition to monitoring of the plan, routine evaluation of the Plan helps provide information and data to measure progress and success in carrying out objectives identified within the Plan. Continued scrutiny of the document will help determine its overall effectiveness and ensure its ongoing relevance to the State's mitigation needs. The end result of evaluating the Plan will be to make necessary revisions and enhancements, keeping the Plan up-to-date with current information, and maintaining the Plan's functionality for the State. NOTE: The evaluation criteria presented below represent all new methods for evaluating the plan than were used in previous versions of the plan.

NCEM will conduct an annual evaluation of the plan, generally in the month of April. The evaluation will consider several basic factors including:

1. Changes in the level of risk to the State and its citizens.
2. Changes in laws, policies, or regulations at the State or local levels.
3. Changes in State agencies or their procedures that will affect how mitigation programs or funds are administered.
4. Significant changes in funding sources or capabilities.

5. Changes in the composition of the RMCC
6. Progress on implementing mitigation actions (including project closeouts) and identification of new mitigation actions that the State is considering.
7. Major changes to local or multi-jurisdictional hazard mitigation plans.

In regard to tracking mitigation actions, NCEM will email RMCC members each year, at a minimum, to determine if there are any changes in status for the mitigation actions. The RMCC will also be encouraged to submit new mitigation actions. If an agency reports changes or submits a new action, NCEM will be responsible for incorporating those changes into the Plan.

Additionally, NCEM will contact the County Emergency Management Agency Directors (or other individuals and organizations as appropriate) to determine if updates have been made to certain elements of the local plans as part of the annual review process. The purpose of this effort is to ensure that local information about risk, goals, projects, and mitigation strategies included in the State Plan remains current.

If any party indicates that an update is warranted, outside of the required, five-year update schedule, then NCEM, in conjunction with the RMCC, will initiate the plan update process.

To further involve the RMCC in the ongoing mitigation planning process, the RMCC will be invited to attend NCEM's applicant briefing following a disaster. The RMCC will also be informed about disaster events via email. NCEM continues to advise agencies on how to incorporate mitigation into their planning efforts. Further, NCEM maintains regular contact with several members of the RMCC. This ongoing communication and relationship facilitates information sharing between agencies regarding mitigation activities.

Updating the Plan

NOTE: The update criteria presented below represent all new methods for updating the plan than were used in previous versions of the plan. The plan will be updated and re-submitted to FEMA for re-approval every five years, as required by law. The plan may also be subject to interim updates if any of the following conditions apply:
1. At the request of the Governor;
2. When significant new risks or vulnerabilities are identified; or
3. If the findings of the annual / post-disaster review and evaluation warrant.

The two sub-paragraphs below describe the procedures for interim and five-year updates, respectively.

Updates Resulting from Interim Evaluations

The nature of plan updates will be determined by the evaluation process described above. In general, NCEM will notify the RMCC that the Agency is initiating an interim plan update, and describe the circumstances that created the need for the update. NCEM will determine if the full RMCC should be consulted regarding the potential changes. If it is determined that the RMCC should be involved, the nature of the involvement will be at the discretion of NCEM.

When interim updates are completed, NCEM will advise all RMCC members that the plan has been updated, and describe the nature of the update.

Updates Related to the Required Five-year Plan Review (by FEMA)

As required by law, every five years the plan will be updated for re-submission and re-approval by FEMA. In those years, the evaluation process will be substantially more rigorous, and will examine all aspects of the plan in detail. It is anticipated that several meetings of the RMCC will be required to conduct a full update of the plan, and that the plan will be formally readopted by the State. Between 6 and 12 months prior to the update deadline, NCEM will initiate the plan update process by contacting RMCC members and other appropriate agencies and organizations to determine a schedule and process for updating the plan.

The update process will entail a detailed and structured re-examination of all aspects of the original plan, followed by recommended updates. The recommendations will be presented to the RMCC for consideration and approval. It is expected that the Director of NCEM will re-approve the plan and adopt as the Governor's Authorized Representative.

6.2 MONITORING IMPLEMENTATION OF MITIGATION MEASURES AND PROJECT CLOSEOUTS

6.2.1 System of Tracking Implementation

The implementation of mitigation grant funding programs including Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, and Pre-Disaster Mitigation (PDM) program, is managed and monitored by the Hazard Mitigation Branch, Resiliency Section of the NCEM. When grant funding is approved by FEMA, the implementation phase begins with the signing of a grant agreement between the State of North Carolina (grantee) and the local government (subgrantee).

The State of North Carolina's current system for monitoring implementation of mitigation measures and project closeouts and emphasizes the development and implementation of projects that can be tracked to demonstrate progress in reducing our vulnerability to disasters. The State typically receives more qualified grant applications than it can fund after each disaster. Through continuous implementation of the measures identified in all previous editions of the state plan, the impact of natural hazards on people and property in the state is measurably being reduced.

NCEM is currently using a software program specifically developed to manage all grant projects called EM Grants Pro. The Hazard Mitigation Section uses EM Grants Pro to manage all aspects of project grants including monitoring mitigation measures and closeouts. In addition, as NCEM transitions to EM Grants Pro, NCEM simultaneously maintains a legacy Hazard Mitigation Project Tracker for all grants that have been awarded.

Project Implementation

The NCEM Hazard Mitigation Branch and the Risk Mitigation Branch is committed to providing technical assistance, monitoring, and tracking of implementation project activities identified in the state and local plans. Prior to project commencement, NCEM conducts an implementation meeting with all subgrantees to ensure that policies and procedures for implementing the grant are explained within the context of program and administrative requirements. The following documents are provided to the subgrantee at this meeting:

- Copy of approved application
- Copy of grant agreement or draft grant agreement
- NCEM Mitigation Standard Operating Procedures
- Getting to Open Space guide
- Citizenship verification forms
- Guide to cost and progress reports with project manager's contact information
- Computer disk including the following:
    - Project Cost Tracking Spreadsheet
    - Progress report form
    - Spreadsheet for determining budget info for cost report

For state or federally funded projects, subgrantees are required to submit progress reports on a monthly basis. Periodic site visits and telephone and email correspondences between the subgrantee and the state reinforces the technical assistance the state provides, and supplements the information stream to verify that projects are on track. In addition, grant managers track requests for reimbursement which provide information on project progress. Hazard Mitigation grant programs are generally operated on a reimbursement basis. At the local level, the subgrantee manages the various phases of the project as outlined in the scope of work. As communities implement projects, they can be reimbursed for project expenditures by submitting invoices and receipts to the state. This entire process must be accomplished within the bounds of the Federal Code of Regulations (CFR Part 44).

Project Closeout

The State uses the same process for all state and federally funded hazard mitigation grant programs when monitoring the implementation of mitigation measures and closing out projects:

- Mitigation staff of the NCEM use periodic site visits, the monthly reports provided by the project grant recipient, and the requests for cost reimbursement to monitor progress and ensure the project is on track.
- Additional site visits are scheduled for projects requiring special assistance.
- Final inspections are conducted by mitigation staff to ensure the project is completed to specification. For example, a project to acquire homes will be inspected to ensure all structures that have been acquired are demolished to specifications.

- Post-completion inspections are conducted regularly by State mitigation staff to ensure the community has complied with the terms of the grant agreement related to the maintenance of the mitigation project. For example, such an inspection will make sure that a park developed from a site of property acquisitions remains a park. The community is also legally required by the grant agreement to bi-annually submit a statement that the property is still being maintained in accordance with open space requirements.
- Project managers conduct a site visit with the community to ensure that files contain all completed forms, reports, and documents pertaining to the grant. Project managers use the attached checklist to guarantee that all necessary information is in the project files.
- Before projects are submitted for close out, financial reconciliation is conducted to validate all reimbursement requests before final payment is made. Requests are validated against the approved Scope of Work to ensure only allowable costs are reimbursed.
- Prior to sending a closeout request letter to FEMA, a NCEM/Hazard Mitigation Supervisor reviews the project closeout checklist and the financial reconciliation performed by the project manager to ensure all work has been completed and the financial portion of the project is correct, as well as ensuring the permanent project files are complete.
- A single NCEM/Hazard Mitigation Supervisor or delegated staff member creates all closeout letters to ensure accuracy. This staff member is responsible for following up to ensure project folders and electronic files are complete and accurate. Financial information is checked to certify that the final costs are correct.
- When the State submits letters for close out, a spreadsheet is provided with information that FEMA has requested for NEMIS data input. This spreadsheet provides property site information for every building acquired, elevated, or retrofitted in a project.
- Since North Carolina maintains status as a Managing State, NCEM is required to submit the Property Site Inventory information via NEMIS for all disasters after DR#1312 and all subsequent disasters. Each time NEMIS is updated, the State is required to revise the PSI spreadsheet to include the additional information for each structure. FEMA may request that the State update the NEMIS PSI information in a timely manner.
- A spreadsheet is also maintained to document when the State's Closeout Request Letter was submitted to FEMA, when the State received the FEMA Final Claims Letter, and when the State submitted a Concurrence Letter back to FEMA. A copy of this spreadsheet is attached.

As part of the closeout process, NCEM Hazard Mitigation Staff began drafting detailed project closeout letters which include Project Closeout Certification Statements and Property Site Inventories. These additional documents have enhanced accountability for all deliverables and financial reconciliation across all properties identified in the Scope of Work. This has produced an "end-to-end" approach, where project development, implementation, and closeout are geared to produce these final closeout deliverables along the path of the life cycle of grants management (and not just as a final step). The Hazard Mitigation Branch also developed an effective process to track all grants during the implementation and closeout phases of grants management, built around an internal tracking tool. This e-tool uses a built-in "countdown clock" to allow Branch staff to track grant deadlines against federal and state periods of performance. The Hazard Mitigation Branch also closely collaborates with FEMA Region IV to compare their list of pending closeouts against the Region's list of closeouts, and continues this comparison as a quality control measure. Going forward, the foundation of closing the 115 projects has led to a foundation which includes a process for collecting deliverables, monitoring periods of performance, and ensuring sound fiscal reconciliation by timely reimbursement of programmatically eligible expenses.

Monitoring Mitigation Activities

Hazard Mitigation Section staff have improved the existing system of Quarterly Reporting procedures which includes more comprehensive descriptions of projects, e.g., number of appraisals, number of elevations in progress, acquisitions, project site visits, monitoring and close-outs anticipated, and improved information regarding financial management. Hazard Mitigation Project Management staff are responsible for collecting and monitoring mitigation information during the implementation of each project

6.2.2 System for Reviewing Progress on Achieving Goals

In order to track progress on achieving the goals identified in this plan, NCEM Risk Mitigation Staff will ensure that both the annual and five-year plan evaluations include a review and analysis of the plan goals, and the various actions that are intended to achieve them. This process will be substantially more rigorous and detailed during the formal plan update process. The Mitigation Strategy describes the hazard mitigation goals, and includes a detailed table that lists various strategies and actions that the State is undertaking or considering to address the goals. The system for reviewing progress on achieving goals will remain the same as it has proved successful over the last five years.

6.2.3 System for Reviewing Progress on Activities and Projects in the Mitigation Strategy

As part of the annual evaluation, NCEM will email the RMCC to determine if there are any changes to the mitigation actions listed in the mitigation strategy section. In addition, members of the RMCC will be encouraged submit new actions at this time.

As part of the five-year update to the plan, NCEM initiated a more detailed review and evaluation of all activities and projects noted in the mitigation strategy. NCEM reported its findings to the RMCC at meetings held as part of the plan update process. The results of these findings have been included in the table of mitigation goals and actions included in the Mitigation Strategy.

6.3 EVALUATION OF IMPLEMENTATION PROGRESS

Due to the previous plan's mitigation effectiveness, many of the same procedures were used in the 2018 update. Progress was reviewed and monitored using different measures, which included:

- Progress Report for Mitigation Planning Projects
- HMGP Cost Report Information
- Cost Tracking Spreadsheet

These procedures have been successful in reviewing progress and were modified and streamlined as needed for the 2018 update. Additionally, meetings were held by members of NCEM's Risk Mitigation Branch and Hazard Mitigation Branch staff to discuss progress made since the last update. Many issues were addressed, such as:

- Establishing realistic objectives and goals
- Results of completed mitigation projects
- Determining how existing state goals can complement anticipated objectives

North Carolina's strong team of federal, state, local, public and private entities have worked together to enhance the state's mitigation abilities. Through coordination, the State has effectively collected data to improve risk assessments and determine which areas need more focus. Noteworthy achievements include:

- The NC Floodplain Mapping Program, which has created, maintained, and strengthened maps for all 100 counties and has helped modify International Building Codes
- Implementation of Integrated Hazard Risk Management and Communications Tool to address flooding, hurricane, severe winter weather, earthquake, wildfire, dam failure, drought, tornado/thunderstorm, and geological hazards.
- Vulnerability Assessment Tools which use GIS data to identify hazard-prone counties and Special Flood Hazard Areas
- Continued working relationships between the NCEM, National Weather Service, NCDENR, NCDOT, Forest Resources and other stakeholders
- Swift and appropriate use of individual and public assistance to aid disaster recovery
- Creation of the NC Resilient Redevelopment Planning program to empower and rebuild communities after disasters
- Formation of the Risk Management Tool that simplifies data to design specific and obtainable mitigation actions

Progress will continue to be evaluated in order to enhance the plan's efficiency in the future and reflect changes throughout the state.

