Preface: 2011 Revision – Durham County Hazard Mitigation Plan

Durham County's Hazard Mitigation Plan (HMP) has been updated in response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), and FEMA's January 2008 Multi-Hazard Mitigation Planning Guidance. This 2011 Plan Update was completed with the assistance of a multiagency planning team consisting of personnel from City and County departments and community partners.

The areas of focus for the updated 2011 Plan are:

- Update the existing Plan to the standards contained within Section 322 of DMA 2000 for
- a hazard mitigation plan;
- Expand on the previous hazard identification and risk assessment section of the Plan; Incorporate FEMA's newest grant programs into the Plan;
- Inclusion of updated information within all chapters of the Plan; and
- Reassessment of the goals, objectives, and activities presented in the 2007 Plan.

Purpose

This Multijurisdictional HMP has been prepared to fulfill the requirements of DMA 2000 and to help minimize the impacts of inland flooding, high winds, hurricanes and other natural hazards that affect the County of Durham and City of Durham.

Scope

This Multijurisdictional HMP addresses natural hazard risk assessment and mitigation implementation for the County of Durham as a whole, and is structured in accordance with pre-disaster planning requirements as stated in Section 201.4 and 201.4(d) of the Disaster Mitigation Act of 2000 (DMA 2000) for a standard hazard mitigation plan.

Federal Authorities

The County of Durham and City of Durham are in compliance with FEMA Regulations - 44 Code of Federal Register (CFR), Part 206, Subpart N (P.L. 100-107, the Robert T. Stafford Disaster Relief and Emergency Assistance Act dated 1994.), the Disaster Mitigation Act of 2000, Section 322, and other related Federal authorities including:

- FEMA regulations - 44 CFR, Part 13, Uniform Administrative Requirements of Grants and Cooperative Agreements to State and Local Governments;
- FEMA regulations - 44 CFR, Part 14;
- Executive Order 12612, Federalism;
- Executive Order 11990, Protection of Wetlands;
- Executive Order 11988, Floodplain Management; and
- 44 CFR, Part 201.4 (c) (7) § 13.11 (c) and § 13.11 (d).

Both jurisdictions will continue to comply with all applicable Federal statutes and regulations during periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend its plan whenever necessary to reflect changes in the State or Federal laws and statutes as required in 44 CFR 13.11(d).

The Planning Process for the 2011 HMP Update

The HMP update planning process is a continual process which began once the original 2006 HMP was approved by FEMA. A planning team which consisted of representatives from several County and City agencies directly responsible for hazard mitigation actions and/or activities performed during a natural hazard event was created and began meeting to discuss the updating process and any necessary changes in August 2009. The planning team met on a monthly basis until the plan update was completed. A total of 20 meetings were held by the group over a two year period.

Representatives of the following agencies participated on the planning team:

- Durham City-County Planning Department
- Durham City-County Inspections Department

- Durham City Public Works Department
- Durham County Engineering Department
- Durham City Water Resources Division
- Durham City Fire Department
- Durham City-County GIS
- Durham County Emergency Management
- Central North Carolina Chapter – American Red Cross

Individual team members provided input on changes and revisions to the existing Plan's chapters throughout the planning process. A primary focus was to create an updated Plan that would be easier to navigate. Each section was reviewed with that focus in mind. Many of the team members represent agencies that perform duties for both jurisdictions while the remainder work solely within one or the other. Each agency, or department, was able to comment on required updates for the jurisdiction represented.

AGENCY	PERSON	ROLE
County Emergency Management	Mark Schell, Emergency Mgt Coordinator	Lead Facilitator, Editor-in-Chief
City-County Inspections Department	William E. (Gene) Bradham, Director of City-County Inspections, Floodplain Administrator	Provided building inspection process information and floodplain regulation information
City Public Works Department	Christina Sokol, PE, CFM, Civil Engineer, Stormwater Services Division	Provided information on floodplain development permitting and regulations.
City-County Planning Department	Amy Wolff, Senior Planner	Provided information regarding planning mechanisms and ordinances
City Public Works Department	Thomas Ayers, Operations Administrator	Provided mitigation project information, jurisdiction process information and regulation information
American Red Cross (Community Partner)	Timothy Bothe, Director – Emergency Services	Provided community response information and regional information regarding response mechanisms
County Engineering Department	Glen Whisler, Director/County Engineer	Provided mitigation project information, jurisdiction process information and regulation information
City Water Resources Division	Ted Cope, Safety Manager	Provided information regarding response mechanisms to disasters, vulnerability assessments and mitigation measures
City Fire Department	Daniel Cremeans, Battalion Chief	Provided information regarding response mechanisms to disasters, vulnerability assessments and mitigation measures
City-County GIS Department	Marcus Bryant, GISP GIS Manager	Provided GIS analysis and expertise

Communication activities between planning meetings during the active Plan Update phase included meeting at regularly scheduled times for meetings, telephone, interpersonal, and email communications. The planning team was asked various questions during the planning process for this plan update.

Examples of questions the members were asked and provided input for include:

- What has changed within the County in terms of natural hazards or mitigation of natural hazards?
- Is the current data provided within the existing plan and utilized to develop the existing plan still viable for planning purposes for this planning period?
- Are the stated goals and objectives stated in the existing plan still relative to achieving the County's mission for natural hazard mitigation?
- What natural hazard mitigation activities could the County and City pursue over the next three to five years to help achieve its natural hazard mitigation goals?
- Is the data that was gathered during the past three years appropriate? Should different data be gathered or more data gathered in the next five years.
- What new data exists that can be beneficial to the plan update and can be incorporated into said plan update?
- What resources are currently available to perform the necessary planning activities required to generate the information needed for the plan update?
- What resources will be available during the next five years to perform planning activities and data analysis required by the updated plan?
- How successful was the County in implementing hazard mitigation projects in the past five years?

Over the course of the 2-year review process, team members assessed the content of each section of the existing plan for data that was true, current, relevant and necessary for the good of the Plan. Revisions made included replacing national statistics with local statistics, updating charts and maps, revising goals and ensuring that mitigation measures were, in fact, true to both jurisdiction's missions.

Validation of data for the updated plan occurred through analysis of existing plans and procedures which include mitigation measures for each scenario (i.e. Durham City-County Emergency Operations Plan, Durham City-County Severe Weather Policy, Durham Winter Weather Plan, Durham Drought Management Plan). Additional data was verified through the inclusion of hazard vulnerability assessments completed annually for critical infrastructure sites throughout the County and related critical infrastructure site emergency contingency plans.

Mission and Goals

The original Hazard Mitigation Plan developed in 2007 was for the jurisdictions of Durham County and the City of Durham. Both jurisdictions participated in the original Plan and in this revision and no other jurisdictions were added or dropped out of the plan update process.

In order to comprehensively update the multijurisdictional HMP, the mission statements of the County and City were reviewed so that the HMP would align with those respective statements.

Durham County Mission Statement:

Durham County provides fiscally responsible, quality services necessary to promote a healthy, safe and vibrant community.

City of Durham Mission Statement:

To provide quality services to make Durham a great place to live, work and play.

City Goals:

1. Strong and Diverse Economy
2. Safe and Secure Community

3. Thriving Livable Neighborhoods
4. Well Managed City
5. Stewardship of City's Physical Assets

This plan update has provided the County and City of Durham with an opportunity to build more effective interagency communication between its many agencies that affect hazard mitigation planning, and to identify enhancements in current hazard mitigation planning that will help move the County and City forward in hazard mitigation planning.

The County and City of Durham are committed to reducing future damage from natural disasters through mitigation. The mission of our Hazard Mitigation Plan is to mitigate the effects of natural hazards by minimizing loss of life and property damage.

Chapter 7 of this Plan lays out the goals, objectives, strategies, and proposed activities that relate to hazard mitigation. The Hazard Mitigation planning team has developed these goals and their associated strategies and potential activities based upon the following:

1. Hazard vulnerability and risk assessments contained in this plan;
2. Evaluation of current state and federal regulations; and
3. State and federal funding sources available to conduct natural hazard mitigation measures across the combined jurisdictions.

It is anticipated that by working towards achieving the goals set out in this Plan, effective natural hazard mitigation measures will be implemented to protect all residents of the County, and will promote the responsible natural hazard mitigation throughout Durham County both on a County and City level.

The implementation of effective hazard mitigation requires on-going planning and dedicated persistence both on a County and City level to maintain what has been done in the past and to improve upon past efforts to strive for implementing the most protection possible from natural hazards.

The related strategies and activities presented in this Plan provide a guide to assist the County in working towards achieving these goals that will be implemented or initiated during the time period encompassing this Hazard Mitigation Plan Update. The goals themselves are achievable, yet they require adequate resources such as financial and staff resources to achieve significant results.

The County of Durham and City of Durham believe in the importance of natural hazard mitigation planning and implementation of hazard mitigation activities both on a County and City level in order to reduce/eliminate lives lost and property damage suffered by natural hazards.

Community Participation

As important as County and City agencies are to the update, it is equally important that the community have a part in the update process. Three separate efforts were undertaken to raise awareness of the HMP – some ongoing and some specific to the required processes for approval:

1. City-County Neighborhood College – The Durham City-County Neighborhood College is a unique educational program offered by Durham City and County governments. It is a nine-week series of classes that will provide information on key City and County services. Participants will have a chance to meet and interact with City and County staff, and learn things about government that they've always wanted to know but didn't know whom to ask. Topics discussed include: City and County services, community development, emergency services, health and human services, the City and County budget processes, and environmental services. The Hazard Mitigation Plan is explained within the "emergency services" presentation.

2. Durham City PAC Groups (Partners Against Crime) – The Partners Against Crime program promotes collaboration among police officers, Durham residents, and city and county

government officials to find sustainable solutions to community crime problems and quality of life issues. It is a community based volunteer organization that promotes and executes safety strategies to prevent crime at the neighborhood level. Each of Durham Police Department's five police districts has a PAC organization that holds monthly PAC meetings. These community groups are the "eyes and ears" of the community with knowledge of all things affecting their community. During the update process, Mark Schell, emergency manager on the HMP planning team, met with the PACs to explain what the HMP program was about and invited their input into the update process. Emergency Management has ongoing presentations with each of the PACs.

3. Formal public meetings – The formal process through which the HMP will be updated and approved with required public meetings for input into the draft updated HMP. An advertised public meeting was held on September 27, 2011, to facilitate public input. Two weeks prior to the meeting, a public notice was posted in the Durham Herald-Sun, and on the City and County's websites, to invite the public ***and other interested entities***. Two citizens from the public attended the meeting, made comments and asked questions about the HMP.

   <<<<Input received will be documented and specifically listed in the draft, complete with how the input was accommodated and addressed.>>>>>

   <<Additionally, during the elected officials' meetings to approve and adopt the revised HMP, public hearings will be opened to receive comments from the public. These meetings will be held following formal approval and notification by FEMA that the HMP revisions have been accepted and approved. These meetings will be conducted by the Durham County Commissioners and the Durham City Council in the Spring of 2012. Formal documentation of same will be provided when it occurs. Blank resolutions are inserted in the front end of the draft.>>

References:

Several operational plans for the combined jurisdictions share interdependencies with the HMP. Worst-case scenarios are based upon the historical extent of commonly-occurring hazards (snow, ice, windstorm debris, etc.) as mentioned in the HMP. It is not the goal of the HMP committee to review and revise these other plans. They are cited here solely because of their interdependencies.