Appendix A. State Mitigation Plan Review Tool

Will include final State Mitigation Plan Review Tool after FEMA approval.

Appendix B. **Emergency Management Accreditation Program (EMAP)**

B.1 STANDARD 4.1

In addition to meeting the standard requirements of the risk and vulnerability section outlined by FEMA, the State of North Carolina addressed the more comprehensive standards set forth by the Emergency Management Accreditation Program (EMAP) for assessing risk and vulnerability. EMAP standards describe the need for a consequence analysis to be performed when analyzing risk and vulnerability. Specifically, EMAP *Standard 4.1.1* requires an evaluation of the risk and vulnerability of hazards on the following:

- People
- Property
- The environment
- The jurisdiction's own operations

Furthermore, EMAP *Standard 4.1.2* requires that the state consider the impact of identified hazards on:

- The public
- Responders
- Continuity of operations, including continued delivery of services
- Property, facilities, and infrastructure
- The environment
- Economic condition of the jurisdiction
- Public confidence in the jurisdiction's governance

Finally, in *Standard 4.1.3*, EMAP requires that the Emergency Management Program have a method and schedule for evaluation, maintenance, and revision of its Hazard Identification and Risk Assessment (HIRA) and Consequence Analysis. This is described in Section 6 of this plan.

In order to simplify EMAP review, the state determined that it would be best to address these standards in a separate appendix of the plan, which is laid out in detail below by hazard. However, it should also be noted that the many other sections of the State Hazard Mitigation Plan also contain important information regarding EMAP requirements and should not be overlooked during an EMAP review. For example, Section 3 contains a great deal of risk and vulnerability data that should be reviewed when considering EMAP *Standard 4.1*.

Although the tables below are primarily provided as a means of addressing EMAP criteria, the analyses they provide are valuable for understanding the state's specific risks and what actions might be best to implement to reduce that risk. Therefore, they are an important component of the state's mitigation plan.

List of Tables

Table B-1 EMAP Flooding Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	During flood events, people are often stranded and have to be rescued by first responders. Often lives are lost or people are injured. Even when injuries and fatalities are avoided, the impact on the public can be great as many people will be forced into shelters or will need to find temporary lodging as they wait for flooding to recede. They may be unable to return to their homes if the damage is great and may find their homes uninhabitable if personal property has become waterlogged and is unusable. Another major impact on the public can be the deteriorating health conditions that result from flooding. After floodwaters recede, homes and personal property that were covered in water may begin to become infested with mold which can create serious health risks. Additionally, waterborne diseases can be pervasive in areas impacted by flooded sewer and water systems. Mosquitoes and other carriers of illnesses often thrive in post-flood conditions, increasing the chances of transmitting vector-borne diseases. Public confidence is often impacted by flood events, especially when impacted people do not have flood insurance and are not covered by their home insurance policy. This can create public relations issues for the government and a loss of public confidence.
Responders	High	Responders are often affected by flooding because floods can trap people in their homes or in other locations, forcing responders to put their lives at risk to return members of the public to safety. Often responders in flood situations face blocked roads and have difficulty safely protecting citizens. Water rescues can be some of the most dangerous as rapidly moving flood waters are difficult to navigate. Rescuers are typically at high risk to loss of life or personal injury during flood events, especially compared to other types of natural hazards.
Operations/Continuity of Operations	High	Flooding can impact continuity of operations by knocking out power sources and preventing emergency management personnel from being able to do their jobs properly. Floods typically have some impact on continuity of operations as they can cause severe disruption to normal operations and have done so in the past in North Carolina in nearly every county. Operations would be most impacted at a localized level as areas that are flooded would experience the most disruption to normal operations.
Built Environment (Property, Facilities, Infrastructure)	High	Many buildings and structures could be impacted by a flood event, but critical infrastructure and key resources (CIKR) within the state are especially important to identify. When these facilities are located in flood-prone areas, there is a substantial risk to important functions of government such as law enforcement and medical care. This also includes any assets, systems, and networks that are vital to the continued operation of government services such as power generation facilities, transmission infrastructure, and road networks, among others. The incapacitation or destruction of these resources would have a debilitating and costly effect on many aspects of the state's normal functionality. Often, in the case of flooding, water and wastewater infrastructure are some of the most prominently impacted. Since these types of infrastructure deal directly with water, often they are located in the most flood prone areas and are

Category	Impact Rating	Description of Impacts
		severely impacted during flood events. When these facilities or infrastructure are flooded, it complicates recovery and impacts people who are unable to utilize normal water sources for drinking, sanitation, and other everyday uses. In addition, personal property such as homes and businesses have been impacted to a large degree by past flooding events and are a major concern in future flooding events. Although a great deal of effort has been undertaken to reduce the number of properties at risk through the use of progressively improved risk assessment and mitigation techniques, there are still a significant number of structures throughout the state that are located in flood zones or which have not been properly mitigated to reduce risk. These properties may sustain billions of dollars of damage during future flood events and are often a major focus of post-disaster recovery efforts.
Economy	High	There are a variety of economic impacts that could result from a large-scale flood event. One major impact is on soil that is covered by flood waters, causing the rapid depletion of oxygen, which is essential for plant growth and development. This can hurt agricultural production in areas of the state were that is a key economic driver. Secondly, flooding often causes the shutdown of businesses, many of which never re-open after a flood event. Indeed, FEMA reports that almost 40 percent of small businesses never reopen their doors after a disaster because only small amounts of flood waters can cause thousands of dollars of damage.[1] The shutdown of these small businesses in many communities can be devastating as many small, rural communities in the state rely heavily on these small businesses as economic drivers and the base of the local economy. After Hurricane Floyd, which was primarily considered to be a flood event, the North Carolina Floodplain Mapping Program reported the following statistics which serve as a sort of benchmark for potential future flooding events: **Hurricane Floyd Impacts (1999)[2]** Businesses Affected: 60,000 Estimated Jobs Lost: 31,000 Physical Damage to Businesses: $1,000,000,000 Business Revenue Lost: $4,000,000,000
Environment	Low	The fluctuation of water levels in a wetland, especially flood waters, supports the biological diversity of low-lying areas by releasing nutrients into the soil and germinating wetland flora. Flooding also offers some control of invasive water weeds. Most features of the environment have come to adapt to the effects of a flood event and respond quickly, although it is possible that some species may not be resilient enough to survive and will experience population loss.

[1] FEMA. (2017). *Protecting Your Businesses*. Retrieved August 21, 2017, from https://www.fema.gov/protecting-your-businesses
[2] North Carolina Floodplain Mapping Program. Retrieved August 21, 2017, from: http://www.ncfloodmaps.com/flood_data.htm

Category	Impact Rating	Description of Impacts
		However, areas that have been modified by human activity tend to suffer more negative consequences from flooding which can result from modifying stream banks or removing vegetation from riverside. When these modifications are present, flooding can cause unnatural erosion of sediment into the waterway and create an imbalance of nutrients in the water which may harm ecosystems and have a negative impact on downstream water quality.[3]

[3] Office of the Queensland Australia Chief Scientist (2017). *What are the consequences of floods?* Retrieved August 21, 2017, from: http://www.chiefscientist.qld.gov.au/publications/understanding-floods/flood-consequences

Table B-2 EMAP Hurricanes/Coastal Hazards Risk, Vulnerability, and Consequence Analysis

<table>
<tr><th>Category</th><th>Impact Rating</th><th>Description of Impacts</th></tr>
<tr><td>People (The Public and Public Confidence)</td><td>High</td><td>During previous hurricane events in North Carolina, there have been significant losses of life and injuries to citizens. A number of people are expected to be displaced from their homes and will require accommodations in temporary public shelters due to a hurricane. Many people may also be permanently displaced and require longer term housing after a major event. In addition, many of the same health and property damage effects listed under the flood hazard would also likely occur as a result of a hurricane. A major difference is that hurricanes can also bring negative effects from high winds and storm surge (especially in coastal areas). High winds can shatter glass and cause personal injury and storm surge and rip tides prior to and during the event can cause loss of life if members of the public are not cautious and continue normal activities in the ocean prior to a hurricane event.

Hurricane Matthew, which was perhaps the most impactful hurricane the state has experienced since the 1990s, had major implications for the people of North Carolina. The table below outlines some of the impacts and gives at least some idea of the potential consequences of future hurricane events. This information was updated on September 29, 2017 through the state's "Rebuild NC" website (rebuild.nc.gov).

<table>
<tr><th colspan="2">Hurricane Matthew Impacts (2016)</th></tr>
<tr><td>Families registered for assistance</td><td>81,498</td></tr>
<tr><td>Total Dollars Distributed through Individual and Households Program</td><td>$98,193,197</td></tr>
<tr><td>Flood Claims</td><td>5,868</td></tr>
<tr><td>Total Dollars Distributed Through National Flood Insurance Program</td><td>$195,493,901</td></tr>
</table>

This hazard could potentially have a large negative effect on public confidence due to the possibility of a high magnitude event and the difficulties that might arise for local governments in terms of response and recovery. As has been the case with several previous events, members of the public who are displaced or whose homes/property are damaged may be frustrated causing a failure of confidence in the government's ability to respond to disasters.</td></tr>
<tr><td>Responders</td><td>High</td><td>The impacts on responders from this type of storm could potentially be very high as responders may be physically injured or killed during a storm event by flooding or high winds. In addition, their homes and personal effects could also be impacted, which would limit their response capability.</td></tr>
</table>

Category	Impact Rating	Description of Impacts
		In terms of their actual response capacity, downed trees in the wake of a hurricane often block roads and make ingress and egress difficult, thereby causing issues with response time. This is also often true of the resulting floodwaters. Moreover, due to the large-scale spatial impact of hurricanes and the number of citizens affected by the storm, response time will be reduced because of the number of incidents that require emergency responders.
Operations/Continuity of Operations	High	Continuity of operations in a hurricane event can be severely affected if power is lost or if critical facilities or infrastructure are damaged during an event. Although North Carolina has a plan in place to maintain continuity of operations in the event of a storm, a hurricane with a high magnitude would likely disrupt operations to some degree due to the impacts it would have on personnel. Some may experience damage from the storm themselves and be unable to work putting a strain on staff who are working as they will be forced to take on additional responsibilities during and after an event. In major events, all staff will likely be called on to work additional hours to maintain continuity of operations, which may result in fatigue and a reduced capability of employees in the long run.
Built Environment (Property, Facilities, Infrastructure)	High	Many buildings and structures could be impacted by a hurricane or tropical storm event including many local and state critical facilities such as police stations, fire stations, medical facilities, and other key buildings. There are also a number of important historic locations located along the coast such as Large-scale damage to infrastructure such as bridges and roads could occur from flood waters and storm surge especially in coastal areas such as the Outer Banks where roadways such as Highway 12 have been damaged severely during past events. Stormwater infrastructure such as culverts could also be damaged if they are clogged with debris from the storm or their design capacity is overrun. Many utilities including water/wastewater may be affected as a result of their location near rivers and other water sources. Power lines may be downed by falling trees or limbs and, due to high demand across the state, utility companies may face challenges in restoring power in a timely manner. Hurricane Matthew also offers some insight on impacts to public infrastructure based on funding distributed through FEMA's Public Assistance (PA) program, though these numbers fall far below total damage to the built environment. According to Rebuild NC, as of September 29, 2017: **Hurricane Matthew Impacts (2016)** Public Assistance (PA) Projects Submitted: 81,498 Total Federal Dollars Distributed through PA Program: $62,663,672
Economy	High	In general, the economy would be severely impacted by a hurricane or tropical storm event. Due to the massive scale of these events and multiple types of impacts from flooding and high winds, commerce would definitively slow down as efforts to rebuild are undertaken. Businesses may be shut down for long periods as owners try to

Category	Impact Rating	Description of Impacts
		rebuild after damage from flood waters, downed trees, or wind. Even business owners without direct physical damage to their workplaces may be shut down temporarily by loss of power or because employees are unable to come in to work as a result of roads that are shut down or personal property damage. As mentioned in the flooding analysis, many businesses that shut down after a major disaster never re-open their doors, which can have a major negative impact on local economies, especially in smaller communities. Some data on impacted businesses during Hurricane Matthew is available via loans distributed through the Small Business Administration (SBA). This certainly does not encompass all the businesses impacted by the storm, but provides an estimate that can be used as a floor. This information was also retrieved from rebuild.nc.gov and is updated through September 29, 2017.
Environment	Moderate	Flooding and wind damage are the main impacts that would be felt by a hurricane in North Carolina. Hurricane winds can down trees and cause disruptions to local ecosystems, particularly if damage is heavy in areas where endangered or protected species are present. As mentioned in the flood analysis, flood waters may cause some losses in species population. In coastal areas, sensitive habitats could be drastically impacted by hurricane events if the storm damages dune systems via storm surge. This may also cause local communities to become more vulnerable to future events as dunes provide a natural barrier against storm surge. Additionally, estuarine habitats may be impacted if floodwaters inundate these complex ecosystems with additional freshwater or saltwater, thereby causing an abnormality in a system that relies on a particular balance of salinity. Hurricane events can also sometimes cause spills of hazardous materials which would have damaging effects on the environment (as detailed further in the hazardous substances analysis below).

Hurricane Matthew Impacts (2016)	
SBA Loans Approved	81,498
Total Dollars Distributed through SBA Program	$102,424,200

Table B-3 EMAP Severe Winter Weather Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Winter weather most often impacts people indirectly and has differing impacts in different areas of the state. Mountainous areas in the western part of the state are much more accustomed to winter weather and therefore, are often more prepared to deal with it. However, these areas are also much more likely to experience larger accumulations of precipitation and colder temperatures than areas further east. Across the state, winter weather can create dangerous driving conditions by limiting visibility for drivers or creating slick conditions that make maneuverability difficult. Loss of power can create very cold conditions for residents, making it difficult to stay warm. Residents may try to heat their home using alternative means, which runs the risk of carbon monoxide poisoning caused by improperly ventilated heating sources. In addition, dangerously cold temperatures increase the risk of wind chill, frostbite, and hypothermia. Another indirect impact of winter weather on the public is its potential to impact public and private school schedules through closings and delays. Poor driving conditions, lack of power and heat, and mechanical problems with school buses and equipment due to cold weather conditions are potential concerns. School closures and delays can lead to logistical problems for teachers and school administrators, especially in the event of end-of-term exams and standardized testing schedules. It can also result in logistical problems for making up school days. Winter storms generally do not have a large impact on public confidence, but it could be somewhat impacted if road clearing or response operations are slow.
Responders	Moderate	Responders in severe winter weather events face a variety of hazards, including slick or icy roads that could cause accidents if they are attempting to quickly respond to an emergency as is often the case. The chances of crashed emergency vehicles and injuries to responders are always a possibility, but increase during a winter storm event due to difficult driving conditions. Winter weather can also make it difficult to access more rural areas if roads are snowed/iced over and emergency vehicles cannot pass through.
Operations/Continuity of Operations	Moderate	Generally, continuity of operations can be maintained during a winter weather event in North Carolina. However, winter weather does have the potential to affect power transmission as the weight of ice and snow can cause trees and limbs to fall and damage transmission lines. Winter precipitation can also freeze to roadways or create slick conditions that make it difficult for emergency management employees to get to work. As a result, there will likely be some disruption of operations during a winter weather event.
Built Environment (Property, Facilities, Infrastructure)	Moderate	One of the primary identified impacts of winter weather in North Carolina is the disruption of utilities. Utilities that are at risk of being affected include telephone, internet, cable, and water. Newspaper reports typically cite trees falling on electrical wires—as well as trees that have already been damaged from previous incidents that fall during a winter storm—or the stress caused by ice accumulation as main causes for power outages. Damage

Category	Impact Rating	Description of Impacts
		to this infrastructure is one of the major consequences of a winter weather event in the state and can lead to life-threatening situations if the public is unable to utilize central heating systems to keep warm during the concurrent cold weather that often accompanies winter weather. Winter weather also has the potential to create hazardous driving conditions leading to accidents on roadways. The North Carolina Climate Office reports that 70 percent of winter-weather–related injuries are a result of accidents on the road.4 The North Carolina Highway Patrol call volume can double during a winter storm compared to a typical 24-hour period. This creates significant problems for emergency workers. Accidents can cause highways to become "large parking lots" as well as cause motorists to strand their vehicles, making it difficult for emergency workers to reach those who need assistance. In general, major and local roadways become severely impacted when temperatures drop, making pre-treatment solutions ineffective. Transportation impacts can be minimized during early- and late-season events when paved surfaces are able to warm sufficiently to prevent winter precipitation accumulation. Winter weather can also cause delays and cancellations of flights at airports in the state due to slick conditions on runways. There is also the potential of a loss of power that can close the airport. The North Carolina Department of Transportation (NCDOT), which maintains the second largest state network in the country, is primarily responsible for maintaining the state's transportation infrastructure during severe winter weather events. As of the end of 2016, NCDOT has the following capabilities in terms of storm preparation:

NCDOT Winter Weather Capabilities[5]	
Plows/Salt and Sand Spreaders	1,739
Front-End Loaders and Backhoes	495
Motor Graders	332
Storage Space for Salt/Sand	170,000 tons
Storage Space for Brine	1,520,000 gallons
Annual Budget for Storm Preparation	$70,000,000

Category	Impact Rating	Description of Impacts
Economy	Moderate	In the event of winter weather, there is a high potential of business and office closures, modified business and office hours, and cancellation or postponement of sporting and other planned events in the state. This can be attributed to poor road conditions (including icy and slick conditions) that result in fewer people using the roads

[4] State Climate Office of North Carolina. *Winter weather—impacts*. Retrieved August 21, 2017, from http://www.nc-climate.ncsu.edu/climate/winter_wx/Impacts.php
[5] North Carolina Department of Transportation. *Severe Weather- Winter Storms*. Retrieved August 21, 2017, from https://www.ncdot.gov/travel/severeweather/winter.html

Category	Impact Rating	Description of Impacts
		to get to their destination or a loss of power and heat that result in a loss of operations at specific facilities. In general, absenteeism is higher during winter weather events as many employers rightly encourage employees to stay home and avoid potential injury in unsafe driving conditions. As can be seen in the chart below, the Bureau of Labor Statistics[6] notes that although any major weather event can cause absences at work, workers are more likely to be absent because of bad weather during winter months because winter weather tends to impact much larger areas and makes travel difficult throughout much more of the transportation network.

[6] United States Bureau of Labor Statistics. *Work Absences Due to Bad Weather from 1994 to 2016*. Retrieved August 21, 2017, from https://www.bls.gov/opub/ted/2017/work-absences-due-to-bad-weather-from-1994-to-2016.htm

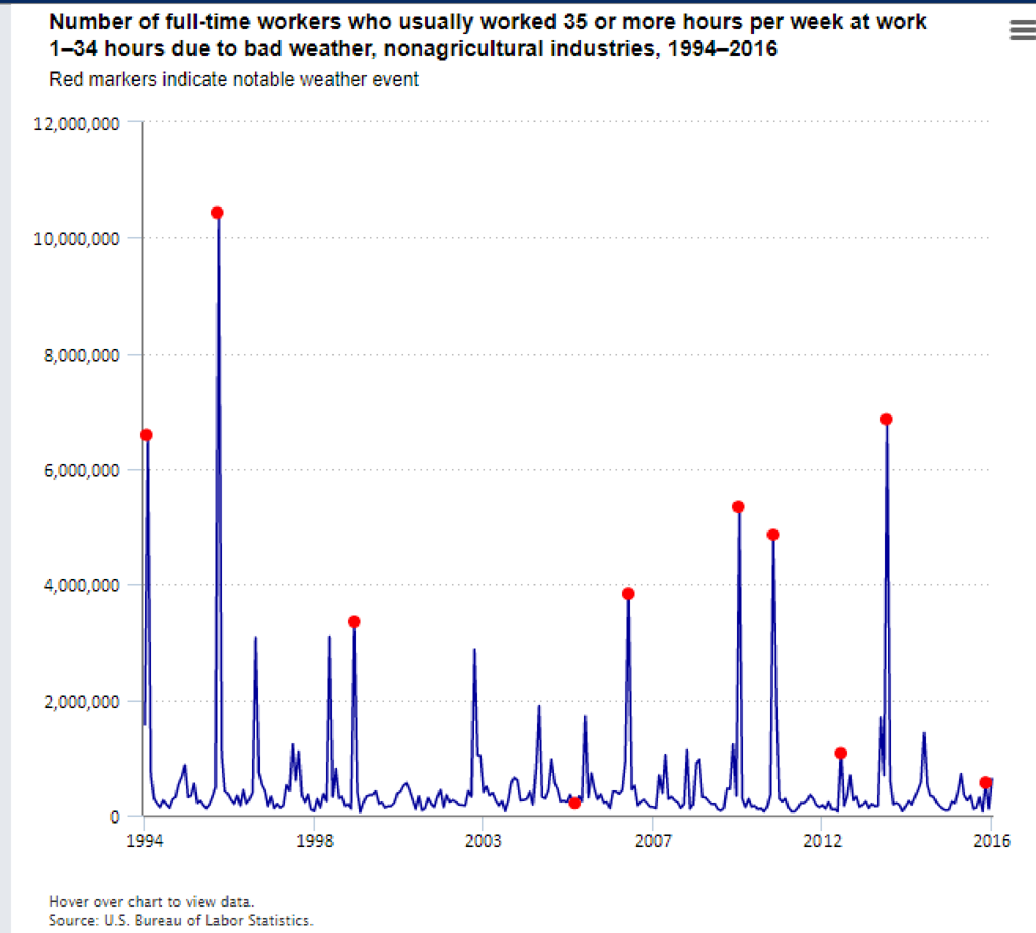
Category	Impact Rating	Description of Impacts
		
Environment	Low	Winter weather has an impact on the environment through the clearing of roadways. Snow on the roads can pick up contaminants from chemicals and oil products in traffic as well as the salt mixture that is used to de-ice the roads. These contaminants can be carried to nearby waterways, which contaminates water sources and is absorbed by groundwater. In addition, vegetation can be damaged by these storm types, which harms habitats and may threaten wildlife.

Table B-4 EMAP Earthquake Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Low	Earthquakes in North Carolina generally are not high impact events that cause injury or death as most are moderate in terms of impacts. The public typically experiences some shaking in these events and the greatest threat to health and well-being is often from objects falling, from shelves or off walls. The western and southeastern parts of the state are where people are most likely to be impacted by an earthquake, but even in these cases, a major disaster would be unlikely. Therefore, public confidence would likely not be affected in the event of an earthquake.
Responders	Low	There would be little impact on responders in the event of an earthquake, because North Carolina is only likely to experience a moderate earthquake magnitude. Since there would be minimal damage to structures and infrastructure, responders would likely not be impacted in their ability to respond to an earthquake. If there were any major collapses of buildings or infrastructure however, responders will need to take care when accessing these structures in case they have become structurally unstable and unsafe. It should also be noted that because earthquakes can knock items such as candles off shelves or damage gas lines, fires are possible directly after an event. This may cause additional emergency calls for responders and create a burden on response operations.
Operations/Continuity of Operations	Low	During and after an earthquake, continuity of operations could relatively easily be maintained and there would likely be little disruption to services or operations during an event, especially at the state level. The most likely impact may be downed communication networks which could cause interruptions to normal operations.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Ground shaking is the primary cause of damage to the built environment during an earthquake. There are three important variables that determine the amount of damage: the intensity of the earthquake, local soil characteristics, and the quality of the impacted structures. The amount of damage caused by an earthquake is strongly influenced by soil characteristics. The velocity at which the rock or soil transmits shear waves is the main contributor to ground shaking. Shaking is increased by soft, thick, or wet soil types. Certain building types are particularly vulnerable to earthquake damage: wood-frame multi-unit buildings, single-family homes, mobile homes, and unreinforced masonry buildings.7 The most susceptible structures are wood-frame, multi-story, mixed-use buildings that have large openings on the first floor for garages or commercial space and housing on the upper floors. During an earthquake, these types of structures could sway or even collapse. Single-family homes built prior to the 1970s are often not bolted to their foundations, and walls surrounding crawl spaces are not braced (i.e., cripple walls). Typical earthquake damage to these structures include cracked foundations, chimneys breaking at the roof line, wood frames coming off their foundations, and racking of cripple walls.

[7] Association of Bay Area Governments. (2017). *Guide to housing vulnerable resources*. Retrieved August 21, 2017, from http://quake.abag.ca.gov/housing/

Category	Impact Rating	Description of Impacts
		Mobile homes that are built of light-weight metal or a combination of steel frame and wood are easily damaged by a quake. Mobile homes installed prior to 1995 were often not attached to their foundations and could shift off their supports. The last type of susceptible building material is unreinforced masonry—masonry walls that have not been reinforced with steel. These buildings were often built before 1960 in an era when reinforcing was not generally used, anchorage to floors and roofs was missing, and use of low-strength lime mortar was common. Earthquake damage to these buildings can be severe. A lack of reinforcement and tie-downs can result in substantial damage in the form of cracked or leaning walls. Damage may also occur between the walls, and separation between the framing and walls could lead to full collapse due to a lack of vertical support. Critical Infrastructure There are a handful of key resource categories that could be impacted by an earthquake including transportation systems, communication systems, and utility systems. Historically, the state has not been impacted by an earthquake with more than a moderate intensity so damage to these resources would be very minor; however, an inspection of certain features after a strongly felt earthquake may be necessary.
Economy	Low	There are several sources of economic loss typically associated with an earthquake including property damage and business interruption costs; cost to repair public transportation, communication, or utility systems; and debris removal costs. Historically, there have been relatively minor economic losses from earthquakes in the state that have not already been described under the impacts to the built environment above.
Environment	Low	There would be very minor impacts to the environment following a significant earthquake that is felt in North Carolina with a moderate intensity. Secondary effects from the damage of key resources mentioned above (e.g. utility systems) could impact the environment, but the probability of this type of situation is very small. For instance, a ruptured pipeline could release dangerous materials that could damage the surrounding environment, but the likelihood of an earthquake causing this in North Carolina is relatively low.