Durham City-County Emergency Operations Plan, 2010
Durham City-County Severe Weather Policy, 2010
Durham Winter Weather Plan, Nov. 2010
Durham Drought Management Plan ("2009 Water Shortage Response Plan")

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Formal adoption of the Hazard Mitigation Plan will be certified here.

Durham County
Resolutions/Approvals/Minutes of Public Meetings
Specific approval sections are highlighted

Durham County
Hazard Mitigation Certifications

I, Mark Schell, Emergency Management Coordinator for the County of Durham, State of North Carolina, do herby certify that public involvement and input regarding the 5-Year Update of the Hazard Mitigation Plan was carried out in accordance with the plan and in accordance with local policy and ordinance.

I further certify that public notification and public input was sought by placing notice to the public in the Durham Herald Sun on _____ and _____. I further certify that a plan briefing of the Durham County Board of County Commissioners and the Durham City Council members was published and the public invited, per the "Open Meetings" laws of North Carolina. I further certify that agendas of regular Board and Council meetings were published prior to consideration for approval of the Hazard Mitigation Task Force for Durham County and that such citizens had ample opportunity for input in plan development. I further certify that copies of Board and or Council meeting minutes, kept in accordance with North Carolina law, regarding approval of the Hazard Mitigation Plan, are on file and available for members of the public, state and Federal agencies. Inspection may be made upon reasonable request to the respective jurisdictional authority.

This certification is in accordance with provisions of the Disaster Mitigation Act 2000 (44 CFR 201.6 and NCGS 62A.

This the ____ day of _____, 2012.

North Carolina,
Durham County

I, _____, a Notary Public for said County and State, do hereby certify that Mark Schell personally appeared before me this day and acknowledged the due the foregoing instrument.

Witness my hand and seal this the _____ day of _____, 20_____.

_____Notary Public My Commission expires _____

Formal adoption of the updated Hazard Mitigation Plan will be certified here.

County of Durham
State of North Carolina
RESOLUTION

WHEREAS, the State of North Carolina in Senate Bill 300 enacted in June 2001 and HB 1584 filed on June 5, 2002 ordained that every County and incorporated municipality in the state was required to have a Hazard Mitigation Plan approved by the NC Division of Emergency Management or they would be ineligible for state disaster assistance after November 2004; and

WHEREAS, the Federal Emergency Management Administration (FEMA) under the Disaster Mitigation Act of 2000 (DMA2K) ordained that every County and incorporated municipality in the County was required to have a Hazard Mitigation Plan approved by FEMA in order to be eligible for Hazard Mitigation Grant Program Funding for Presidentially declared disasters after November 2004; and

WHEREAS, under the Disaster Mitigation Act of 2000, the Federal Emergency Management Agency (FEMA) has issued an Interim Final Rule that details the minimum criteria for local hazard mitigation plans; and

WHEREAS, under the Hazard Mitigation Act of 2000, FEMA requires the jurisdiction to review and update their approved Hazard Mitigation Plan every five (5) years; and

WHEREAS, the County and Municipality agree with the concept of and necessity for Hazard Mitigation Planning; and

WHEREAS, the State of North Carolina, Division of Emergency Management has conducted a review of the Hazard Mitigation Plan;

NOW THEREFORE, we the Board of Commissioners hereby approve the Durham County Hazard Mitigation Plan as submitted this _____ day
Of _____20___.

_____
Chairman – Durham County Board of Commissioners

_____

Clerk to the Board

Formal adoption of the Hazard Mitigation Plan will be certified here.

City of Durham
County of Durham
State of North Carolina

RESOLUTION

WHEREAS, the Disaster Mitigation Act of 2000, the Code of Federal Regulations and North Carolina General Statutes require the development of a Hazard Mitigation Plan; and

WHEREAS, these regulations require that the approved Hazard Mitigation Plan be reviewed and updated every five (5) years; and

WHEREAS, the Hazard Mitigation Plan has been reviewed and updated by the Hazard Mitigation Planning Team and reviewed by members of this Board, staff and the public; and

WHEREAS, the State of North Carolina, Division of Emergency Management has conducted a review of the Hazard Mitigation Plan;

NOW THEREFORE, we the Durham City Council hereby approve the Durham County Hazard Mitigation Plan as submitted this _____ day of _____20___.

_____
Mayor – City of Durham

_____

City Clerk

1. Executive Summary and General Problem Statement

Webster defines mitigate as "*to make mild, to make or become milder, less severe or less painful, moderate."* The Federal Emergency Management Agency (FEMA) defines mitigation as “any *action taken to permanently eliminate or sharply reduce the long term vulnerability of human life and property from hazards."* There is a distinction between mitigation and prevention and both are discussed in this plan. Senate Bill 300 (NCGS 166A as modified) and the Disaster Mitigation Act of 2000 and 44CFR 201.6 mandate counties and municipality to construct and then implement a hazard mitigation plan in order to receive state and Federal disaster and mitigation assistance funding. The local governing body on or before November 1, 2004 must approve the plan. Draft plans must be submitted for review to the North Carolina Division of Emergency Management, Hazard Mitigation Section on or before January 30, 2004. Failure to complete the plan and have it approved would mean the loss of eligibility for thousands of dollars in disaster recovery and mitigation grant funding. The plan must also be submitted to the state hazard mitigation officer for review and ultimately forwarded by the state to the Federal Emergency Management Agency for approval. The plan must also be reviewed and updated every five years thereafter.

This plan will outline the hazards faced by Durham County and the City of Durham (hereafter, also referred to as “the municipality”) of both historical and potential events. A rating is given to each hazard for the purposes of prioritizing the mitigation process. This rating is reflective of information from the State of North Carolina and the concerns of Durham County and the municipality. Not all mitigation is possible or cost effective.

This plan also considers the current political climate on a global, national, state and local level. Perception of the public and government officials of realistic mitigation, realistic hazards and realistic prevention may differ widely from this plan.

Meetings with top government officials, local planners, state mitigation planners, the public and others that make up Durham County's Hazard Mitigation Task Force, were held and input sought prior to its' completion and submission for approval. The public was notified of the planning process via newspaper publications of the agendas of local or jurisdictional governing bodies.

Durham County and the municipality face a number of hazards every day. During the past decade and a half we have faced the effects of damaging tornadoes, severe winter storms, high winds, freezing temperatures, chemical spills and more. We have learned from each disaster and each incident and your emergency services and response forces are better trained and better equipped to deal with these hazards than ever before. Numerous hazard mitigation efforts have been ongoing in Durham County and continue to evolve to this day.

Problems that Durham County and municipality face in an all hazard mitigation program are numerous, as are the challenges to have an effective mitigation program. Durham County and the municipality are vulnerable to a variety of hazards and those hazards have been identified (3. Hazard Identification). Because of the number of both natural and manmade hazards that have occurred and that have effectively been controlled, Durham County and the municipality have a better understanding of the level of vulnerability and each has taken many steps, as outlined in this plan, to mitigate that vulnerability. This plan further outlines areas of concern and recommendations to address those concerns for future mitigation efforts.

Durham County, and the municipality, following the intent of Senate Bill 300, and the Disaster Mitigation Act of 2000, have assessed their vulnerability to hazards and they are incorporated herein. When mitigation issues and strategies are unique to a municipality they are included as separate items as required by 44CRF 201.6.(3).

2. Purpose

The local Hazard Mitigation Plan identifies long-term disaster resistance through identification of actions that can reduce the exposure of people and property to natural and/or technological hazards. The plan also determines the jurisdiction's commitment to their citizens by determining goals, objectives, policies and programs that will reduce or eliminate losses. The plan can serve as a catalyst for citizens, businesses, and governments to educate and create public awareness of the risks facing the community as a whole. The plan can also:

- Provide for additional grant funding (pre-disaster and post-disaster)
- Provide for additional credit under the Community Rating System (CRS)
- Speed recover and development after a disaster event
- Comply with both state and Federal requirements for Hazard Mitigation Plans

3. Authority and Government

County of Durham – consists of a body of five (5) commissioners, elected at-large, who oversee the affairs of County government in a commissioner-manager format where the Board of Commissioners appoints a County Manager to execute the affairs of the County, including budgetary and personnel issues. Durham County was founded in 1881 under an act of the state's General Assembly that apportioned the County's territory from the neighboring counties of Orange & Wake. Durham County has one (1) major municipality, the City of Durham, which is the County seat.

City of Durham – consists of a city council of seven (7) members, elected in a combination of three at-large and three wards plus a mayor, who govern the affairs of this major municipality in Durham County. Chartered in 1869, the city is operated under a council-manager structure that provides for day-to-day operations and budgetary issues to be executed by a council-appointed City Manager.

The Durham County Board of Commissioners and the Durham City Council have adopted the Hazard Mitigation Plan by resolution.

The plan has been developed in accordance with rules and regulations governing local hazard mitigation plans to maintain compliance with the following legislation:

(A) NC General Statues, Chapter 166A: North Carolina Emergency Management Act as amended by Senate Bill 300.
(B) The Robert T. Stafford Disaster Relief and Emergency Assistance Act as amended by the Disaster Mitigation Act of 2000.

4. Hazard Identification

Durham County and the municipality identified the hazards that are addressed in this plan. These hazards were identified through an extensive process that utilized input from Hazard Mitigation Task Force members, public input, researching past disaster declarations in the County, a review of current FIRMs (Flood Insurance Rate Maps), and risk assessments completed by Durham County Emergency Management, and the North Carolina Division of Emergency Management Hazard Mitigation Section as well as the Federal Emergency Management Agency.

The City-County Planning Department provided considerable data regarding current and projected land use and this data was then analyzed to assess potential problem areas, including critical facilities. Initial data from this study was also used to determine those hazards that present the greatest risk to the County and the municipality. Hazards were assigned a "risk value" by potential. Based upon the "risk value", analysis was made for those hazards with the highest ratings first. Additional in-depth analysis was also performed on hazards with lower ratings as outlined in the Hazard Vulnerability Assessment section of this plan. Durham County and the municipality agreed that an all-hazards approach would serve the needs of the community better and provide a better planning tool for future growth.

The hazards identified include those listed below. Other natural or manmade hazards that could occur in other parts of the country (i.e.: landslides, volcanoes, tsunamis, commercial aircraft accidents, etc.) were not analyzed because of (1) the location of our jurisdiction, (2) lack of history of any such occurrence and the likelihood of such an occurrence was less than .1%, (3) there was no indication in any researched document that such events were ever likely to occur and (4) possible or potential mitigation was outside of the geographical or political jurisdiction of the County and the municipality. Therefore, the Hazard Mitigation Task Force felt it appropriate that time and limited resources be used to identify and analyze those realistic hazards listed below.