Table B-5 EMAP Wildfires Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	There are a number of potential losses from a wildland fire in North Carolina including loss of life and injury due to severe burns. Health hazards from smoke caused by wildland fires can include breathing difficulties and worsening of chronic breathing and/or cardiovascular disease. Smoke and air pollution pose a risk for children, the elderly, and those with respiratory and cardiovascular problems. Wildfire tends to create some issues with public confidence because of the very visible impacts that the fire has on the community.
Responders	High	Responders are often at great risk when responding to wildfire, especially firefighters who are responsible for putting out the blaze. All response personnel are potentially at risk when dealing with a wildfire, as changing winds and a number of other factors can often cause a fire to spread rapidly. Although many areas of the state are urbanized and are not at a high risk to wildfire, moderately-developed rural areas that are located in the wildland urban interface may require response personnel to be ready to act. Like the general public, first responders are also at risk for exposure to dangers from the initial incident and after-effects such as smoke inhalation and/or heat stroke. However, their risk is often more prominent as they are often in the middle of an incident through their responsibilities as a responder.
Operations/Continuity of Operations	Moderate	Since wildfire often moves quickly and can affect infrastructure that is important to maintaining continuity of operations, there is some level of concern for maintaining continuity. However, operations at the state level, which are generally run from urbanized areas, will probably not be impacted in a major way. Local continuity of operations in rural areas is much more susceptible to the impacts of a wildfire.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Wildland fires have the potential to substantially burn forested areas as well as private residences. Damage and destruction to state, county, private, and municipal structures and facilities are major losses that are attributed to wildland fires. Private residences and communities that are located within the Wildland Urban Interface (WUI) are particularly susceptible to the threat. Population increases in North Carolina's WUI areas, for example, can create significant challenges for firefighters and residents. This is especially notable considering a study in 2000 showed that North Carolina ranked number one in terms of the amount of land area located within the WUI zones and fifth in number of homes located within the WUI.8 Many new homes are constructed without considering community wildland fire planning. This creates neighborhoods with limited accessibility, flammable building construction, and landscaping. A lack of firewise planning can also greatly increase the probability of a wildland fire occurrence with more homes and emergency personnel being threatened. All types of private property may suffer losses from wildfires. This includes business properties, homes, vehicles, and livestock. Damage to capital goods and equipment as well as evacuation expenses and other losses are directly related to fire and smoke damage. Additional potential losses include building and

[8] North Carolina Firewise (2000). *North Carolina Firewise.* Retrieved August 21, 2017, from http://www.ncfirewise.org/index.htm

Category	Impact Rating	Description of Impacts
		landscape maintenance expenses, firefighting equipment purchases, and fire-related business closures. Additional post-fire losses include cleanup, rehabilitation and repair expenses, equipment and capital goods replacement, drinking water pollution, smoke damage, deflated real estate values, and an increase in fire insurance premiums.
Economy	Moderate	Given the fact that a number of homes, businesses, and infrastructure are located in areas that could be impacted by wildfire, there could be some significant economic impacts of a wildfire in the state. If homes or businesses are burned, the cost of rebuilding could be substantial. Impacts to agricultural crops are another economic loss that the state could face in the event of a wildland fire. Wildfires can be particularly damaging to the lumber and Christmas tree farming industries which are important to the state.
Environment	Low	Wildland fires have the potential to damage or destroy forage on grazing lands, secondary forest products destruction, and/or degradation and loss of wildlife habitat on public lands. On private lands, vegetation losses could include agricultural crops that are either burned or impacted by wildland fire smoke. Indirect losses could include loss of growing stock as well as irrigation systems. Another potential loss includes damage and destruction to a wide variety of common or protected habitats in the state. Finally, the release of smoke from wildfires can pollute the air and reduce air quality. It should also be noted, however, that wildfires are a naturally occurring element of the environment and have played an important part in the development of many ecosystems in that they are regenerative and provide vital nutrients for the soil which can help sustain a forest habitat and all of the organisms living within it. Therefore, although there are some negative impacts of wildfire, there are also some positive impacts on the environment.

Table B-6 EMAP Dam Failures Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)		Many of the impacts associated with a dam/levee failure are the same as those that would be associated with a flood event. However, the primary difference for members of the public in the case of a dam/levee failure is that often citizens who might be impacted by a dam/levee failure may believe themselves to be protected from flood events as a result of the dam/levee and therefore, may not be anticipating the event. This may have a severe impact on public confidence in the long run as citizens may view this as a failure of government institutions to properly regulate and control the dam/levee. That is to say, they may ultimately view the incident as preventable, unlike a flood that occurs purely from natural causes.
Responders		Similar to the issues associated with the flood hazard, responders would be impacted by a dam/levee failure as they may be forced to attempt to assist citizens who have become trapped in their homes or in flood waters. Responders may have difficulty accessing homes or other structures where they need to provide support and their lives and well-being will likely be put at risk if they are forced to assist in a flooded area.
Operations/Continuity of Operations		A dam/levee failure would be unlikely to impact continuity of operations as the event would likely be confined to a specific area directly surrounding the dam/levee and most operations-related facilities in the state are not at risk of being impacted by a dam/levee failure.
Built Environment (Property, Facilities, Infrastructure)		A dam/levee failure may impact any properties located downstream of a dam/levee, especially any that are within identified inundation zones. The effects of a dam/levee failure on property, facilities, and infrastructure would be similar to those that have been outlined in the flood analysis although it is possible that the damage may be more severe, as high volumes of water are released all at once rather than over time. For example, during Hurricane Matthew a number of homes were damaged by dam breaks that were caused by massive rainfall in the state. Many of these dam breaks were at private dams and were the result of uncoordinated releases among operators along the river systems. In this scenario, when one dam failed, it caused a rush of water that impacted the downstream dams and resulted in similar failures and flooding of buildings.
Economy		The economic costs of a dam/levee failure could be significant as there will likely be a high economic cost for the owner of the structure (whether it be a privately or publicly-owned) to rebuild or reconstruct the dam/levee. If a dam/levee fails, the owner may also need to rebuild the new structure to a higher standard to prevent future failures. If the dam was involved in electricity production as is the case for many dams in the state (Lake Jocassee Dam, Fontana Dam, High Rock Lake Dam), the failure will result in a loss of revenue for the owner, which could impact local utilities and may also result in temporary power outages (although most communities do not rely solely on hydroelectric power, so this is less likely). Many of these dams/levees are also used to create recreational lakes (Kerr Lake, Lake Gaston, Lake Norman) and when this type of dam fails, that recreational resource will be lost, which in turn may reduce tourism and visitors to the area and reduce property values in and around the lake.

Category	Impact Rating	Description of Impacts
Environment		The impacts on the environment from a dam/levee failure might be that ecosystems and habitats that existed while a dam was in place on a stream/river could be destroyed as floodwaters destabilize areas by inundating places that had not previously been under water or causing higher flow rates downstream. Similar to flood events, if a facility that houses hazardous materials is impacted by flooding from a dam/levee failure, there may be contamination of the stream/river and ultimately the water supply. Although the dam failure itself would likely disrupt habitats in the short term, in some sense, a dam failure may restore the environment to a more natural state by allowing the river to return to its natural course and flow. That is to say, the absence of a dam/levee may be a long-term boon to the local environment.

Table B-7 EMAP Drought Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Drought can have a detrimental effect on the livelihood of farmers and agricultural producers in North Carolina. Efforts to mitigate against drought, such as using irrigation equipment, have a high initial cost, including the need for an increase in management requirements, cost of operation and maintenance, and the lack of good quality water resources—which during times of drought would be severely affected. Although the general public may be subject to water restrictions during extreme drought events, it is unlikely that public confidence in the state's governance would be impacted severely as a result of a drought.
Responders	Low	Although drought would have many of the same impacts on responders as it would on the public, the overall effects would be relatively limited when compared to the impacts other hazards could potentially have on responders. Since a drought is typically a slowly developing event, the risk and exposure that responders would face is minimal.
Operations/Continuity of Operations	Low	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. Normal operations would very likely be able to continue throughout the event and there would likely be little change to the program's management overall.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Water Use Drought has the potential to affect North Carolina's water supply for residential, commercial, institutional, industrial, and government-owned areas. Drought can reduce water supply in wells and reservoirs. When drought conditions persist with no relief, local or state governments often institute water restrictions which may have an impact on personal property to some degree, though generally these restrictions are meant to protect life safety by ensuring adequate supplies of drinking water for consumption and other critical purposes. Irrigation Drought would affect irrigation and outdoor landscaping efforts around residential, commercial, institutional, industrial, and government-owned land. Water conservation strategies can limit the amount of water used to maintain the aesthetic environment around buildings, businesses, and areas such as golf courses. This would include automatic and non-automatic spray irrigation systems, hose-end sprinklers, handheld hoses, bucket watering, drip irrigation, athletic field irrigation, swimming pools, car washing, pressure washing, and reuse water.
Economy	High	Drought can have a detrimental effect on agricultural and agribusiness industry sectors which account for one-sixth of North Carolina's income and employees.[9] Extreme drought also has the potential to depress local businesses and industries such as landscaping, recreation and tourism, and public utilities. Nursery and

[9] Walden, Mike. North Carolina State University College of Agriculture and Life Sciences. (2017). *Agriculture and agribusiness: North Carolina's Number One Industry.* Retrieved August 21, 2017, from https://cals.ncsu.edu/intranet/news/agriculture-and-agribusiness

Category	Impact Rating	Description of Impacts
		landscape businesses can also face significant losses from a drought. Losses include reduction of output and sales of crops, reduction in plant sales, and an increase in watering costs. This can lead to the closing of many business locations, laying-off employees, and increases in bankruptcy filing. Agriculture The agriculture sector of North Carolina is particularly susceptible to drought damage. The table below shows there are more than 50,000 farms in North Carolina, with over ¼ of the land area of the state being farmland.10 Agricultural drought has the potential to directly affect much of the land in North Carolina. Agricultural areas at particular risk are cropland and pastures.

Census of Agriculture (2012)	
Total Acres in State	31,115,462
Number of Farms	50,218
Total Land in Farms, Acres	8,414,756
Average Farm Size, Acres	168

Crops
Prolonged periods of dry weather are the most difficult and damaging problem faced by crop growers and agricultural suppliers. North Carolina has 4,378,097 acres of harvested cropland, which is 14.1 percent of total land area of state.

Short- or long-term moisture deficits—even with the use of irrigation methods—during critical stages of crop development can severely reduce yields, with the amount of yield lost depending on when the drought occurs (see table below for a list of North Carolina crop specific information), the growth stage of the crop, the severity of dry conditions, and the amount of available water that the soil can hold.

Crops	Value of Sales	U.S. Rank[11]
Tobacco	$732,772,000	1
Cut Christmas trees and short rotation woody crops	$67,097,000	2
Cotton and cottonseed	$403,366,00	5

[10] North Carolina*: Census of agriculture—2012*. Retrieved August 21, 2017, from https://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/North_Carolina/index.asp
[11] Rank in production among all states

Category	Impact Rating	Description of Impacts
		Nursery, greenhouse, floriculture, and sod — $580,230,000 — 7 Vegetables, melons, potatoes, and sweet potatoes — $434,974,000 — 10 Livestock Table 5.1 shows the type of livestock in North Carolina, including the quantity of livestock and the state's rank compared to other states in the United States. These are at risk for being affected by drought conditions in the state. Livestock losses from drought will most likely be confined to forage-based production systems. Losses in beef and dairy systems will potentially be of a single-season or multiyear variety. Single-season losses will include lost forage production (on both hay and grazing land), reduced weaning weights, reduced milk production, and increased mortality. Multiyear losses could include the cost of reestablishing pastures and reduced meat or milk production in subsequent years due to forced sales in the drought year. In addition, drought conditions could result in poor pasture conditions, reduced drinking water supplies, and a critical hay shortage that directly affects livestock and poultry health.
Environment	Moderate	Drought may also lead to pollution of water sources as a result of lack of rainwater to dilute industrial and agricultural chemical runoff. This poses a risk to plants and animals and makes it difficult to maintain a clean drinking water supply. Lack of water reaching the soil may also cause the ground to become dry and unstable. Erosion can increase and loss of topsoil can be severe if a high-intensity rain falls on ground lacking a ground

Livestock	Number	U.S. Rank[12]
Turkeys	17,1919,277	2
Hogs and pigs	8,901,434	2
Broilers and other meat-type chickens	148,251,469	4
Layers	13,091,384	8
Pullets for laying flock replacement	6,239,251	8

12 Rank in production among all states

Category	Impact Rating	Description of Impacts
		cover of plants. As a result of these environmental impacts, habitats may be degraded through a loss of wetlands, lake capacity, and vegetation.