Dams
Drought
Earthquake
Floods
Forest Fires
Hurricanes
Thunderstorms
Tornadoes
Winter Storms

5. Hazard and Vulnerability Analysis

Durham County and the municipality have conducted exhaustive research into existing documents, history, land use, demographics, ordinances, state and Federal law and accepted codes and practices. Durham County also reviewed existing FIRMs (flood insurance rate maps) from the Federal Emergency Management Agency and incorporated that review onto GIS maps to fully assess impacts of natural hazards.

The results of this study, taking place over a period of several months, resulted in updates regarding the following information and documentation:

a. Critical facilities

b. Risk assessment by hazard or threat and rating associated with each hazard
c. Data Used
d. Data developed
e. Vulnerability assessment
f. Maps

6. Hazard and Vulnerability Mitigation

Durham County and the municipality jointly developed, with guidance from the North Carolina Division of Emergency Management and the Federal Emergency Management Agency, the overall concept of the Hazard Mitigation Plan, including the format of the plan and then developed its planning process. Durham County developed a Hazard Mitigation Task Force as a planning group. Members of this task force were appointed by elected officials or by city and County managers or served as volunteers.

The following outline was developed to assess those areas of the plan of the greatest interest or concern:

a. Concept
b. Planning
c. Planning Process and responsibility assignment
d. Participants in / Public Involvement
e. Coordination, Maintenance and Approval
f. Current legal measures
g. Current mitigation measures
h. Need to modify current measures
i. Current development trends - Future needs planning

7. Implementation

The most thoughtful and discussed portion of the Durham County Hazard Mitigation Plan was the implementation process. Debate centered on funding for the initiatives outlined in the Mitigation Strategy. Most agreed that with sufficient funding the primary goal as well as the objectives that were outlined could be accomplished within specified time periods. The Hazard Mitigation Task Force decided on the "action plan" approach, which outlines the actions that will be taken to achieve the objective, as well as time lines and the primary area or agency that will have the responsibility for carrying out the action. Objectives were not only enumerated, but also expanded upon to give detail of how those objectives *may* be carried out.

Without guarantees of funding, specific actions or timelines for implementation for each objective that was identified speculative. Without funding, the Hazard Mitigation Task Force felt that the time required to develop an action plan for each objective would be extensive.

The entire plan is presented as a "living document" and one that will be changed, reviewed, updated and reprocessed over the next five-year period. It was noted that while the objectives were listed and discussed, many of the objectives would require modification or adoption of local ordinances. This will require the County and the municipality to hold public hearings, allowing for input from the public and established due process, before implementation of the objective can occur or be considered.

General action plans were developed. The following outline was developed to access those areas of the

plan of interest or concern.

a. Mitigation Strategy
    1. Action Plan - Research
    2. Action Plan - Hazard Mapping and Assessments
    3. Action Plan - Real-Time Monitoring
    4. Action Plan - Loss Assessment
    5. Action Plan - Information Collection, Interpretation, and Dissemination
    6. Action Plan - Guidelines and Training
    7. Action Plan - Public Awareness and Education
    8. Action Plan - Implementation of Loss Reduction Measures
    9. Action Plan - Emergency Preparedness, Response, and Recovery
    10. Action Plan - Define reasonable and measurable goals and objectives
b. Adopting new or additional legal or voluntary measures
c. Goals / Action Plan Priority Table
d. Goals detailed
e. Potential program funding sources

Planning Process

Concept

Hazard and vulnerability mitigation can be an all encompassing program that can be complex or it can be resolved to do only those things necessary, practical or cost effective to accomplish. Reduction or elimination of a threat or the potential damages and loss of life from a catastrophic incident is the main goal of hazard mitigation. Hazard and vulnerability mitigation is not just a government function. It involves government certainly, but both the public and private sector must work together to reduce risks for the good of the community.

Mitigation can be in the form of legal measures, new building codes and construction techniques or simply restricting parking near critical facilities. Details of recommendations are found in later documents.

Planning

Each jurisdiction agreed that it was important to have a multi-jurisdictional plan and that it be coordinated. Interviews with local County and municipal officials were used to identify existing capabilities. Interviews are helpful developing the critical professional relationship needed to build a mitigation network. These personal interviews also allow in-depth questioning when a particular question or response prompts additional issues. Where interviews are not possible, survey questionnaires can be used to obtain data regarding each department's specific programs and authorities. These surveys, like the interviews, seek information from appropriate representatives about their department's day-to-day and emergency programs. In addition, questionnaires allow respondents the opportunity to make recommendations for improvement in their own agencies and in others where it might not otherwise be welcomed. This data provides a valid starting point for gathering information for the vulnerability assessment. Additional information is sought from individuals, agencies or departments via email. This electronic means of communications has allowed for rapid questioning and the receipt of information. Internet resources were and are used extensively.

Following the recommendations of the Division of Emergency Management (NC Department of Crime Control and Public Safety) and the Federal Emergency Management Agency (FEMA), Durham County has taken the necessary action and determined its capability to develop an exemplary hazard mitigation plan. The Capability Assessment for Durham County included the following categories:

- Legal – An inventory of the powers available to local governments enumerated in the North Carolina General Statues to identify which can be used to craft hazard mitigation measures at the local level, and also assess legislation that may impose limits on certain mitigation efforts.

- Institutional – A description of the type of government, including an inventory of key decision-making positions (both long range and day-to-day).

- Political Capability – Discussion as to how mitigation can be inserted into everyday decision-making, and aid in de-politicizing the issue.

- Fiscal – Inventory of sources of funding available to communities to implement local hazard mitigation plans, including both government and private programs.

Similar techniques are used in data collection. The information gathered will assist in making suggestions for suitable mitigation opportunities.
In addition to the items listed above, Durham County also seeks to identify local practices, which may weaken existing mitigation efforts or even exacerbate risk.
Local Mitigation planning activities include:

- The identification and analysis of hazards that threaten the community;
- An assessment of vulnerable properties and populations;
- An assessment of local capabilities to implement various mitigation programs and policies; and
- the identification and prioritization of feasible mitigation opportunities.

Planning Process

The planning process included meetings with a multi-jurisdictional Hazard Mitigation Task Force where discussions regarding the hazards (based on the priority as outlined in the hazard matrix), are identified and rated, as well as numerous meetings, interviews and conversations with staff, local citizens, state officials and others. Current policy, County ordinance, building code, general statute or Federal code was examined for possible mitigation efforts for each hazard. Each hazard mitigation effort was assessed for the capability of the community to respond effectively as well as its potential for effective recovery. An assessment was made for mitigation potential from either legal or voluntary means or a combination of those means. Interim conclusions were drawn and recorded. From the Interim conclusions goals were established which may include recommendations for policy, code or ordinance or outreach education programs to achieve those goals. Formal recommendations can then be made to appropriate officials for action. Implementation of the goals, policy, procedure, or ordinance of each hazard to be mitigated will be assigned to the appropriate department or agency for conclusion. The effectiveness will be monitored for a period of not more than two years and a report of the effectiveness will be forwarded to the Chair of the Hazard Mitigation Task Force, as outlined below. The Federal Emergency Management Agency (FEMA) will conduct a thorough plan review and update not more than five years from the date of formal approval.

Durham County, and the municipality, following the intent of Senate Bill 300, and the Disaster Mitigation Act of 2000, has assessed their vulnerability to hazards.

Hazard Mitigation Planning Team

The following department and agencies are members of the Mitigation Planning Committee:

AGENCY	PERSON	TITLE
City-County Emergency Management	Mark Schell	EM Coordinator
City-County Inspections	Gene Bradham	Director
City Public Works	Christina Sokol	Certified Floodplain Manager
City-County Planning	Amy Wolff	Senior Planner
City Public Works	Thomas Ayers	Operations Administrator
American Red Cross (Community Partner)	Timothy Bothe	Director – Emergency Services
County Engineering	Glen Whisler	Director/County Engineer
City Water Resources	Ted Cope	Safety Manager
City Fire	Daniel Cremeans	Battalion Chief
City-County GIS	Marcus Bryant	GIS Manager

Public Involvement

1st Public Hearing

On September 27, 2011, Durham County conducted a public meeting for the hazard mitigation review process. The meeting was advertised in the Durham Herald Sun (local daily newspaper) and was announced on the City and County's websites.

Neighboring communities, State and Federal Agencies, businesses, academia, nonprofits, and other interested parties were invited by advertising a public announcement in the Durham Herald Sun Newspaper as well as through email on the County website.

At the meeting, a presentation was made describing the purpose of the hazard mitigation planning process and the schedule for plan development. The section of the plan on hazard identification and analysis was also presented. Public comments were solicited and received. Two citizens attended and asked questions about the HMP. Input was reviewed by the HMP planning team and incorporated into the Plan.

In addition to the meeting, public announcement of the meeting provided an address and phone number for persons who were unable to attend the meeting but who wanted to receive more information about the planning process. During the planning process, drafts of the plan were also available for public review at the Durham County Emergency Management Office and public library branches.

2nd Public Hearing

<<<Future>>>
Two public hearings were advertised in the Durham Herald Sun (local daily newspaper) and were announced on the County and City websites (http://www.durhamcountync.govand www.durhamnc.gov). The meetings were held **_____ and _____** to receive public input and comment about the proposed mitigation plan update and official adoption. Public comments were solicited. The Durham County Board of County Commissioners and the Durham City Council approved and adopted the Plan.

Public Involvement / Participants

Durham County went to great lengths to ensure the public was informed of the planning process. A copy of the certification is contained in the Hazard Mitigation Plan. The draft was submitted to the Hazard Mitigation Branch of the North Carolina Division of Emergency Management on August 19, 2011. The North Carolina Division of Emergency Management completed its review and returned the plan on September 7, 2011 with comments and concerns. Those comments and concerns were addressed and the plan returned to the State on November 11, 2011.
Final approval was given by the State on February 15, 2012 and the plan was sent to the Federal Emergency Management Agency (FEMA) for Approval. On March 19, 2012, FEMA sent notice of Plan approval pending local adoption.
Additional meetings were held as necessary, and often on an individual department, agency or personal basis. Input was sought from state and Federal mitigation planners as necessary or appropriate. A final draft was prepared and submitted to the Board of Commissioners and the municipal Councils and Boards for approval. The approved mitigation plan was then copied and distributed to users, including the appropriate state and Federal agencies.

Whenever possible or practical, the public was notified and invited to participate in the planning process. This was conducted by advertising in a local newspaper the availability, at a public place or by Internet, of the plan for inspection and comment by members of the public (see Durham County Hazard Mitigation Certifications). An opportunity for comment was open for a period of not less than ten nor more than thirty days from the date of publication. When revisions to the plan were required, requested or recommended and these revisions were beyond the scope of administrative correction, drafts of those items to be included in the plan were offered for public inspection and comment. Public comments on the plan were accepted in the time period up until the governing body convened to consider the plan for adoption.