Table B-8 EMAP Tornado/Thunderstorms Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	The entire State of North Carolina's population is vulnerable to the impacts of a tornado regardless of the measured magnitude. Because it cannot be predicted where a tornado will touch down, it cannot be said which areas of the population within the state are most vulnerable. However, injuries and deaths resulting from tornadoes are the most significant impacts and are most likely to occur to those living in mobile homes or older homes that have not been built to current design standards. Tornadoes often have a high likelihood of affecting public confidence due to their destructive and highly visible impacts. Thunderstorms are generally associated with several other hazards such as high wind and flooding, the latter of which is caused by torrential rain. As such, the public could be impacted in a number of ways by a thunderstorm event. High wind can cause trees to fall and potentially result in injuries or death and rising floodwaters can lead to drowning or other serious injury. Although often not as severe as tornadoes, the impacts on the public from thunderstorms can be significant, especially in the long run. However, the public confidence is usually not affected to a large degree as a result of thunderstorms.
Responders	High	Responders could be critically affected by tornado events as the onset is often very rapid and unpredictable, thereby putting response personnel potentially in harm's way. Many responders may be out in the open while on duty when a tornado forms and they may be caught in a dangerous position as a result. Due to the unpredictability of such events, response may also be hindered post-event as responders may be unable to access those that have been affected if storm conditions persist and they are unable to safely enter affected areas. Responders are not generally affected to any great degree by thunderstorm events, although it should be noted that they could be impacted in many of the same ways as the public. Otherwise, responders could be affected by road blockages caused by downed trees or floodwaters, which would ultimately reduce their response time.
Operations/Continuity of Operations	Moderate	Continuity of operations could be greatly impacted by a tornado as personnel may be harmed and critical resources damaged or destroyed during a tornado. In many ways, since the impacts of a tornado are unpredictable, it is also difficult to predict and plan for the appropriate ways to ensure continuity of operations. Although North Carolina is prepared for such an event, disruption of operations will likely take place to some degree if the event is large enough and spurs multiple tornadoes across the state, as has happened frequently in the past. In general, continuity of operations during a thunderstorm event can be maintained as these events are common in all parts of the state. Thunderstorm events often affect power in much the same way as tornadoes and hurricanes, which ultimately may impact operations. However, thunderstorm events are typically not large

Category	Impact Rating	Description of Impacts
		enough to severely affect normal operations and their impacts are not wide enough to disrupt continuity of operations at the state level.
Built Environment (Property, Facilities, Infrastructure)	High	*Building Inventory* According to the National Climatic Data Center, North Carolina has been impacted by tornadoes ranging in intensity from F0/EF0 to F4/EF4 based on the Fujita scale. An F5/EF5 has never been experienced, but it is certainly possible. Because it cannot be predicted where a tornado may touch down, all buildings, facilities, and infrastructure within the state are considered exposed to the hazard and at risk for being impacted. Older buildings that are constructed with less-advanced building techniques are at higher risk as are mobile homes. Building materials play a role in how well a structure can withstand tornado force winds. Buildings that use structural steel, reinforced concrete, or load-bearing masonry have the best change of withstanding a tornado event in the state. Homes constructed of wood or manufactured material are most at risk. Non-engineered structures in the state are far more vulnerable than engineered buildings to damage from tornado winds. It is also notable that materials that are well-tied to all other building components are also more likely to survive extreme wind events.[13]The magnitude of the tornado will determine the extent of damage and impacts that are felt throughout the county. These impacts can include structural failure, debris damage, and loss of facility functionality. *Critical Infrastructure* The state's infrastructure system is also vulnerable to the impacts of a tornado. This includes critical infrastructure such as roads, railroads, bridges, utilities (power and gas), and pipelines. Any number of these infrastructure systems could be damaged in the event of a tornado, although often power lines are the most common assets that are affected during a tornado. Impacts could include structural damage, impassable or blocked roadways, failed utility lines, railway failure, and impassable bridges. Thunderstorms often have their greatest impact on the built environment as they can cause damage to homes via strong winds or flooding and will often impact facilities and infrastructure in the same way. Power losses often occur due to damage to power lines and roads can flood and cause damage as well. In fact, thunderstorms are often considered one of the greater hazards of concern for local communities, even though any given event will cause relatively little damage, because damaging events occur so frequently.
Economy	High	A tornado can impact any area of North Carolina at any time and bring with it significant property damage costs to individual citizens and the disrupt the regular functioning of the local economy. After past events, there has been a substantial halt to many economic activities and losses to businesses have often been high. The loss of

[13] Federal Emergency Management Agency. *Tornado Protection: Selecting Refuge Areas in Buildings. FEMA P-431, Second Edition, October 2009.* Retrieved August 21, 2017 from: https://www.fema.gov/media-library-data/20130726-1456-20490-4099/fema_p_431.pdf

Category	Impact Rating	Description of Impacts
		power can also interrupt local economies and have a strong negative impact on daily functioning of business activities. Similarly, economic impacts from thunderstorm events can often be far reaching as the damage from these events are often widespread, affecting both homes and businesses. This damage can result in business and economic disruption through the recovery process.
Environment	Moderate	Downed trees and other forms of vegetation are often one of the most visible impacts to the environment from a tornado. Additionally, building material or other debris can be carried or thrown great distances by the force of wind and end up spread out in unexpected places such as natural areas. Coordinated statewide cleanup efforts after a tornado can include removal of debris, but much debris ends up remaining in local habitats. Finally, if hazardous materials facilities are impacted by the tornado, these may release dangerous chemicals into the environment that can cause long-term harm. Thunderstorms can impact crops via high wind and flooding and can also impact the natural environment through these elements. Flooding can kill plants and animals as well as contaminate drinking water supplies for human populations. High wind can harm forests by bringing down trees and cause fires from downed power lines that impact the environment.

Table B-9 EMAP Geological Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Geological hazards such as landslides/rock falls and sinkholes can pose a threat to human life and safety, as these events often occur with very little warning time due to a lack of available data on risk. Landslides/rock falls are especially a risk in the more mountainous western part of the state where several fatalities have been caused by in this region historically. The quick and unexpected slide of rocks, dirt, and other debris is extremely dangerous and can cover and destroy homes, thereby causing injuries and death. Sinkholes are a much larger risk in the eastern part of the state where soils are more conducive to this type of activity. Similar to landslides/rock falls, these events are often unexpected as they can develop from underneath the ground and suddenly cause a collapse of soil at the surface level, causing loss of life or injury. Any event that can cause loss of life could potentially have an impact on public confidence, however, since these events are often geographically confined to a small area and do not have wide-ranging impacts on large segments of the population, public confidence is typically not affected to a great degree.
Responders	Low	In most cases, responders are not directly impacted by geological events to any greater degree than the public. However, it should be noted that responders should generally be wary when responding to a geological event because of the risk of secondary events (additional landslides/rock falls or sinkholes). When the ground has been disrupted by one of these events, it could set the stage for additional events and any disruption to the soil by responders during their response may further exacerbate those conditions. Additionally, responders working on site of a geological event may find that the uneven terrain provides an extra challenge in terms of operating normally and carrying out life-saving tactics.
Operations/Continuity of Operations	Low	Continuity of operations during a geological event is unlikely to be interrupted in any major way. As mentioned previously, geological events tend to be confined to small areas and so it is unlikely that operations centers would be impacted. If they are, it should not prove too much of a challenge to move operations to a backup facility and continue normal operations from there.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Impacts on the built environment are probably the greatest effect of geological events. During both landslide/rock fall and sinkhole events, people's homes and/or businesses may be impacted and most typical insurance policies in the state do not cover these kinds of events so homeowners may suffer total losses to their homes. Even when these events do not cause complete destruction of homes, they can frequently damage foundations of structures and make them unsafe for dwelling. Similarly, landslides/rock falls and sinkholes that occur around major infrastructure such as roadways and other utilities can cause severe damage to key facilities. In western North Carolina, landslides/rock falls have occurred a number of times along major highways such as I-40 and caused local and state officials to have to shut down these roadways until equipment can be brought in to remove the large boulders and return the road to normal conditions.

Category	Impact Rating	Description of Impacts
		Similarly, sinkholes in the eastern part of the state have caused breaks in roadways, making them unsafe for driving. In many locations across the state, sinkholes have shut down primary roadways for weeks while the issues were addressed and roads were rebuilt. At times the cause of these sinkholes are man-made as leaking or faulty water/wastewater infrastructure can create the same conditions that cause sinkholes to form naturally.
Economy	Low	Although geological events could impact local businesses and therefore affect the economy, this would likely have very minor effects overall. The greatest impact to the economy from an economic standpoint would be related to the impacts on infrastructure such as roadways. When these are shut down for long periods of time, local economies can be dramatically affected, especially in more rural areas. If traffic has to be re-routed around these areas due to road closures for weeks or even just days, losses in revenue could be significant and have a negative impact on business owners. Both landslides/rock falls and sinkholes have the capacity to cause this level of shutdown as has been the case during a number of past events in the state.
Environment	Low	In general, the environment would be unaffected by a geological event. Some of the minor impacts that might be expected are damage to trees and habitats from falling rocks/debris or from other types of damage to the soil/ground. In past events, large swaths of mountainside have been torn away creating large dead areas where plant life is ripped away. These impacts would be generally confined to a small area and therefore would not have sweeping implications for the ecosystems overall. It is also possible that debris or structural materials could end up in streams or rivers as a result of the event and cause damage to localized populations in these habitats.

Table B-10 EMAP Infectious Disease Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The general public can be exposed to infectious diseases through different means based on the particular threat and its potential transmission routes. Vaccinations, when available, are the best means of preventing transmission and infection. Public health information messages will be disseminated via the media in order to provide preventative measures to limit or avoid exposure. According to the North Carolina Public Health Department, in terms of vaccine-preventable diseases, in 2016 there was a slightly higher occurrence rate of Hepatitis A and Mumps in 2016 compared to the five-year average from 2011-2015.14 There were also increased rates of non-vaccine-preventable diseases like Zika which have become more prominent across the United States in recent years. Public confidence in government organizations may be impacted by public health outbreaks. The level of confidence the public possesses is based upon societal expectations, media influence, and past experience following other outbreaks. An effective response to the outbreak can help to guide public confidence toward a favorable level. Collaboration with media outlets can also assist in keeping the public informed and helping to protect them from exposure.
Responders	Low	During a disease outbreak, responders can expect an increase in workload and should practice a higher level of precaution toward exposure than they would normally. Plans exist for first response and health care to address the needs of such situations. Communication between these agencies regarding plans and procedures maximizes the efficiency and effectiveness of these combined efforts. Responders are much more likely on the whole to be impacted by an infectious disease since they will be working directly with those affected to help treat the disease (especially EMS personnel). This will make them more susceptible to becoming infected and, as such, it is critical that they wear the appropriate personal protective equipment to minimize their risk and ensure they can continue providing the care and assistance that is needed to help the public.
Operations/Continuity of Operations	Low	Continuity of operations may be impacted if those in governmental or other key roles are impacted by the disease or public health threat and cannot perform their normal duties. Although plans are in place to ensure continuity of operations, a large-scale event or one that has significant impacts on operational-level staff could negatively affect continuity of operations. Since many diseases are spread through some form of contact with others who have already been infected, a disease event could rapidly disable many of those who are working together to carry out normal operations. Due to their close proximity to one another and need to communicate and coordinate on a daily basis, it is incredibly important to try to reduce the spread of the disease among key personnel once an outbreak has been identified.

[14] North Carolina Department of Public Health (2016). Vaccine-Preventable Diseases Reported in North Carolina, 2016. Retrieved August 21, 2017 from: http://epi.publichealth.nc.gov/cd/figures.html

Category	Impact Rating	Description of Impacts
Built Environment (Property, Facilities, Infrastructure)	Low	An infectious disease would likely have little direct impact on the built environment itself as the disease would not affect the structural stability of any buildings or infrastructure. However, an infectious disease would have a major impact on the functioning of many structures that would be operating at a high capacity during an infectious disease event, especially medical care facilities. Hospitals and Medical Care Facilities The primary impacts for hospitals/medical facilities during disease outbreaks are an increase in patients and the spread of disease within hospitals. It is highly likely that those affected by the disease will make their way to a medical care facility and it may be necessary to implement quarantines or other measures to reduce the risk of disease spreading. Hospitals and other medical care facilities should have plans in place to deal with such a scenario and also reduce risk of spreading the disease to medical care providers whose workload may be increased as individuals infected with disease may require treatment.
Economy	Low	One of the more significant economic impacts that could be seen in North Carolina involves absenteeism at local businesses which could have a significant impact as the absence of several employees at a small business could force temporary shutdowns or reduced hours of availability. There would also likely be an impact on the local government budget as officials try to respond to the disease and assist those impacted. City centers and downtown areas tend to be where large masses of people congregate and thus may be where the likelihood of disease spread is more prominent. Many people may realize this and avoid these key economic hubs which would result in reduced revenue and a negative impact on the economy overall. Additionally, large events in communities across the state may have to be cancelled if the outbreak is large enough or has the potential to be spread easily and quickly. This would also reduce revenue for many local economies.
Environment	Low	The environmental impact is dependent on the particular biological substance or disease being transmittable to animal or plant life or if it can be distributed through the water supply. If the infectious disease in question can be transmitted to other species, there could be an extremely negative impact on species populations. Since animal life does not have the same capacity has humanity to understand the spread of disease and reduce transmission rates, the disease may spread more quickly through animal populations and cause larger-scale loss of life.

Table B-11 EMAP Hazardous Substances Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	The accidental or intentional release of a hazardous substance could have both immediate and long-lasting effects on the health of the public. Any release needs to be quickly identified and the proper response guidelines followed to reduce the possible impact on the public. Evacuation is always a consideration when dealing with harmful substances. The public should be aware that hazards exist from the presence of hazardous substances and should take preparedness actions at home and in the workplace to act should a release of substances occur. Hazardous substances can have a significant effect on public confidence in government as incidents often cause serious harm to people via long-term health impacts, contamination of soil or drinking water, and even death. Because of the dangers associated with many hazardous substances and the level of control that humans have over hazardous substance incidents compared to natural hazards, public confidence could be damaged severely in the event of an incident.
Responders	Moderate	First responders must be vigilant when hazardous substances are suspected to be involved. The proper protective apparel must be worn and protocols must be followed to ensure that contaminated individuals and objects go through appropriate decontamination procedures prior to being moved away from the incident, regardless of the situation. Contamination of other responders or citizens must be avoided. The appropriate personnel, such as Hazardous Materials teams, must be notified to ensure that the proper measures are taken to prevent further harm.
Operations/Continuity of Operations	Moderate	During a hazardous substance incident, normal operations are likely to be maintained with only moderate stress on daily operations. In the event of a larger scale hazardous substance spill, there could be some loss of continuity of operations as a result of strain on personnel and equipment, but typically this will not be the case.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Hazardous Materials Facilities A hazardous substance event is most likely to take place where the substance is created or stored. Hazardous materials facilities have their own highly-trained personnel for handling and cleaning up the particular substances stored onsite. The facility's plans are highly specific to the substances stored there, thus providing for effective responses to incidents that involve these substances. Some facilities contain hazardous substances that can spread or leak quickly, or are held in extremely dangerous concentrations. There can still be significant effects on workers and others in close proximity despite having good planning in place. These facilities are inventoried in the state through Tier II reporting and there have been some major incidents in the state historically. Utilities Natural gas distribution lines can be problematic with some hazardous substances if contact is made with the natural gas supply. Most of the natural gas infrastructure is located underground, making exposure highly

Category	Impact Rating	Description of Impacts
		unlikely. However, natural gas itself can be the hazardous substance involved in the incident. One example of how this may occur is if a utility, work crew, or citizen strikes a gas line causing a leak. Degradation of the line may also be the cause of a release. A gas leak would cause an immediate threat and explosions and fires would be significant concerns for the immediate vicinity. Transportation Systems Hazardous substances can have an impact on interstate transportation if a release occurs on or in the vicinity of the roadway which may be the case if a truck or other vehicle carrying hazardous materials is involved in a traffic accident. Significant traffic disruptions may occur, slowing commerce or forcing alternative routing and further congestion of other areas. Similarly, rail lines are one of the more prominent places that hazardous substances are transported. A hazardous substance event on the rail system can impact rail traffic and the overall system. Cleanup efforts wherever the event occurred could be costly and go on for extended periods, shutting down that part of the rail system for that time. Critical Facilities Hospitals utilize and store some hazardous substances on site. Biological materials and radioactive wastes are the primary concerns in a hospital setting. Plans are in place to manage these concerns in both routine and emergency situations. An external hazardous substance event that occurs near the hospital or directly impacts a hospital could create service disruptions such as patient care. A large event may also create a high demand on hospital services and cause an overload on resources. Similarly, some emergency services facilities such as emergency shelters may be opened if homes have been exposed to hazardous substances and evacuations occur. Other Structures Commercial, industrial, and residential buildings all may have hazardous substances contained within them that are not reported through the Tier II reporting system but which could still present a smaller scale hazard. Proper containers and labeling can prevent inappropriate use, but accidents can still cause workers to be exposed. Cleaning products, fertilizers, and pesticides are common examples of supplies that are considered hazardous substances and which could cause a smaller incident.
Economy	Moderate	The economic impact of a hazardous substance related incident can be significant locally. Affected commerce is the greatest concern, as spills and releases can force businesses such as shopping centers, markets, and financial centers to be shut down for indeterminate periods of time. Contaminated water can be especially problematic as it can cause extensive shutdowns and put many people in danger. The overall costs depend on the substance(s) involved, how much is released, the processes and time used to manage the spill or release, who or what is contaminated, whether a fire takes place, etc. Cleanup can be a less significant cost and is typically handled by the party responsible for the spill or release.

Category	Impact Rating	Description of Impacts
		A hazardous substance incident could occur at any large gathering if it was the target of a terrorism event (see Terrorism below). Also, a large event arena could be forced to deal with a hazardous substance incident if it is located in close proximity to them. Arenas and other major event venues may be at significant threat as they are often situated along transportation routes where vehicles transporting such substances could become involved in an accident.
Environment	High	The environmental impact is highly dependent on the location and the severity of the event. Some of the substances involved in these incidents can be cleaned up or do not have lasting impacts on the areas affected. Others may cause crops and other vegetation to be destroyed, sometimes beyond the ability to grow back and animal populations may become displaced or killed. Some areas may be deemed uninhabitable or not fit for development. Water sources may also be impacted by hazardous substance releases or spills, which can affect fish, animal, and plant populations as well as humans that come in contact with contaminated water. The threat to water sources is perhaps the greatest potential threat of a hazardous substance spill on the environment. Water can rapidly transport the substance great distances and expand the scope of the incident. This can make it difficult to respond to the incident and cause serious health impacts.

Table B-12 EMAP Radiological Emergency- Fixed Nuclear Facility Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	Although many areas of the state are well outside of the defined risk zones for a radiological emergency, there are also a number of areas that are located within the emergency planning risk zones, including several of the major metropolitan areas of the state. Areas located within 10 miles of a nuclear 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. In the 50-mile zone, the public would be most impacted from ingesting radiological materials through home grown crops, milk produced from livestock which have fed on contaminated grasses, and consuming contaminated surface water. Ingestion of radiological materials may result in internal contamination if ionizing radiation is released in the body. This can cause serious health risks, especially if critical organs are affected. Some organs such as the thyroid take in certain isotopes. It is extremely difficult to purge the material from the body. The public will be extremely concerned about their health and safety during and after a nuclear incident. Confidence will be dependent upon the availability of information and perceived quality of response by government and non-government service providers, but it is likely that confidence in the state's governance will be a significant concern.
Responders	High	First responders are vulnerable to the same impacts as the general public but will also be at greater risk due to their need to function outdoors and operate in contaminated environments. These responders will likely need to operate in personal protective equipment to limit their outdoor exposure. Proper decontamination is likely to be necessary to reduce the spread of contamination. Since responders will be first on the scene and directly dealing with the issues of a radiological incident, their risk will potentially be very high.
Operations/Continuity of Operations	Moderate	In the wake of a nuclear accident, continuity of operations could be impacted. It is very likely that many key employees could be a part of the evacuation if their homes are located within the 10-mile evacuation zone. This could cause many issues with maintaining continuity of operations and, depending on the severity of the event, there may be significant disruption to normal operations. Generally, it is likely that operations would proceed from outside their normal location, as there are plans at all stations for setting up command posts outside of high risk areas when incidents occur. This will likely impact continuity of operations to some degree, though exercises on radiological incidents are carried out frequently.
Built Environment (Property, Facilities, Infrastructure)	Moderate	It is unlikely that a radiological incident would cause the kind of damage that is typical of many other hazards identified in this plan as there would be minimal destruction of buildings and other infrastructure as a result of

Category	**Impact Rating**	**Description of Impacts**
		this type of incident. However, many structures and facilities could potentially be contaminated with radioactivity rendering it extremely dangerous for humans to be near them or live/work there. In this sense, a major radiological event may cause significant damage to the built environment and result in large areas that must be quarantined or considered off-limits to the public after an incident. Further, checkpoints and decontamination stations may need to be set up along routes that leave the evacuation zones, resulting in increased travel times along major roadways and necessitating traffic re-routes.
Economy	Moderate	Economies within the risk zones are likely to see decreased spending as evacuation takes place. Travel and tourism across the state may be limited for an extended period of time due to travelers associating the entire state with the incident. Interstate commerce may be impacted as decontamination stations may need to be established and some drivers may elect to attempt to circumnavigate the state altogether extending travel times and increasing the time to market for products on a regional and statewide level. Employers in the surrounding areas may see increased absenteeism and requests for leaves of absence to deal with the aftermath of the event and some employees may self-evacuate, resulting in a loss of productivity.
Environment	High	Environmental impacts as a result of a radiological incident may be very serious. Contaminants may impact the land and water for many years and wildlife may experience increased likelihood of cancer and other health problems. In general, habitats and ecosystems will suffer long-term from a radiological incident as the organisms within these areas will face similar impacts to those that humans experience, but since they are unable to evacuate or permanently migrate to new locations, they will be exposed for longer periods and be impacted to a greater degree.

Table B-13 EMAP Terrorism (CBRNE) Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	In addition to the clear impacts that terrorism can have on human life and safety, there are a number impacts on the public that will be more widespread if major events take place. As seen after the attacks on September 1, 2001 in New York City and Washington, D.C., there can be significant impacts far away from the site of the incident. Fear and worry about additional attacks or for loved ones in areas affected are just a couple examples of impacts that could occur. Other impacts include discrimination or changed interactions between people of differing nationalities depending on the nature and intent of the attack(s) and who perpetrated the attack(s). During and after a terrorism event, the public will be expecting services to be provided despite the uncertainty of any existing hazards or further impacts. The partnership and involvement of the media is crucial not just for providing public guidance, but also for keeping the public informed of the efforts underway or of any obstacles or concerns hindering response efforts. Although public confidence will almost certainly be shaken, agencies and organizations in the government working together in an efficient and effective way will provide for the best chance of positive public perception of the government.
Responders	High	The danger to human life in a terrorist event is dependent on the form of attack utilized as well as its location, severity, and scope (see Section 3). In any terror incident, responders must conduct a scene size-up to determine hazards to themselves and others. Decisions must be made about how to handle victims and those in close proximity that may have been victimized or exposed. If hazardous materials are present, it could change the strategy as well. Fear and panic will be significant in the case of a terrorist act, whether it occurs in North Carolina or elsewhere in the nation. As front-line government officials, responders will be at a significant risk during an attack and may even be the object of the attack in some cases. Depending on the location, the scope, and the nature of the event(s), response efforts could last hours, days, or potentially longer. Collaboration at all levels can provide for the most stable, effective, and efficient effort in returning to normal activities and operations. Identification of further threats and open communication lines can prevent further harm or detriment to response operations.
Operations/Continuity of Operations	High	A terrorist event would likely have a high impact on continuity of operations, especially due to the disorder that would result and the unpredictability of this kind of event. Emergency personnel may be directly affected or targeted, which would cause definitive harm to maintaining continuity of operations.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Major Events/Centers Often terrorist events are targeted at major events or at large event centers in an attempt to create widespread loss on a large number of people. Therefore, large arenas, convention centers, and event spaces may be at higher risk of a terrorist attack than most other buildings. Similarly, prominent or symbolic structures may also be at an elevated risk for targeting.

Category	Impact Rating	Description of Impacts
		Critical Facilities At hospitals, the primary concern with a terrorism event is the influx of patients requiring care. Terrorism may pose a specific hazard to a hospital structure itself, but it is more likely to be impacted when in close proximity to a target. Many patients could be injured or their medical condition worsened by the impacts of a terrorism event. In general, emergency services buildings are not considered high probability targets for terrorists to strike. In other countries, ambulance services and 9-1-1 centers have been targets; however, that pattern has not been seen here in the United States. Alternate locations should be set up so that emergency operations can continue if an emergency services facility was affected or targeted by a terrorism event. Shelters may need to be activated in a terrorism event to house and care for displaced individuals. Transportation Systems Bridges found throughout the interstate system may be targeted by terrorism. Not only would the actual structural failure affect those on, under, or near the bridge, but the loss of its functionality would also significantly hinder travel and commerce. Past experiences with terrorists using airplanes for terrorist activity suggest a need for planning and collaboration with all parties of interest at airports including local, state, and federal agencies. In terms of railway transportation, the most likely means of disrupting these lines would be the derailing of a train, primarily by sabotage of the rail or the switching control system. Using explosives would be more likely because hacking into systems to cause collisions and other undesired actions to moving rail cars would be more complex operations. In addition to disrupting rail traffic, a derailing can impact other means of travel such as a nearby road or airport. The rail cars involved in an incident could contain hazardous materials, which would add an element of complexity to the situation. Utilities Damage to high voltage lines or power plants structures could disrupt power distribution for a large area, affecting emergency response and other facets of government and business. The economic impacts may also be significant as extended outages can be costly. Natural gas lines are also a concern as a target for terrorists. Major pipelines run through the state, but natural gas itself must be exposed to oxygen before it could cause an explosion. Most natural gas explosions are small and rarely deadly. The real concern is in shutting off natural gas to end consumers. Sabotage of a pipeline could disconnect a significant number of homes and businesses for considerable periods of time. Other Structures Single-family dwellings and small businesses or industries are not likely to be targets for terrorism. However, areas that have high concentrations of certain targeted populations could be vulnerable to an attack. These populations may relate to a person or group's ethnicity, religion, and socioeconomic status. Dwellings in close

Category	Impact Rating	Description of Impacts
		proximity to a targeted event center may also be more likely to experience indirect impacts. Depending on the method of attack, impacts could include stray bullets or debris from explosions. These could affect people, electrical systems, water systems, cause structural collapse, or fires. Also, the presence of chemical agents can create health hazards through dangerous reactions with water sources or building materials.
Economy	Moderate	The economic impact of a terrorist attack can vary from minimal to severe. If the incident occurs in North Carolina, it could hinder the state's economy but may not have an impact at the national level. Tourism and some commerce could decline significantly if people, events, or businesses are hesitant to come to the area following an incident. An incident in a major city or a financial hub could affect the entire country. For example, the events of September 11, 2001 had an immediate impact on local, state, and national economies. This event and other large-scale attacks like it can drastically alter the economy in both the short- and long-term. Major Events/Centers Terrorism would mostly likely occur in city centers during large public gatherings or during business hours to cause the most harm and promote the most fear. Political gatherings would be high priority targets as well. Arenas can be targeted by terrorism, particularly during events that may have some form of political, cultural, or historical value, or simply any event with a large number of people in attendance. These could all have a negative impact economically on the state.
Environment	Moderate	Impacts on the environment depend on the type of attack utilized by terrorists. A biological, chemical, or other hazardous material can have impacts on human, animal, and plant populations alike. The impacts can vary depending on the particular hazard(s) at play, but there will certainly be at least some negative impacts from a terrorist attack including potentially the release of smoke, chemicals, or debris into the environment.