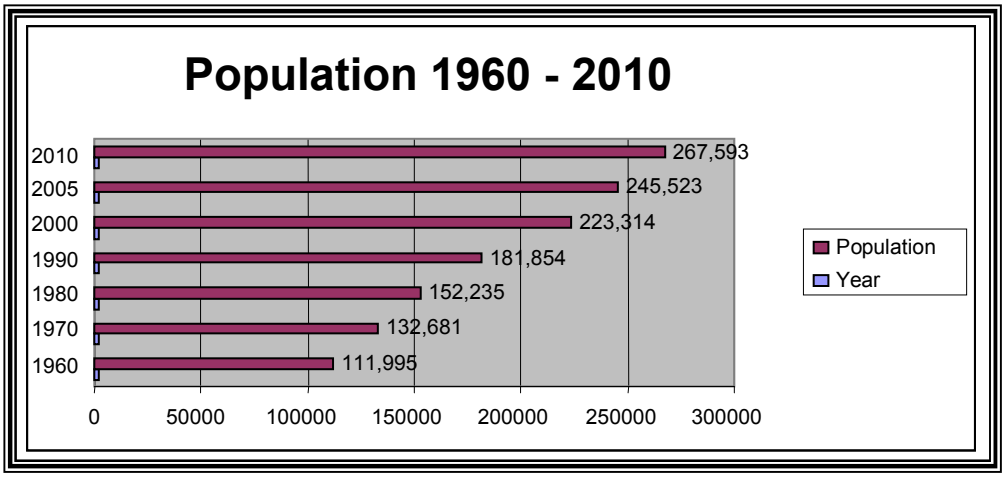
In general, it is anticipated that any opposition to the final plan will be low given the history of the County with numerous severe weather and chemical events. It has been demonstrated in disaster planning literature that citizens place mitigation high on their agendas as much as a year and a half after the most recent events. Durham County has faced numerous disasters in the past 50 years. Most County residents understand the risk they face and favor a proactive approach.

County Overview

Durham County is located in the rolling Piedmont Region of North Carolina about halfway between the Blue Ridge Mountains and the pristine beaches of the Outer Banks. 2010 Census population estimates indicate that Durham County is home to 267,587 citizens, a number which ranks Durham County among the most populated in the state. Durham County has one (1) major municipality, the City of Durham, with a population of 228,330. Of the 267,587 citizens within the County, 85% reside in the City of Durham.

Durham County is also home to Research Triangle Park (RTP), the largest and most successful planned research park in the United States. The park is located on 7,000 acres of North Carolina pine forest and nearly 75% of the Park's property and 95% of the corporate enterprises are located in Durham County. *(www.durhamchamber.org/business/rtp.html)*

POPULATION



POPULATION 1960 – 2010

	1960	1970	1980	1990	2000	2010
Total	**111,995**	**132,681**	**152,235**	**181,854**	**223,314**	**267,593**
Change		**20,686**	**19,554**	**29,619**	**41,460**	**44,279**
Percent Change		**15.6%**	**12.8%**	**16.3%**	**18.6%**	**16.5%**

(Census 2010)

CLIMATE

Durham County encompasses 299 square miles *(773 sq km)* and the City of Durham has 94.9 square miles. The City of Durham encompasses 33% of the total land within Durham County. It is physically located 406 feet above sea level. Climate of the area is as follows:

CLIMATE CHARACTERISTICS

Average Summer High/Low	87/68F
Average Winter High/Low	52/29F
Annual Precipitation	48 Inches
Annual Snowfall	6.8 Inches
Prevailing Wind (Southwest)	7 MPH
Coldest Month	January
Warmest Month	July
Wettest Month	March
Driest Month	November
Annual Sunshine Days	217 Days

DEMOGRAPHIC OVERVIEW

Durham County Demographics including the municipality:
(US Census Office 2010)

Group	Countywide
Total County Population (2010 Census)	*267,587*
Median Age	33.1 years
Households	103,268
Housing Units	118,847
Gender	Countywide
Female	51.4%
Male	48.6%

Age Distribution	*Countywide*
Under 5	7.9%
5-9	6.5%
10-14	5.5%
15-19	6.9%
20-24	7.6%
25-34	19.2%
35-44	14.7%
45-54	13.0%
55-59	5.3%
60-64	4.1%
65-74	4.8%
75-84	3.2%
85 and Over	1.4%

Race and Ethnicity	*Countywide*
White	46.4%
Black	38.0%
Asian	4.6%
Native Hawaiian or Pacific Islander	0.1%
American Indian	0.5%
Some Other Race	NA
Two Or More Races	2.6%
Hispanic (any race)	13.5%

Educational Attainment	
Population 25 years and over	168,326
Less than 9th grade	9,114
9th to 12th grade, no diploma	14,301
High school graduate (includes equivalency)	32,305
Some college, no degree	28,139
Associate degree	10,483
Bachelor's degree	41,368
Graduate or professional degree	32,616
Percent high school graduate or higher	86.1
Percent bachelor's degree or higher	44.0

Income Characteristics	Countywide
Mean Household Income (dollars)	$48,770
Median Family Income (dollars)	$61,607
Per Capita Income (dollars)	$27,698

Source: US Census 2010

Structures in Durham County	Countywide
Housing Units	118,847
Business Units	22,105
Total Units in Mapped Hazard Areas	2,941

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Hazard Ratings and Risk Assessment

Durham County, and the municipality, following the intent of Senate Bill 300, and the Disaster Mitigation Act of 2000, has assessed their vulnerability to hazards. The primary source of historical information was "History of Hazards by County" compiled by North Carolina Department of Crime Control and Public Safety, Division of Emergency Management.

The hazards identified include those listed below. Other natural or man-made hazards that could occur in other parts of the country (i.e.: volcanoes, tsunamis, aircraft accidents, etc.) were not analyzed because of (1) the location of our jurisdiction, (2) there were no history of any such occurrence and the likelihood of such an occurrence was less than .1%, (3) there was no indication in any researched document that such events were ever likely to occur, therefore, the Hazard Mitigation Task Force felt it appropriate that time and very limited resources be used to identify and analyze those realistic hazards listed below.

A public meeting was held on _____, 2011, at _____. The focus of the forum was limited to natural hazards that have occurred in Durham County. Each hazard was discussed individually and included the hazard specific threat, the frequency of occurrence in history and the probability for future occurrence. **Table 2** – Historical Weather Events, presents the number and types on incidents that have occurred in the past. After considerable discussion the Hazard Mitigation Task Force agreed and adopted the findings in **Table 1**. This table differs slightly from **Table 3** – Hazard Risk By Climate Division provided by the NCDEM Hazard Mitigation Branch.

In the criteria for mitigation plans, "for multi jurisdictional plans, the risk assessment *(*see **Table 1** below) must determine each jurisdiction's risks where they vary from the risks facing the entire planning area*."* The County and the municipality agree they each face the same threat level from each of the threats listed in **Table 1** and at the same level of threat. The frequency at which these threats occur is supported in **Table 2**, which is a consolidated table of the history of incidents from 1950 through April, 2011. Also see Current Mitigation Measures. Also see Hazard Vulnerability Assessments.

Probable Level of Impact

The probable level of impact, or estimated strength and damage potential, of a particular hazard within a specific jurisdiction is classified in one of four categories as described in the Table below.

Description of Hazard Probable Level of Impact

Level	Area Affected	Impact[1]
Catastrophic	More than 50%	• Multiple deaths. • Complete shutdown of facilities for 30 days or more. • More than 50% of property is severely damaged.
Critical	25 to 50%	• Multiple severe injuries. • Complete shutdown of critical facilities for at least 2 weeks. • More than 25% of property is severely damaged.
Limited	10 to 25%	• Some injuries. • Complete shutdown of critical facilities for more than 1 week. • More than 10% of property is severely damaged.
Negligible	Less than 10%	• Minor injuries. • Minimal quality of life impact. • Shutdown of critical facilities and services for 24 hours or less. • Less than 10% of property is severely damaged.

Source: "Keeping Natural Hazards from Becoming Disasters", NC Division of Emergency Management, November 2001, p. 12.

[1] The impact of a natural hazard is a combination of the severity of the occurrence, the magnitude of the event, and the density of human activity in the affected area

Likelihood of Occurrence

The likelihood, or frequency, of occurrence of a particular hazard within a specific jurisdiction will be classified in one of four categories. These four categories are explained in the Table below.

Explanation of Hazard Likelihood of Occurrence

Likelihood	Frequency of Occurrence
Highly Likely	Near 100% probability in the next year.
Likely	Between 10% and 100% probability in the next year or at least one chance within the next ten years.
Possible	Between 1% and 10% probability in the next year, or at least one chance in the next 100 years.
Unlikely	Less than 1% probability in the next year, or less than one chance in the next 100 years.

Source: "Keeping Natural Hazards from Becoming Disasters", NC Division of Emergency Management, November 2001, p. 11.

Likely Range of Impact

The likely range of impact, or predictable size and location, of a particular hazard within a specific jurisdiction will be classified in one of three categories. These three categories are described in the Table below.

Description of Likely Range of Impact

Size of Area	Description
Small	10 % or less of the total jurisdictional area
Medium	10 % to 40 % of the total jurisdictional area
Large	40 % to 100 % of the total jurisdictional area

Source: "Keeping Natural Hazards from Becoming Disasters", NC Division of Emergency Management, November 2001, p. 11

TABLE 1

DURHAM COUNTY RISK ASSESSMENT

Types of Hazards & Associated Elements	**Likelihood of Occurrence** Highly Likely – 4 Likely – 3 Possible – 2 Unlikely -1	**Intensity Rating** Relative Terms Severe – 3 Moderate – 2 Mild - 1	**Impact** Catastrophic – 4 Critical – 3 Limited – 2 Negligible – 1	**Conclusion** Rank Determined by Sum of Assessments
Thunderstorms	4	3	1	8
Flooding	3	1	1	5
Winter Storm	3	2	2	7
Tornadoes	2	2	3	7
Hurricanes	2	2	3	7
Drought/Heat Wave	2	2	2	6
Earthquakes	2	2	2	6
Landslides/Sinkholes	2	1	1	4
Wildfires	3	1	1	5
Dam Failure	1	2	1	4

TABLE 2

HISTORICAL WEATHER EVENTS IN DURHAM COUNTY AND MUNICIPALITY

332 event(s) were reported in **Durham County, North Carolina** between **01/01/1950** and **04/30/2011** (**High Wind limited to speed greater than 0 knots**).