Table B-14 EMAP Cyber Attack Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The aim of a cyber attack is typically to corrupt or exploit protected information. Depending on the target of the ploy, a significant number of people can be victims of identity theft, fraud, or other forms of technology-based crime. Anyone with an account, membership, or other relationship with an entity that requires storage of information is vulnerable. An individual/user must rely on the entity of affiliation to create and maintain safeguards against the intrusion of computerized systems. However, even the strongest of safeguards can be corrupted or evaded. Continual monitoring of attempted or successful attempts at cyber attacks is warranted to lessen the potential impacts. Public confidence in the response of government organizations may be impacted by a cyber attack based upon societal expectations and media influence with respect to cyber attacks. There may be an expectation that government entities should do a better job of patrolling cyber crime and hold those responsible accountable. Public confidence may be impacted by media interpretation and reporting of the event, positive or negative.
Responders	Low	Cyber attacks may be used to try to intrude into electronic safety equipment or systems. This may increase call volume, block systems, or otherwise hinder emergency operations. Although responders are not likely to be at risk to a cyber attack in a physical sense, they may be impacted financially or through identity theft, much like members of the public.
Operations/Continuity of Operations	Moderate	In the event of a cyber attack, continuity of operations could be impacted if many of the services (such as internet or other IT programs) that are required to maintain daily operations are shut down by the attack. This could cause considerable disruption to normal operations in the state and could make the state potentially vulnerable to other events that may be occurring simultaneously.
Built Environment (Property, Facilities, Infrastructure)	Low	Cyber attacks may have the effect of disrupting life sustaining equipment or systems in hospitals or medical facilities by causing technological disruptions. These attacks may also sabotage information networks and communications equipment that could disrupt services within medical facilities. Normal operations in communications equipment such as telephones, cell phones, and internet could all be severely impacted by a cyber attack which would impact large numbers of people including critical facilities operators.
Economy	High	Freezing, redirecting, or stealing financial assets can have drastic impacts on a business. Banking and credit institutions are commonly affected or targeted by fraudulent activities and often store a great deal of information on businesses, so large-scale intrusions can have significant impacts on the local economy. Large employers are more likely to be targeted by cyber attacks than individuals or small businesses. Larger businesses generally have greater assets to exploit and store more personal information on private individuals or employees.
Environment	Low	Because cyber attacks occur in cyberspace and would not truly have any impacts outside of the physical sphere, there are no expected environmental impacts from this type of event.

Table B-15 EMAP Extreme Heat Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Extreme heat can affect many people and to varying degrees. Often the elderly and very young are susceptible to the most detrimental impacts, but heat stroke and exhaustion can plague anyone. People who are overweight, who overexert during work or exercise, and who are ill or are on certain medications are also at greater risk of suffering from heat-related illness. Risks from exposure to extreme heat include heat cramps, heat exhaustion, heat stroke, and death. Many of the impacts of extreme heat on people are the result of heat exhaustion or improperly functioning air conditioning units. A heat wave or extreme heat event would have minimal effects on public confidence as these events are frequent and the public likely understands the potential impacts. However, if an extreme heat event results in a large number of illnesses and fatalities, government organizations may be accused of failing to properly prepare for or respond to the threat, and public confidence could suffer.
Responders	Moderate	Extreme heat can also affect responders who are often more susceptible to heat stroke and exhaustion due to the nature of their work. This work forces police and emergency medical providers to be exposed to the elements, physically exert themselves, or wear heavy personal protective equipment. In these cases, responders could be negatively impacted by extreme heat and will need to protect themselves and prepare accordingly.
Operations/Continuity of Operations	Low	Extreme heat would likely have few impacts on continuity of operations as the warning time for these events is usually long and direct impacts to large numbers of personnel or other resources necessary to maintain operations are unlikely. If air conditioning systems in operations centers break down due to overuse, operations could be interrupted or forced to move to secondary facilities.
Built Environment (Property, Facilities, Infrastructure)	Low	Extreme heat would likely have a minor effect on the built environment, although high temperatures could potentially put a strain on infrastructure such as power generation and water systems due to higher demand. During times of extreme heat, air conditioning units work harder and require more electricity, making brownouts and blackouts possible if electricity demands exceed generation. Extreme heat can also cause transportation infrastructure such as roads, bridges, railways, and runways to buckle, crack, or shatter.
Economy	Low	An extreme heat event could potentially have a negative impact on the economy in the short term as the public may be advised to stay indoors, causing them to reduce overall spending and negatively impact businesses in the community. Additionally, extreme heat events can also result in decreased worker productivity as high temperatures can result in decreased energy, loss of concentration, and heat-related illness in workers. This can cause disruptions to the regular working of the local economy. Extended periods of extreme heat may also disrupt the local economy if agricultural, dairy, and livestock production declines, resulting in income loss for farmers and other related industries as well as increased prices for consumers.
Environment	Moderate	The environment would be impacted by extreme heat as many plants and animals that are not able to withstand the heat may die off and crops and livestock may be impacted by unusually high temperatures,

Category	Impact Rating	Description of Impacts
		resulting in death or illness. Heat waves can also contribute to higher levels of air pollution since air becomes stagnant and traps emitted pollutants, often causing increased levels of surface ozone.

Table B-16 EMAP Electromagnetic Pulse (EMP)/Geomagnetic Storms Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The entire State of North Carolina's population is vulnerable to the impacts of an EMP/geomagnetic storm, regardless of the measured magnitude, although most low-classification events will not have any noticeable impact on the daily lives of people. If a large event were to occur and cause widespread power outages or communications systems disruptions, there may be a panic and people may temporarily be unable to undertake normal activities such as cooking or using mobile devices. Consumer electronics may also be damaged, including HVAC systems, newer model appliances, radios, and televisions. EMP/geomagnetic storms have some likelihood of affecting public confidence due to their highly visible impacts and the fact that most members of the public are unaware of the hazard and may be confused about the cause of loss of power/communications systems.
Responders	High	Responders could be critically affected by an EMP/geomagnetic storm event as response personnel rely heavily on communications equipment to carry out their normal operations. If a large event were to occur that knocked out communications equipment for several hours or possibly more than a day, this would significantly hinder responders' abilities to perform their duties. Additionally, other electronic equipment or devices used by responders may be damaged by an EMP/geomagnetic storm further impacting their ability to respond to emergencies following an event.
Operations/Continuity of Operations	High	Continuity of operations would potentially be impacted in many ways by a major EMP/geomagnetic storm. As mentioned above, if communications equipment is disrupted, it would be challenging for government officials to coordinate with one another and respond to citizen needs such as emergency medical care. It is also possible that some satellites will be damaged, affecting satellite-based communications. Additionally, if power is lost, there would be a disruption to normal operations, though there are generally plans in place to maintain continuity of operations in this case as several operations centers have backup power systems.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Critical Infrastructure The primary impact on the built environment from an EMP/geomagnetic storm would be on communications and power infrastructure. Most of the built environment (e.g. homes, buildings, roadways) would not be impacted in any way by this type of event. However, if power or communications systems are damaged or temporarily shut down, some aspects of the built environment will be impacted such as traffic lights, street lights, and cell phone towers. Additionally, electronic equipment and control systems could also be damaged and water and wastewater systems, gas stations, and pipelines may be shut down throughout the state.
Economy	Moderate	An EMP/geomagnetic storm can impact any area of the State of North Carolina at any time and may bring with it an interruption of service for local businesses as well as governments that lose power or cannot utilize communications systems. As a result, there will be significant disruption of the local economy as long as the effects (such as power or communications loss) of the EMP/geomagnetic storm remain in place. ATMs,

Category	Impact Rating	Description of Impacts
		credit card processing, and other electronic financial transactions may also be disrupted, further impacting the economy.
Environment	Low	There will likely be relatively minimal impacts on the environment from an EMP/geomagnetic storm. These types of events do not directly impact plants or animals and typically do not have any effect on water systems or other natural areas. There may be indirect impacts if, for example, power systems are damaged at facilities that house hazardous materials, causing releases into the environment. However, the likelihood of this occurring is relatively low.

B.2 STANDARD 4.2

Another important component of hazard mitigation that goes beyond developing a plan is implementation of that plan through hazard mitigation programs and projects. This is directly connected to the development of a successful plan and requires the state's mitigation program to use its resources systematically to mitigate the effects of the hazards/disasters identified in the risk assessment. In *Standard 4.2.1*, EMAP requires that the state's program have a plan in place to implement mitigation projects and set priorities based on loss reduction. This plan should:

- Be based on the natural and human-caused hazards identified in Standard 4.1.1 and the risk and consequences of those hazards
- Be developed through formal planning processes involving Emergency Management Program stakeholders
- Establish interim and long-term strategies, actions, goals, and objectives

In addition, the program must carry out the following as outlined in EMAP *Standards 4.2.2* and *4.2.3*:

- Document project ranking based upon the greatest opportunity for loss reduction and documents how specific mitigation actions contribute to overall risk reduction
- Have a process to monitor overall progress of the mitigation activities and document completed initiatives and their resulting reduction or limitation of hazard impact on the state

In *Standard 4.2.4*, EMAP requires that the state do the following:

- Provide technical assistance in implementing applicable mitigation codes and ordinances
- Identify ongoing opportunities and track repetitive losses
- Participate in applicable jurisdictional, inter-jurisdictional and multi-jurisdictional mitigation efforts

Finally, in *Standard 4.2.5*, the program must have a method and schedule for evaluation, maintenance, and revision of the plan as identified in *Standard 4.2.1*.

Documentation of how the state's program has addressed all of these standards is extensive and would be much too large to include within the pages of this plan. It is currently stored on the state's servers and can be retrieved as needed to ensure these EMAP Standards are met. However, in order to ensure continuity between the plan itself and the implementation of the mitigation program (which is meant to achieve the goals/objectives of the plan), the planning team felt that it would be useful to address Standard 4.2 to some degree within the plan document itself. As such, below is an overview of how the state's program has addressed this EMAP Standard, which includes references to locations on the state's server where additional information can be located.

B.2.1 Standard 4.2.1

The State of North Carolina's Emergency Management Program has a definitive plan to implement mitigation projects and sets priorities based on loss reduction. In large part, the State Hazard Mitigation Plan lays out these priorities through the risk assessment (Section 3) and mitigation actions (Section 5) that are discussed in previous sections of this plan. However, there are also many other active components of the implementation process that are carried out by the Hazard Mitigation Branch through their grant programs. Especially key to these programs is the Benefit-Cost Analysis (BCA) that is a critical component of large-scale risk reduction projects such as acquisition/elevation/reconstruction of structures. NCEM is always focused on prioritizing projects that provide the greatest benefits and loss reduction potential to the state, its local governments, and citizens.

Documentation of the grant process for prioritizing projects and emphasizing loss reduction as well as a number of other documents that address this standard can be found in the following folder on NCEM's server: \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.1

- The plan discussed above for implementing mitigation projects and setting priorities is based largely on the risk assessment that was carried out during the planning process and is intended to focus on those hazards (natural or human-caused) that are considered to be the greatest threat to the state. It is notable, for example, that flood was identified as one of the highest risk hazards that poses the greatest threat to the state in terms of future damage potential.

  As such, many of the actions identified in the State Hazard Mitigation Plan deal with flooding and are attempts to mitigate losses from future flood events. Similarly, many of the projects that the state has implemented in recent years through its UHMA programs and other funding sources have been focused on reducing flood risk. Additionally, the state often implements and funds actions that are aimed at addressing multiple or all hazards identified in the risk assessment section of this plan. Examples of these projects include generators, early warning systems, and safe rooms.