Location	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 DURHAM	03/05/1955	1615	Hail	1.50 in.	0	0	0	0
2 DURHAM	04/24/1955	2050	Hail	2.75 in.	0	0	0	0
3 DURHAM	04/15/1956	2245	Tstm Wind	0 kts.	0	0	0	0
4 DURHAM	11/08/1957	1500	Tstm Wind	65 kts.	0	0	0	0
5 DURHAM	04/22/1958	1500	Tstm Wind	0 kts.	0	0	0	0
6 DURHAM	07/20/1958	1400	Tstm Wind	0 kts.	0	0	0	0
7 DURHAM	07/20/1958	1400	Tstm Wind	0 kts.	0	0	0	0
8 DURHAM	05/13/1959	1000	Tstm Wind	0 kts.	0	0	0	0
9 DURHAM	04/28/1961	1600	Hail	0.75 in.	0	0	0	0
10 DURHAM	07/21/1962	1950	Tstm Wind	80 kts.	0	0	0	0
11 DURHAM	05/21/1963	1553	Tstm Wind	65 kts.	0	0	0	0
12 DURHAM	05/21/1963	1600	Hail	0.75 in.	0	0	0	0
13 DURHAM	03/17/1965	1730	Tstm Wind	50 kts.	0	0	0	0
14 DURHAM	10/01/1966	1240	Tstm Wind	0 kts.	0	0	0	0
15 DURHAM	05/14/1967	1650	Hail	1.75 in.	0	0	0	0
16 DURHAM	05/24/1968	1700	Tstm Wind	0 kts.	0	0	0	0
17 DURHAM	06/02/1969	1700	Tstm Wind	0 kts.	0	0	0	0
18 DURHAM	08/10/1969	1348	Tstm Wind	50 kts.	0	0	0	0
19 DURHAM	07/20/1970	1222	Tstm Wind	65 kts.	0	0	0	0
20 DURHAM	06/29/1971	1310	Tstm Wind	57 kts.	0	0	0	0
21 DURHAM	03/16/1972	1455	Tstm Wind	50 kts.	0	0	0	0
22 DURHAM	05/15/1972	1700	Hail	1.00 in.	0	0	0	0
23 DURHAM	07/29/1972	1530	Hail	1.00 in.	0	0	0	0

24 DURHAM	07/29/1972	1530	Tstm Wind	50 kts.	0	0	0	0
25 DURHAM	09/29/1972	2206	Tstm Wind	53 kts.	0	0	0	0
26 DURHAM	12/31/1975	1615	Tornado	F0	0	0	0K	0
27 DURHAM	01/09/1978	0215	Hail	1.75 in.	0	0	0	0
28 DURHAM	06/22/1978	1500	Hail	1.00 in.	0	0	0	0
29 DURHAM	07/27/1981	1745	Tstm Wind	0 kts.	0	0	0	0
30 DURHAM	01/04/1982	0600	Tstm Wind	70 kts.	0	0	0	0
31 DURHAM	03/20/1984	2330	Tstm Wind	0 kts.	0	0	0	0
32 DURHAM	03/20/1984	2345	Tstm Wind	0 kts.	0	0	0	0
33 DURHAM	04/04/1984	1800	Tornado	F2	0	4	2.5M	0
34 DURHAM	04/04/1984	1930	Tstm Wind	0 kts.	0	0	0	0
35 DURHAM	05/06/1984	0700	Hail	1.00 in.	0	0	0	0
36 DURHAM	05/08/1984	1400	Tstm Wind	50 kts.	0	0	0	0
37 DURHAM	05/08/1984	1430	Tstm Wind	0 kts.	0	0	0	0
38 DURHAM	03/24/1985	1805	Hail	0.75 in.	0	0	0	0
39 DURHAM	05/22/1985	1925	Tstm Wind	0 kts.	0	0	0	0
40 DURHAM	07/10/1985	2000	Hail	1.75 in.	0	0	0	0
41 DURHAM	07/10/1985	2015	Tstm Wind	0 kts.	0	0	0	0
42 DURHAM	10/15/1985	1540	Tstm Wind	61 kts.	0	0	0	0
43 DURHAM	04/06/1986	1700	Tstm Wind	0 kts.	0	1	0	0
44 DURHAM	04/06/1986	1723	Tstm Wind	0 kts.	0	0	0	0
45 DURHAM	04/26/1986	1710	Hail	1.00 in.	0	0	0	0
46 DURHAM	04/26/1986	1730	Hail	1.00 in.	0	0	0	0
47 DURHAM	07/26/1986	1630	Tstm Wind	0 kts.	0	0	0	0
48 DURHAM	07/26/1986	1700	Tstm Wind	0 kts.	0	0	0	0
49 DURHAM	08/02/1986	1805	Tstm Wind	0 kts.	0	0	0	0
50 DURHAM	08/02/1986	1820	Tstm Wind	0 kts.	0	0	0	0
51 DURHAM	08/02/1986	1835	Tstm Wind	0 kts.	0	0	0	0
52 DURHAM	08/11/1986	1338	Tstm Wind	0 kts.	1	0	0	0
53 DURHAM	08/27/1986	1335	Tstm Wind	0 kts.	0	0	0	0

54 DURHAM	08/27/1986	1405	Tstm Wind	0 kts.	0	0	0	0
55 DURHAM	08/28/1986	0240	Hail	1.75 in.	0	0	0	0
56 DURHAM	06/03/1987	1850	Tstm Wind	0 kts.	0	0	0	0
57 DURHAM	07/08/1987	1515	Tstm Wind	0 kts.	0	0	0	0
58 DURHAM	12/10/1987	2200	Tstm Wind	0 kts.	0	0	0	0
59 DURHAM	05/16/1988	1500	Tstm Wind	0 kts.	0	0	0	0
60 DURHAM	05/19/1988	1805	Hail	0.75 in.	0	0	0	0
61 DURHAM	05/23/1988	2030	Tstm Wind	0 kts.	0	0	0	0
62 DURHAM	07/10/1988	1745	Tstm Wind	0 kts.	0	0	0	0
63 DURHAM	09/24/1988	1350	Hail	1.75 in.	0	0	0	0
64 DURHAM	03/15/1989	1630	Hail	0.75 in.	0	0	0	0
65 DURHAM	04/25/1989	2140	Tstm Wind	0 kts.	0	1	0	0
66 DURHAM	04/27/1989	1730	Tstm Wind	0 kts.	0	0	0	0
67 DURHAM	05/05/1989	1540	Hail	0.75 in.	0	0	0	0
68 DURHAM	05/05/1989	1720	Tornado	F2	0	0	25.0M	0
69 DURHAM	05/06/1989	1252	Tstm Wind	0 kts.	0	0	0	0
70 DURHAM	05/15/1989	1440	Hail	1.75 in.	0	0	0	0
71 DURHAM	06/12/1989	1730	Hail	0.75 in.	0	0	0	0
72 DURHAM	06/16/1989	1305	Hail	1.75 in.	0	0	0	0
73 DURHAM	06/16/1989	1730	Tstm Wind	0 kts.	0	0	0	0
74 DURHAM	06/28/1989	1425	Hail	1.00 in.	0	0	0	0
75 DURHAM	07/16/1989	0835	Tornado	F1	0	0	25K	0
76 DURHAM	04/02/1990	1646	Hail	1.00 in.	0	0	0	0
77 DURHAM	04/02/1990	1926	Hail	0.75 in.	0	0	0	0
78 DURHAM	05/01/1990	1800	Tstm Wind	0 kts.	0	0	0	0
79 DURHAM	06/03/1990	1655	Tstm Wind	0 kts.	0	0	0	0
80 DURHAM	06/22/1990	1032	Tstm Wind	0 kts.	0	0	0	0
81 DURHAM	07/10/1990	1630	Tstm Wind	0 kts.	0	0	0	0
82 DURHAM	07/11/1990	1600	Tstm Wind	0 kts.	0	0	0	0
83 DURHAM	08/04/1991	1715	Tstm Wind	0 kts.	0	0	0	0

84 DURHAM	04/24/1992	1920	Tstm Wind	0 kts.	0	0	0	0
85 DURHAM	06/24/1992	1425	Hail	0.75 in.	0	0	0	0
86 DURHAM	06/25/1992	1305	Tstm Wind	0 kts.	0	0	0	0
87 DURHAM	06/26/1992	1515	Tstm Wind	0 kts.	0	0	0	0
88 Statewide	03/12/1993	1600	Winter Storm	N/A	2	10	50.0M	0
89 NCZ001>510	03/23/1993	1200	Flash Floods	N/A	0	0	0	0
90 Rdu	03/27/1993	1624	Hail	0.75 in.	0	0	0	0
91 Durham	04/21/1993	1907	Hail	0.75 in.	0	0	0	0
92 Durham	04/21/1993	1915	Hail	0.75 in.	0	0	0	0
93 Durham	08/03/1993	1540	Hail	0.88 in.	0	0	0	0
94 Durham	08/03/1993	1628	Thunderstorm Winds	52 kts.	0	0	0	0
95 Durham	08/03/1993	1700	Lightning	N/A	0	1	0	0
96 Durham	08/17/1993	1910	Thunderstorm Winds	0 kts.	0	0	5K	0
97 Quail Roost	08/26/1993	1318	Hail	0.75 in.	0	0	0	0
98 Northern And Central	01/03/1994	1800	Heavy Snow	N/A	0	0	0	0
99 Statewide	01/15/1994	0000	Extreme Cold	N/A	3	0	500K	0
100 Statewide	01/19/1994	0000	Extreme Cold	N/A	6	0	0	0
101 Northern Interior And	02/10/1994	1000	Ice Storm	N/A	0	0	0	0
102 Durham	07/11/1994	1341	Lightning	N/A	0	0	5K	0
103 Durham	03/08/1995	1530	Hail	0.75 in.	0	0	0	0
104 DURHAM	05/10/1995	2317	Thunderstorm Winds	0 kts.	0	0	0	0
105 DURHAM	06/08/1995	2045	Thunderstorm Winds	0 kts.	0	0	0	0
106 Durham	07/04/1995	2200	Flash Flood	N/A	0	0	0	0
107 Ncaz033>034-049-055-0	10/05/1995	0700	Flash Flood	N/A	0	0	0	0

108 Durham	10/27/1995	1730	Thunderstorm Winds	0 kts.	0	0	25K	0
109 Durham	10/27/1995	2100	Thunderstorm Winds	0 kts.	0	0	0	0
110 NCZ025	01/06/1996	01:00 PM	Winter Storm	N/A	0	0	0	0
111 NCZ025	01/11/1996	10:00 PM	Ice Storm	N/A	0	0	0	0
112 Durham	01/19/1996	07:58 AM	Hail	0.75 in.	0	0	0	0
113 Durham	01/19/1996	07:58 AM	Tstm Wind	0 kts.	0	0	0	0
114 NCZ025	02/02/1996	02:00 AM	Ice Storm	N/A	0	0	0	0
115 NCZ025	02/03/1996	10:00 PM	Extreme Cold	N/A	0	0	0	0
116 NCZ025	02/16/1996	06:00 AM	Heavy Snow	N/A	0	0	0	0
117 Durham	05/11/1996	03:50 PM	Tstm Wind	0 kts.	0	0	30K	0
118 Durham County	05/27/1996	06:30 PM	Tstm Wind	0 kts.	0	0	30K	0
119 Durham	05/29/1996	05:30 PM	Hail	1.75 in.	0	0	0	0
120 Durham	05/29/1996	07:35 PM	Hail	0.75 in.	0	0	0	0
121 Durham	05/29/1996	07:35 PM	Tstm Wind	0 kts.	0	0	0	0
122 Durham	06/04/1996	06:40 PM	Hail	0.75 in.	0	0	0	0
123 Durham	06/11/1996	06:55 PM	Hail	0.75 in.	0	0	0	0
124 Bahama	06/20/1996	03:30 PM	Flash Flood	N/A	0	0	0	0
125 Durham	07/02/1996	03:30 PM	Tstm Wind	0 kts.	0	0	0	0