  Overall, through its actions, projects, and funding distribution to local governments, the state tries to remain focused on the hazards that pose the greatest threat as identified in the risk assessment of the plan. Documentation of the local grant application process and examples of projects that demonstrate that they are aimed at addressing the risks and consequences identified in Standard 4.1.1 can be found in the following documents in the folder location listed above:
  Local Grant Application Process: SOP- NCEM UHMA Development SOP HM 2017-12-1
  Generator Project Example (Addresses All Hazards): Presentation- NCEM NTB Generator Closeout-FINAL v1 HM 2017-8-24

Early Warning System Project Example (Addresses All Hazards): Presentation- NCEM WILSON'S CREEK POWER SIREN POSITION_PP HM 2015-4-29

- The implementation plan for mitigation projects has been developed through a formal process involving stakeholders from the state's Emergency Management Program, including numerous state agencies outside of Emergency Management, as well as in conjunction with local and federal officials. Documentation of how the plan was developed through a formal planning process involving many different stakeholders can be found in Section 2 of the State Hazard Mitigation Plan.

- Interim- and long-term strategies, actions, goals, and objectives for the state mitigation plan are outlined in Section 5 of this plan and are comprehensively known as the state's mitigation strategy. This strategy is coordinated with the implementation plan for mitigation projects that are funded by the state via Planning-Project Dependency worksheets that are written for every project that the state funds. The purpose of these worksheets is to ensure that the projects that are actually implemented within the state address the risks that were identified in both state and local hazard mitigation plans. Documentation of example Planning-Project Dependency worksheets can be found in the following documents in the folder location listed above:
  Planning-Project Dependency Worksheets: Plan – NCEM Bladen Reconstruction PPD Checklist 2015-7-14; Plan – NCEM Mitchell Acquisitions PPD Checklist 2016-3-7; Plan – NCEM Sampson Acquisitions PPD Checklist 2016-4-12; Plan – NCEM Tarboro Elevations PPD Checklist 2015-8-13; Plan – NCEM Windsor Reconstruction PPD Checklist 2017-7-7

B.2.2 **Standard 4.2.2**

The State of North Carolina's Emergency Management Program has a detailed process in place for documenting project ranking based on the greatest opportunity for loss reduction and has documented how specific mitigation actions contribute to overall risk reduction. This is mainly achieved through previous sections of the State Hazard Mitigation Plan, namely in Section 5, which identifies all state-level hazard mitigation actions and describes how each of those actions contributes to overall risk reduction. This section of the plan also outlines the relative priority of each action, which corresponds directly to the level of opportunity that the action provides for loss reduction. In short, the actions that provide the greatest opportunity are ranked highest in terms of priority.

However, it should also be noted that the state-level actions found within Section 5 of the State Hazard Mitigation Plan are focused at a broad scale because of the size of the state and the scale at which state agencies typically operate. Often the state serves more of a facilitator role within the Emergency Management field, leaving more specific and tangible projects to be Hazard Mitigation Branch has also developed a process for ranking local projects in terms of the opportunity they present for reducing overall risk. This process is primarily focused on performing Benefit-Cost Analysis to determine which projects present the greatest opportunity for risk reduction.

The entire grant application process is documented through Standard Operating Procedures and numerous other supporting documents that can be found in the following folder on NCEM's server: \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.2

B.2.3 **Standard 4.2.3**

The State of North Carolina's Emergency Management Program has a process in place to monitor the overall progress of its mitigation activities and document completed initiatives and their resulting reduction or limitation of hazard impact on the state. This process is documented in two primary ways. The first is through the State Hazard Mitigation Plan which identifies all of the state-level mitigation activities that are being carried out by state agencies and officials in Section 5. These activities are closely monitored and evaluated through the process laid out in Section 6 of the State Hazard Mitigation Plan.

In addition to the process that is described in the State Hazard Mitigation Plan for activities at the state level, the Hazard Mitigation Branch has also laid out a process for monitoring the overall implementation of mitigation activities at the local level. These local activities are also closely monitored and evaluated by state officials to ensure that they are having the intended effect of reducing overall risk. In many cases, the state has been active at documenting the resulting risk reduction through losses avoided studies and other technical evaluation techniques. Examples of losses avoided studies, the process for documenting post-mitigated property uses, and numerous other supporting documents can be found in the following folder on NCEM's server: \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.3

A recent example of the Emergency Management Program documenting successful risk reduction was in the wake of Hurricane Matthew in which North Carolina Emergency Management developed map products overlaying the inundation areas from the storm with previously mitigated properties and demonstrating the losses that were avoided due to these mitigation actions taken prior to the storm (e.g. buyouts, elevations). This study can be located at the following website: https://rebuild.nc.gov/resiliency/hazard-mitigation-grant-program

All of these post-mitigation monitoring activities are an integral part of the mitigation process, especially when it comes to ensuring that other properties that are at high risk to hazards are being appropriately targeted by effective mitigation action.

B.2.4 Standard 4.2.4

As part of the State of North Carolina's Emergency Management Program, state officials carry out a number of functions to ensure that efforts among all levels of government and across all organizations are coordinated and effective in implementing mitigation activities. Specifically, state officials:

- Provide technical assistance to local governments in implementing applicable mitigation codes and ordinances. For example, the state's Building Code Council frequently updates the state building code and assists local governments with implementation and interpretation of these codes. The North Carolina Division of Emergency Management is not directly involved in developing these codes in most cases, but plays a critical role in the development and implementation of certain areas of the code, namely the sections related to floodplain management and local flood damage prevention ordinances (FDPOs).

  The program is very involved in code development and implementation and acts as the primary liaison for local governments in addressing questions concerning the code and in providing technical assistance. State officials have also been proactive in providing training to local governments, such as the frequently offered L-273 course on floodplain management which has led to the certification of many additional local floodplain managers in the state, giving them the knowledge and expertise to appropriately manage floodplain areas in their communities.

  There are also many workshops offered throughout the state at conferences and on a regional basis to ensure that local floodplain managers stay up to date on the latest code changes and understand how to support risk reduction through the implementation of their codes. In addition, the state is available for consultation on including higher standards in local codes where desired by local governments. Technical assistance documentation such as presentations that have been used for local technical assistance and other supporting documents can be found in the following folder on NCEM's server:
  \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.4

- Identify ongoing opportunities and track repetitive loss. As part of its mitigation program, the state keeps an ongoing list of opportunities that local governments have submitted and makes inquiries on a regular basis to local governments requesting ideas for projects intended to reduce risk. Given that there are many project ideas and limited funding, there is nearly always a backlog of project ideas. Examples of where the state keeps project ideas that have been submitted by locals through its Letter of Interest process can be found in the following folders on NCEM's server:

2015: \\ncemjfhqfs01\Archived Disaster Files\PDM\UHMA 2015\Coordinator\LOI and NOFA
2016: \\ncemjfhqfs01\Archived Disaster Files\PDM\UHMA 2016\Coordinator\LOI and NOFA
2017: \\ncemjfhqfs01\Archived Disaster Files\PDM\UHMA 2017\Coordinator (PDM)\LOI and NOFA

In addition, the state is constantly tracking repetitive loss properties and properties on the Greatest Savings to the Fund List. NCEM maintains an up to date list of these properties on its server and copies of the lists from recent years are located in the above folder location.

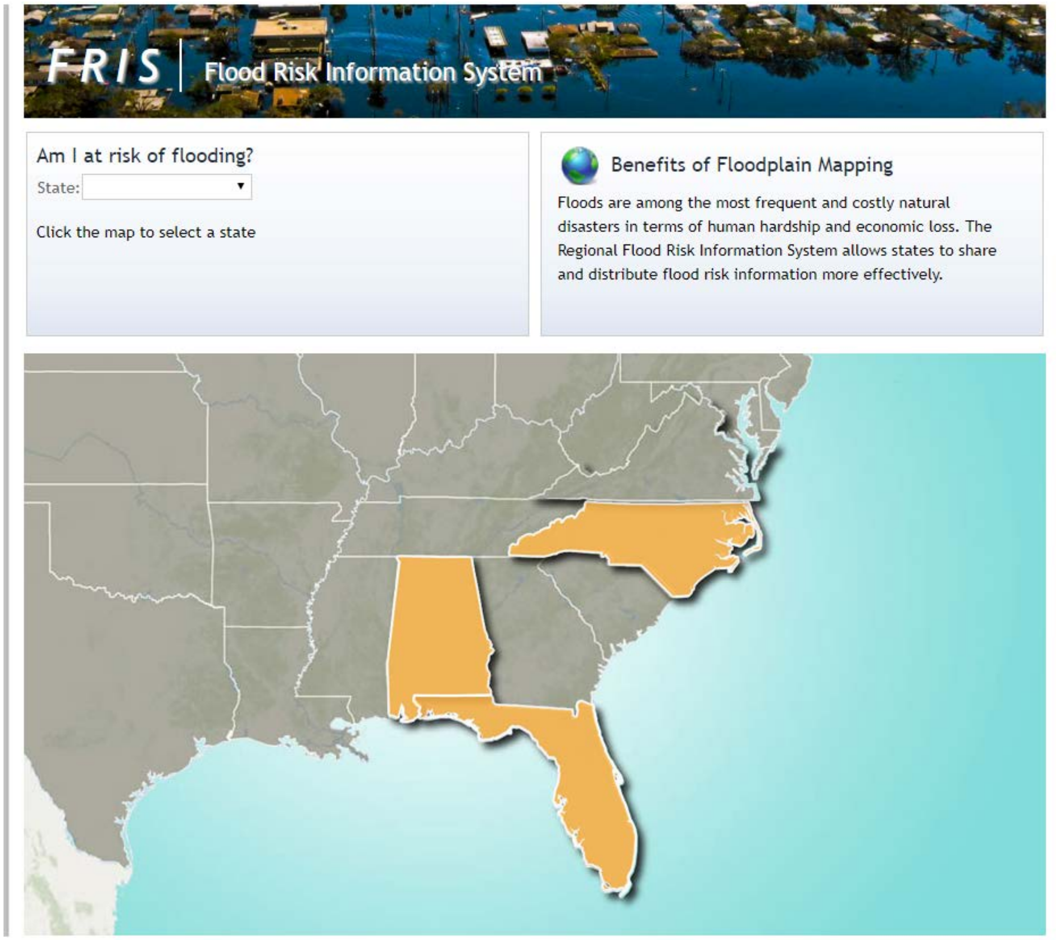
A primary goal of the state, as outlined in the State Hazard Mitigation Plan, is to reduce the number of repetitive loss properties in the state and to prevent future properties from becoming repetitive loss properties through proactive mitigation activities.

- Participate in applicable jurisdictional, inter-jurisdictional, and multi-jurisdictional mitigation efforts.

The state is very active in coordinating within its own organization at the jurisdictional level to implement mitigation activities as outlined above and in Section 2 and Section 5 of the State Hazard Mitigation Plan.

The state is also a critical driver of inter-jurisdictional mitigation activities, especially in conjunction with local level officials where the state frequently acts as the intermediary for managing federal mitigation funding with local governments as the ultimate recipients to carry out projects at the local level. These inter-jurisdictional efforts are largely documented through the mitigation grant and project development process that is outlined along with other supporting documents in the following folder on NCEM's server: \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.4

Finally, the state works to be a critical partner on inter-state and regional level efforts to conduct mitigation, often working through federal agencies like FEMA and its Regional offices to perform larger-scale efforts at reducing risk. These efforts are often coordinated through the State Hazard Mitigation Officer at conferences such as the Partners in Mitigation Conference. One major example of this is that the State of North Carolina hosts flood data for two partner states in the southeast (Alabama and Florida) on its Flood Risk Information System website (fris.nc.gov/fris).



These are only a few examples of the ways in which the state is a partner in implementing mitigation efforts. Additional documentation of selected multi-jurisdictional efforts, such as attendance at conferences and other supporting documents, can be found in the following folder on NCEM's server: \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.4

B.2.5 **Standard 4.2.5**

The State of North Carolina's Emergency Management Program has a method and schedule for evaluation, maintenance, and revision of the implementation plan described in Standard 4.2.1. In large part, this schedule for review is laid out in Section 6 of the State Hazard Mitigation Plan. As new methods and technologies for implementing mitigation are developed, it will undoubtedly be necessary to make revisions to the implementation plan for mitigation projects to ensure the most effective strategies are being employed. It is also important to frequently review the identified mitigation projects in terms of prioritization to confirm that the most important and effective projects are receiving the appropriate time and resources. As part of this review, the state has recently begun implementing a process of carrying out After Action Reports (AARs) in the wake of declared disasters and major grant funding submittals to identify any ways that these processes can be improved to ensure future processes maximize risk reduction. Examples of AARs from recent application packages and other supporting documents can be found in the following folder on NCEM's server: \\ncemjfhqfs01\common\Administrative\Emergency Management Accreditation Program (EMAP)\2018 Re-Accreditation\Candidate Documents\4.2 Hazard Mitigation\4.2.5

Appendix C. Plan Maintenance Records

Version	Date	Summary of Changes
	6/6/18	Risk Management Coordinating Council Conference Call