126 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	07/12/1996	08:00 AM	Hurricane	N/A	0	0	0	0
127 Durham	07/18/1996	04:15 PM	Hail	0.75 in.	0	0	0	0
128 Durham	08/07/1996	04:00 PM	Flash Flood	N/A	0	0	20K	0
129 Durham	08/16/1996	03:53 PM	Hail	0.75 in.	0	0	0	0
130 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	09/05/1996	05:00 PM	Hurricane	N/A	7	2	0	0
131 Countywide	09/06/1996	02:00 AM	Flash Flood	N/A	0	0	0	0
132 Durham	09/06/1996	07:30 AM	Flash Flood	N/A	0	0	0	0
133 Durham	03/05/1997	07:20 PM	Hail	0.75 in.	0	0	0	0
134 Durham	03/05/1997	07:20 PM	Tstm Wind	50 kts.	0	0	0	0
135 Durham	04/28/1997	10:35 PM	Flash Flood	N/A	0	0	0	0
136 5nw Rdu Airport	05/01/1997	03:42 PM	Hail	0.75 in.	0	0	0	0
137 East Durham	05/01/1997	03:50 PM	Hail	0.75 in.	0	0	0	0
138 Durham	07/04/1997	10:23 PM	Hail	1.00 in.	0	0	0	0
139 Durham	07/16/1997	04:00 PM	Lightning	N/A	0	0	0	0

140 Durham	07/16/1997	04:05 PM	Tstm Wind	50 kts.	0	0	0	0
141 Countywide	07/24/1997	07:40 AM	Flash Flood	N/A	0	0	0	0
142 Durham	09/10/1997	06:05 PM	Tstm Wind	50 kts.	0	0	20K	0
143 Durham	01/16/1998	12:55 PM	Hail	0.75 in.	0	0	0	0
144 NCZ024>025 - 039>041 - 074>075 - 077 - 088	02/03/1998	09:00 PM	High Wind	35 kts.	0	0	0	0
145 Durham	02/03/1998	12:00 PM	Heavy Rain	N/A	0	0	0	0
146 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	02/16/1998	10:00 PM	High Wind	52 kts.	0	0	0	0
147 Durham	02/16/1998	12:00 PM	Heavy Rain	N/A	0	0	0	0
148 Durham	03/19/1998	04:00 AM	Flash Flood	N/A	0	0	0	0
149 Durham	03/20/1998	06:20 PM	Hail	0.75 in.	0	0	0	0
150 Bahama	03/20/1998	06:30 PM	Tornado	F2	0	1	600K	0
151 Bahama	03/20/1998	07:30 PM	Hail	0.75 in.	0	0	0	0
152 Durham	03/20/1998	08:30 PM	Hail	1.00 in.	0	0	0	0
153 Durham	03/20/1998	09:45 PM	Hail	1.00 in.	0	0	0	0
154 Durham	05/26/1998	03:21 AM	Hail	1.75 in.	0	0	0	0

155 Durham	05/26/1998	03:27 AM	Hail	1.75 in.	0	0	0	0
156 Durham	06/03/1998	08:15 PM	Hail	0.75 in.	0	0	0	0
157 Durham	06/03/1998	09:20 PM	Tstm Wind	50 kts.	0	0	0	0
158 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	07/22/1998	11:00 AM	Excessive Heat	N/A	0	0	0	0
159 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	12/23/1998	02:00 PM	Ice Storm	N/A	0	0	0	0
160 Durham	03/03/1999	01:25 PM	Tstm Wind/hail	0 kts.	0	0	0	0
161 Durham	03/03/1999	01:59 PM	Tstm Wind/hail	0 kts.	0	0	0	0
162 Durham	03/21/1999	02:00 PM	Lightning	N/A	0	0	20K	0
163 Parkwood	07/06/1999	03:48 PM	Hail	0.75 in.	0	0	0	0
164 Durham	08/14/1999	02:25 PM	Hail	0.75 in.	0	0	0	0
165 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	09/04/1999	09:00 PM	Hurricane	N/A	0	0	0	3.0M
166 Countywide	09/05/1999	01:00 PM	Flash Flood	N/A	0	0	0	0

167 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	09/15/1999	04:00 PM	Hurricane	N/A	0	0	3.0B	500.0M
168 Countywide	09/16/1999	03:30 AM	Flash Flood	N/A	0	0	0	0
169 Countywide	09/27/1999	08:08 AM	Flash Flood	N/A	0	0	0	0
170 Countywide	09/28/1999	05:30 PM	Flash Flood	N/A	0	0	0	0
171 Countywide	09/30/1999	12:30 AM	Flash Flood	N/A	0	0	0	0
172 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	01/18/2000	02:00 AM	Winter Storm	N/A	0	0	0	0
173 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	01/22/2000	06:00 PM	Winter Storm	N/A	0	0	0	0
174 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	01/24/2000	05:00 AM	Winter Storm	N/A	0	0	0	0
175 NCZ007>011 - 021>028 - 038>043 - 073>077 -	01/28/2000	10:00 AM	Winter Storm	N/A	0	0	0	0

083>086 - 088>089								
176 Durham	04/08/2000	03:15 PM	Tstm Wind	50 kts.	0	0	0	0
177 Durham	04/17/2000	09:43 PM	Hail	1.75 in.	0	0	0	0
178 Durham	04/29/2000	05:05 PM	Hail	1.00 in.	0	0	0	0
179 Durham	05/20/2000	07:40 PM	Tstm Wind	50 kts.	0	0	0	0
180 Durham	05/20/2000	08:00 PM	Tstm Wind	50 kts.	0	0	0	0
181 Durham	05/25/2000	09:55 AM	Tstm Wind	60 kts.	0	0	0	0
182 Durham	07/23/2000	11:30 PM	Flash Flood	N/A	0	0	0	0
183 Durham	08/04/2000	04:58 PM	Flash Flood	N/A	0	0	0	0
184 Durham	08/10/2000	01:40 AM	Tstm Wind	50 kts.	0	0	0	0
185 Durham	08/13/2000	12:40 PM	Hail	0.75 in.	0	0	0	0
186 NCZ007>011 - 021>028 - 038>043 - 073>077 - 083	11/19/2000	11:00 AM	Heavy Snow	N/A	0	0	0	0
187 Durham	12/17/2000	04:10 AM	Tstm Wind	50 kts.	0	0	0	0
188 Durham	06/22/2001	07:45 PM	Flash Flood	N/A	0	0	0	0
189 Durham	08/27/2001	06:40 PM	Hail	0.88 in.	0	0	0	0
190 Durham	08/27/2001	07:00 PM	Tstm Wind	50 kts.	0	0	0	0
191 NCZ007>011 -	01/03/2002	12:00 AM	Winter Storm	N/A	0	0	0	0

021>028 - 038>043 - 073>078 - 083>086 - 088>089								
192 Durham	05/13/2002	06:40 PM	Tstm Wind	50 kts.	0	0	0	0
193 Durham	09/15/2002	04:11 PM	Tstm Wind	50 kts.	0	0	0	0
194 Durham	10/11/2002	06:10 AM	Flash Flood	N/A	0	0	0	0
195 Durham	10/11/2002	08:45 AM	Flash Flood	N/A	0	0	0	0
196 NCZ007>011 - 021>028 - 038>043 - 073>077 - 083>084	12/04/2002	03:00 PM	Winter Storm	N/A	0	0	0	0
197 NCZ007>011 - 021>027 - 038>043 - 073>077 - 083>084 - 086	02/16/2003	12:00 PM	Winter Storm	N/A	0	0	0	0
198 Durham	02/22/2003	12:15 PM	Tstm Wind	50 kts.	0	0	0	0
199 NCZ007>009 - 021>025 - 038>041	02/27/2003	12:00 AM	Winter Storm	N/A	0	0	0	0
200 NCZ007>009 - 021>026 - 038>041 - 073>075 - 077 - 083>084 - 086 - 088	03/20/2003	06:30 AM	Flood	N/A	0	0	150K	0
201 NCZ021>023 -	04/10/2003	12:15 PM	Flood	N/A	0	0	0	0

025 - 038>041 - 073>076 - 083								
202 Durham	04/26/2003	05:40 PM	Hail	0.75 in.	0	0	0	0
203 Gorman	04/26/2003	06:00 PM	Hail	0.75 in.	0	0	0	0
204 Countywide	08/09/2003	08:35 PM	Flash Flood	N/A	0	0	0	0
205 East Durham	08/22/2003	01:54 PM	Hail	0.75 in.	0	0	0	0
206 NCZ007>011 - 025>028 - 041 - 043 - 078 - 088	09/18/2003	09:00 AM	Hurricane/typhoon	N/A	1	0	7.3M	0
207 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	01/26/2004	04:30 AM	Winter Storm	N/A	0	0	0	0
208 NCZ007>011 - 021>027 - 038>039 - 041	02/15/2004	11:00 PM	Winter Storm	N/A	0	0	0	0
209 NCZ007 - 021>028 - 038>039 - 041>043 - 073>078 - 083>086 - 088>089	02/26/2004	09:00 AM	Winter Storm	N/A	0	0	0	0
210 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088>089	03/07/2004	07:20 PM	High Wind	65 kts.	0	0	136K	0
211 Durham	05/23/2004	01:00	Flash Flood	N/A	0	0	0	0

		AM						
212 Durham	06/11/2004	07:40 PM	Tstm Wind	50 kts.	0	0	0	0
213 Quail Roost	08/02/2004	06:21 PM	Flash Flood	N/A	0	0	0	0
214 Durham	08/12/2004	03:30 PM	Flash Flood	N/A	0	0	0	0
215 Durham	09/28/2004	04:20 AM	Tstm Wind	60 kts.	0	0	0	0
216 Durham	10/03/2004	09:45 PM	Hail	0.88 in.	0	0	0	0
217 Durham	01/14/2005	04:55 AM	Tstm Wind	50 kts.	0	0	0	0
218 NCZ008 - 021>025 - 038>040 - 073>074	01/29/2005	04:00 PM	Winter Storm	N/A	0	0	0	0
219 Durham	06/07/2005	02:35 PM	Hail	0.75 in.	0	0	0	0
220 Durham	07/28/2005	08:05 PM	Tstm Wind	50 kts.	0	0	0	0
221 Durham	07/28/2005	08:25 PM	Hail	1.00 in.	0	0	0	0
222 Durham	07/28/2005	08:45 PM	Hail	1.75 in.	0	0	0	0
223 NCZ007>009 - 023>025 - 039 - 073	12/15/2005	06:00 AM	Winter Weather/mix	N/A	1	3	0	0
224 Durham	04/03/2006	06:30 PM	Tstm Wind	50 kts.	0	0	0	0
225 Durham	04/08/2006	08:12 AM	Hail	0.75 in.	0	0	0	0
226 Bahama	04/08/2006	08:17 AM	Hail	1.00 in.	0	0	0	0
227 Durham	05/14/2006	02:38 PM	Funnel Cloud	N/A	0	0	0	0

228 Durham	05/14/2006	02:42 PM	Hail	0.88 in.	0	0	0	0
229 Durham	05/14/2006	02:57 PM	Hail	0.88 in.	0	0	0	0
230 Durham	05/14/2006	03:15 PM	Hail	0.88 in.	0	0	0	0
231 Durham	05/14/2006	04:44 PM	Funnel Cloud	N/A	0	0	0	0
232 Durham	05/14/2006	05:03 PM	Hail	1.75 in.	0	0	0	0
233 Gorman	05/14/2006	05:10 PM	Funnel Cloud	N/A	0	0	0	0
234 Gorman	05/14/2006	05:10 PM	Tornado	F0	0	0	0	0
235 Bahama	05/15/2006	09:45 PM	Hail	0.75 in.	0	0	0	0
236 Bahama	05/26/2006	07:10 PM	Tstm Wind	50 kts.	0	0	0	0
237 Bahama	06/24/2006	10:35 PM	Flash Flood	N/A	0	0	0	0
238 Bahama	06/24/2006	11:30 PM	Flash Flood	N/A	0	0	0	0
239 Durham	07/13/2006	09:08 PM	Flash Flood	N/A	0	0	0	0
240 Durham	07/19/2006	01:35 PM	Tstm Wind	50 kts.	0	0	0	0
241 Durham	08/07/2006	03:36 PM	Hail	0.75 in.	0	0	0	0
242 Bahama	08/30/2006	03:35 PM	Tstm Wind	50 kts.	0	0	0	0
243 Durham	11/16/2006	09:00 AM	Flash Flood	N/A	0	0	0K	0K
244 NCZ023>025	11/22/2006	10:00 AM	Strong Wind	35 kts.	0	0	0K	1K
245 Durham	11/22/2006	10:00 AM	Heavy Rain	N/A	0	0	0K	0K

246 NCZ007>010 - 021>026 - 038>042 - 073	01/18/2007	05:00 AM	Winter Weather	N/A	0	0	0K	0K
247 NCZ008>010 - 021>022 - 024>025 - 038	01/21/2007	15:00 PM	Winter Weather	N/A	0	0	0K	0K
248 Durham	03/27/2007	22:00 PM	Lightning	N/A	0	0	10K	0K
249 NCZ025 - 041	04/16/2007	08:54 AM	Strong Wind	42 kts.	0	0	0K	5K
250 Gorman	05/09/2007	16:03 PM	Hail	0.75 in.	0	0	0K	0K
251 East Durham	06/09/2007	20:10 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
252 Durham	06/09/2007	20:15 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
253 Durham	06/09/2007	20:20 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
254 Durham	06/09/2007	20:25 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
255 Parkwood	06/09/2007	20:45 PM	Hail	0.88 in.	0	0	0K	0K
256 Durham	07/27/2007	17:00 PM	Hail	0.88 in.	0	0	0K	0K
257 Bahama	08/21/2007	16:55 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
258 NCZ007>011 - 021>026 - 038	12/07/2007	04:00 AM	Winter Weather	N/A	0	0	20K	0K
259 NCZ007 - 021>025 - 038>042 - 073>077 - 083>086 - 088	01/17/2008	02:00 AM	Winter Weather	N/A	0	0	0K	0K
260 NCZ007 - 009 - 021 -	01/19/2008	16:00 PM	Winter Storm	N/A	0	0	0K	0K

023>026 - 038>040 - 042 - 073>077 - 083>084 - 086 - 088								
261 NCZ007 - 009 - 021 - 023>026 - 038>040 - 042 - 073>077 - 083>084 - 086 - 088	01/19/2008	16:00 PM	Winter Weather	N/A	0	0	0K	0K
262 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088	02/10/2008	12:00 PM	Strong Wind	43 kts.	0	0	5K	0K
263 NCZ009 - 021>023 - 025 - 038	02/13/2008	18:00 PM	Winter Weather	N/A	0	0	0K	0K
264 Rougemont	03/04/2008	18:05 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
265 West Durham	03/04/2008	21:57 PM	Hail	0.75 in.	0	0	0K	0K
266 Mangum Store	03/04/2008	22:02 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
267 Bahama	05/20/2008	14:53 PM	Hail	1.00 in.	0	0	0K	0K
268 Huckleberry Spg	05/20/2008	15:20 PM	Hail	0.75 in.	0	0	0K	0K
269 Hope Vly	05/20/2008	15:23 PM	Hail	0.75 in.	0	0	0K	0K
270 Orange Factory	05/31/2008	17:00 PM	Hail	1.50 in.	0	0	0K	0K
271 Huckleberry Spg	05/31/2008	17:10 PM	Hail	0.88 in.	0	0	0K	0K
272 Orange Factory	05/31/2008	17:17 PM	Hail	1.00 in.	0	0	0K	0K

273 North Durham	05/31/2008	17:36 PM	Hail	1.25 in.	0	0	0K	0K
274 Hope Vly	05/31/2008	17:44 PM	Hail	1.75 in.	0	0	0K	0K
275 Weaver	06/01/2008	17:50 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
276 Bethesda	06/29/2008	18:22 PM	Hail	0.88 in.	0	0	0K	0K
277 West Durham	07/04/2008	20:15 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
278 Bethesda	07/04/2008	20:29 PM	Hail	0.88 in.	0	0	0K	0K
279 Few	07/05/2008	15:33 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
280 Huckleberry Spg	07/31/2008	14:00 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
281 Quail Roost	08/10/2008	17:05 PM	Hail	1.00 in.	0	0	0K	0K
282 Bahama	08/10/2008	17:10 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
283 Bahama	08/27/2008	20:30 PM	Flash Flood	N/A	0	0	100K	0K
284 Orange Factory	09/06/2008	03:45 AM	Flash Flood	N/A	0	0	0K	0K
285 Oak Grove	09/06/2008	03:55 AM	Flash Flood	N/A	0	0	0K	0K
286 NCZ024>026 - 040>042 - 077 - 088	09/06/2008	07:00 AM	High Wind	50 kts.	0	0	100K	0K
287 NCZ024>026 - 040>042 - 077 - 088	09/06/2008	07:00 AM	Strong Wind	39 kts.	0	0	50K	0K
288 NCZ007>011 - 022 - 024>028 - 038>039 -	01/07/2009	08:00 AM	Strong Wind	46 kts.	0	0	30K	0K

041>043 - 073>078 - 084>085 - 088								
289 NCZ007 - 021 - 024>025 - 038	01/22/2009	00:00 AM	Winter Weather	N/A	0	0	0K	0K
290 NCZ008>010 - 025>026 - 041	03/02/2009	01:00 AM	Winter Storm	N/A	0	0	0K	0K
291 Few	05/09/2009	17:15 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
292 Hope Vly	05/09/2009	17:17 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
293 Bethesda	05/09/2009	17:32 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
294 East Durham	05/09/2009	17:32 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
295 Few	05/09/2009	17:41 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
296 Braggtown	06/02/2009	16:02 PM	Hail	1.00 in.	0	0	0K	0K
297 North Durham	06/02/2009	16:25 PM	Hail	0.88 in.	0	0	0K	0K
298 Huckleberry Spg	06/02/2009	16:30 PM	Hail	1.50 in.	0	0	0K	0K
299 Rougemont	07/17/2009	13:07 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
300 NCZ007>011 - 021>028 - 038>043 - 073>078 - 083>086 - 088	11/11/2009	12:00 PM	Strong Wind	35 kts.	0	0	10K	0K
301 Oak Grove	12/02/2009	23:00 PM	Flash Flood	N/A	0	0	0K	0K
302 NCZ007>011 - 021>028 -	12/09/2009	10:00 AM	Strong Wind	40 kts.	0	0	1K	0K

038>043 - 073>078 - 083>086 - 088								
303 NCZ007 - 021>026 - 038 - 040	12/18/2009	12:00 PM	Winter Storm	N/A	0	0	0K	0K
304 NCZ007 - 021>026 - 038 - 040	12/18/2009	12:00 PM	Winter Weather	N/A	0	0	0K	0K
305 NCZ022>025 - 039	12/30/2009	20:00 PM	Winter Weather	N/A	0	0	0K	0K
306 NCZ025 - 038>040 - 073	01/29/2010	20:00 PM	Winter Storm	N/A	0	0	0K	0K
307 NCZ008>011 - 023 - 025>028 - 040>043 - 076>078 - 083>086 - 088	02/10/2010	12:00 PM	High Wind	50 kts.	0	0	1K	0K
308 NCZ023 - 025 - 039 - 042 - 076>077 - 086 - 088	02/12/2010	19:00 PM	Winter Storm	N/A	0	0	0K	0K
309 NCZ023 - 025 - 039 - 042 - 076>077 - 086 - 088	02/12/2010	19:00 PM	Winter Weather	N/A	0	0	0K	0K
310 NCZ007 - 011 - 021>028 - 038>043 - 073>078 - 088	03/02/2010	15:00 PM	Winter Storm	N/A	0	0	0K	0K
311 NCZ007 - 011 - 021>028 - 038>043 - 073>078 - 088	03/02/2010	15:00 PM	Winter Weather	N/A	0	0	0K	0K
312 Bethesda	05/22/2010	17:00 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
313 Oak Grove	05/22/2010	17:10 PM	Thunderstorm Wind	50 kts.	0	0	4K	0K

314 Quail Roost	05/22/2010	19:25 PM	Flash Flood	N/A	0	0	0K	0K
315 Few	05/28/2010	21:00 PM	Thunderstorm Wind	50 kts.	0	0	10K	0K
316 Huckleberry Spg	05/28/2010	21:00 PM	Lightning	N/A	0	0	20K	0K
317 Huckleberry Spg	05/28/2010	21:25 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
318 East Durham	05/28/2010	21:35 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
319 Few	05/28/2010	21:35 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
320 East Durham	05/28/2010	21:37 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
321 East Durham	05/28/2010	21:37 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
322 Huckleberry Spg	05/28/2010	21:40 PM	Flash Flood	N/A	0	0	50K	0K
323 Durham	06/23/2010	12:55 PM	Thunderstorm Wind	50 kts.	0	0	15K	0K
324 Weaver	07/13/2010	20:10 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
325 Huckleberry Spg	07/25/2010	20:33 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
326 Fairntosh	08/05/2010	17:40 PM	Lightning	N/A	0	0	3K	0K
327 West Durham	08/05/2010	17:41 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
328 Lowes Grove	11/16/2010	23:25 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
329 NCZ023>025	12/04/2010	12:00 PM	Winter Weather	N/A	0	0	0K	0K
330 NCZ007>009 - 025>026 - 041 - 076 - 088	12/16/2010	03:00 AM	Winter Weather	N/A	0	0	0K	0K
331 NCZ023 -	01/10/2011	13:00	Winter Weather	N/A	0	0	0K	0K

025		PM						
332 Durham	04/05/2011	02:36 AM	Thunderstorm Wind	50 kts.	0	0	25K	0K
				TOTALS:	21	23	3.087B	503.006M

Source – http://www.nc-climate.ncsu.edu/products_old/wx/events/events.php , via NOAA National Climate Data Center

Table 3
Hazard Risk by Climate Division

County	Climate Division (NOAA)	Earthquake	Landslide	Hurricane	Nor'easter	Tornado	Severe Winter Weather	Wildfire	Flood
Durham	**3**	**Low**	**Mod**	**Low**	**Low**	**Mod**	**Mod**	**Low**	**Mod**

Source – NCDEM Hazard Mitigation Branch:
http://www.nccrimecontrol.org/Index2.cfm?a=000003,000010,001623,000177,000891,000922

Table 4
Means to Measure Hazard Extent

HAZARD	EXTENT MEASUREMENT
Dam Failure	Flood Depth
Drought	Palmer Drought Severity Index; Keetch-Byram Drought Index (KBDI)
Earthquake	Modified Mercalli Scale of Earthquake Intensity
Flood	Flood Depth
Hurricane	Saffir-Simpson Scale
Landslide	*Average # of events per year
Sever Winter Storm	*Snowfall or Ice in inches
Thunderstorm	Thunderstorms are classified by NOAA as Single cell, multi cell, Severe, and Supercell.
Tornado	Fujita-Pearson Tornado Scale
Wildfire	Acres burned

Hazard Identification

Severe Thunderstorms:

EVENT	DATE	DAMAGES
Thunderstorm	August 17, 1993	$5,000.00
Lightning	July 11, 1994	$5,000.00
Thunderstorm Winds	October 27, 1995	$25,000.00
Thunderstorm Winds	May 11, 1996	$30,000.00
Thunderstorm Winds	May 27, 1996	$30.000.00
Thunderstorm Winds	September 10, 1997	$20,000.00
Lightning	March 21, 1999	$20,000.00

A thunderstorm is formed from a combination of moisture, rapidly raising warm air and a force capable of lifting air such as a warm and cold front, a sea breeze or a mountain. Thunderstorms may occur singly, in clusters or in lines. Thus, it is possible for several thunderstorms to affect one location in the course of a few hours. Some of the most severe weather occurs when a single thunderstorm affects one location for an extended time. Straight-line winds, which in extreme cases have the potential to exceed 100 miles per hour, are responsible for most thunderstorm wind damage. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado. Thunderstorms are also associated with tornadoes and heavy rains that can lead to flooding. *(http://www.fema.gov/hazard/thunderstorm/index.shtm)*

All thunderstorms contain ***lightning***. Lightning is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt." This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning reaches a temperature approaching 50,000 degrees Fahrenheit in a split second. The rapid heating and cooling of air near the lightning causes thunder. Lightning is a major threat during a thunderstorm. In the United States, between 75 to 100 Americans are hit and killed each year by lightning. If you are caught outdoors, avoid natural lightning rods such as tall, isolated trees in an open area or the top of a hill and metal objects such as wire fences, golf clubs and metal tools. It is a myth that lightning never strikes twice in the same place. In fact, lightning will strike several times in the same place in the course of one discharge. The power of lightning's electrical charge and intense heat can electrocute on contact, split trees, ignite fires and cause electrical failures. *(http://www.fema.gov/hazard/thunderstorm/index.shtm)*

Hail is produced by many strong thunderstorms. Hailstones are products of the updrafts and downdrafts that develop inside the cumulonimbus clouds of a thunderstorm, where super cooled water droplets exist. The transformation of droplets to ice requires not only a temperature below 32 degrees F (0C), but also a catalyst in the form of tiny particles of solid matter, or freezing nuclei. Continued deposits of super cooled water cause the ice crystals to grow into hailstones. Hail can be smaller than a pea or as large as a softball and can be very destructive to property, crops, livestock, and people. *(http://www.fema.gov/hazard/thunderstorm/index.shtm)*

Thunderstorms are common throughout North Carolina, and have occurred in all months. Thunderstorm-related deaths and injuries in North Carolina (1959-1992) have peaked during July and August. Most tornadoes in North Carolina develop in areas of atmospheric disturbance, including along squall lines ahead of an advancing cold front; in an area where warm air masses converge; in some local summer thunderstorms; and in association with a tropical cyclone.

Of all ***tornadoes*** reported in North Carolina between 1953 and 1990, 71 percent have been classified as weak, 28 percent as strong, and about one percent as violent. Weak tornadoes have caused three percent of North Carolina tornado deaths, similar to the national figure. Strong tornadoes were responsible for 49 percent of North Carolina deaths (versus 30 percent nationwide), while violent tornadoes caused 48 percent of North Carolina deaths, compared to 70 percent for the nation. Based on

state tornado statistics (SERCC, 1996), North Carolina ranks 22nd in total number of tornadoes and 18th in tornado deaths for the period 1953-1995.

Although tornadoes have been reported in North Carolina throughout the year, most of them have occurred in the spring, with 13 percent in March, 11 percent in April, 22 percent in May and 14 percent in June. The most severe tornadoes have also taken place during the spring, with more than half of all F2 or strongest storms occurring in that time period. *(www.ncem.org/mitigation)*

Because mountainous areas disrupt the inflow of air near the surface of squall lines and individual thunderstorms, organized thunderstorm activity is generally not as strong in western North Carolina, and thus tornadic activity is muted in this region. Hurricane-induced tornadic activity generally occurs close to the coastline as a hurricane makes landfall. *(www.ncem.org/mitigation)* However, due to Durham County and the Municipality's proximity to both the mountains and the coast, many times the warm and cold air meets in the middle region of North Carolina developing into severe and frequent thunderstorm activity in this area.

Severe thunderstorms are common in North Carolina. Durham County and the Municipality are no exception. According to the National Climatic Data Center, there were a total of 124 thunderstorms between the years 1950-2011. In addition, there were 92 hail and 7 lightning events recorded for Durham County. These totals do not include the 6 tornado events listed in the Tornado Hazard description. Information recorded as to damage for specific thunderstorm events are reported by the National Climatic Data Center: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

The magnitude for thunderstorms is classified by NOAA as single-cell, multicell cluster, multicell lines, severe and supercells. Which type forms depends on the instability and relative wind conditions at different layers of the atmosphere. Single-cell thunderstorms form in environments of low vertical wind shear and last only 20–30 minutes. Organized thunderstorms and thunderstorm clusters/lines can have longer life cycles as they form in environments of significant vertical wind shear, which aids the development of stronger updrafts as well as various forms of severe weather. A storm is generally considered severe if winds reach over 58 mph, hail is 1 inch (25 mm) in diameter or larger, or if funnel clouds and/or tornadoes are reported. The supercell is the strongest of the thunderstorms (in excess of 80mph winds), most commonly associated with large hail, high winds, and tornado formation. Based on previous occurrences, the greatest magnitude expected in a future event in Durham County would be a supercell thunderstorm, with winds exceeding 80 mph.

The effects of severe thunderstorms are not bound by geopolitical boundaries. Thus, the entire jurisdiction may be impacted by flooding rains, damaging winds, hail and lightning strikes which may damage buildings and property.

Flooding:

Flooding is a localized hazard that is generally the result of excessive precipitation. Floods can be generally considered in two categories: flash floods, the product of heavy localized precipitation in a short time period over a given location; and general floods, caused by precipitation over a longer time period and over a given river basin.

Flooding is the most common environmental hazard, due to the widespread geographical distribution of river valleys and coastal areas, and the attraction of human settlements to these areas. Usually, Presidential declarations of major disasters are associated with flash and general floods.

Flash floods occur within a few minutes or hours of heavy amounts of rainfall, 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 a local area, or by heavy rains from hurricanes and tropical storms. Although flash flooding occurs often along mountain streams, it is also common in urban areas where much of the ground is covered by impervious surfaces. Roads and buildings 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.

The severity of a flooding event is determined by a combination of river basin terrain, local thunderstorm movement, past soil moisture conditions and the degree of vegetative clearing. Abnormal weather patterns may also contribute to flooding of a local area. Large-scale climatic events, such as the El Nino-Southern Oscillation in the Pacific, 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, and nearly 90 percent of flash floods occur during the April through September period.

While flash floods occur within hours of a rain event, general flooding is a longer-term event, and may last for several days. The primary types of flooding are **riverine flooding, coastal flooding** and **urban flooding**.

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 within the floodplain. **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 a flood of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are divided into areas that experience different levels of floods depending on their elevation. A 100-year flood will inundate the 100-year zone of that floodplain. A 500-year flood will inundate the 500-year floodzone, which is higher in elevation. The chances of a 100-year flood event occurring for any given year is 1 percent; for a 500-year event, the chances drop to 0.2 percent for any one-year period. The Army Corps of Engineers calls a 100-year flood an Intermediate Regional Flood, while a Standard Project flood describes a major flood that could be expected to occur from a combination of severe meteorological and hydrologic conditions. Most dam and flood-related structures have been designed to meet 100-year flood conditions.

Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by hurricanes 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 sea

water up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forest lands 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. 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 price of this accessibility was increased flooding of the ensuing urban areas. Urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land and, occasionally, overwhelming sewer systems.

Likelihood of Occurrence

Flood hazard varies by location and type of flooding. Coastal areas are most at risk from flooding caused by hurricanes, tropical storms and nor'easters. Low-lying coastal areas in close proximity to the shore, sounds or estuaries are exposed to the threat of flooding from storm surge associated with these systems. In mountainous regions, population areas typically lie in narrow valleys, which lack the ability to store and dissipate large amounts of water. Consequently, stream flow tends to increase rapidly. Large amounts of impervious surfaces in urban areas increase runoff amounts and decrease the lag time between the onset of rainfall and stream flooding. Manmade channels may also constrict stream flow and increase flow velocities.

Vulnerability

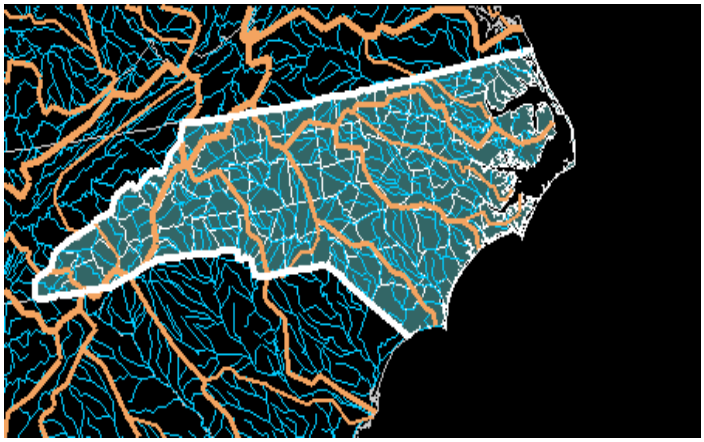


Figure (2) North Carolina River Basins (USGS, 1998)

North Carolina is divided into 13 river basins: Hiwassee, Upper Little Tennessee, Tuckasegee, Upper French Broad, Upper Broad, Upper New, Upper Yadkin, Upper Dan, Haw, Lumber, Upper Neuse, Upper Tar and Abemarle. These river basins are shown in *Figure (2).* State lines are in thick white, County lines are in thin white, streams are in thin gray, and river basin boundaries are in thick gray.

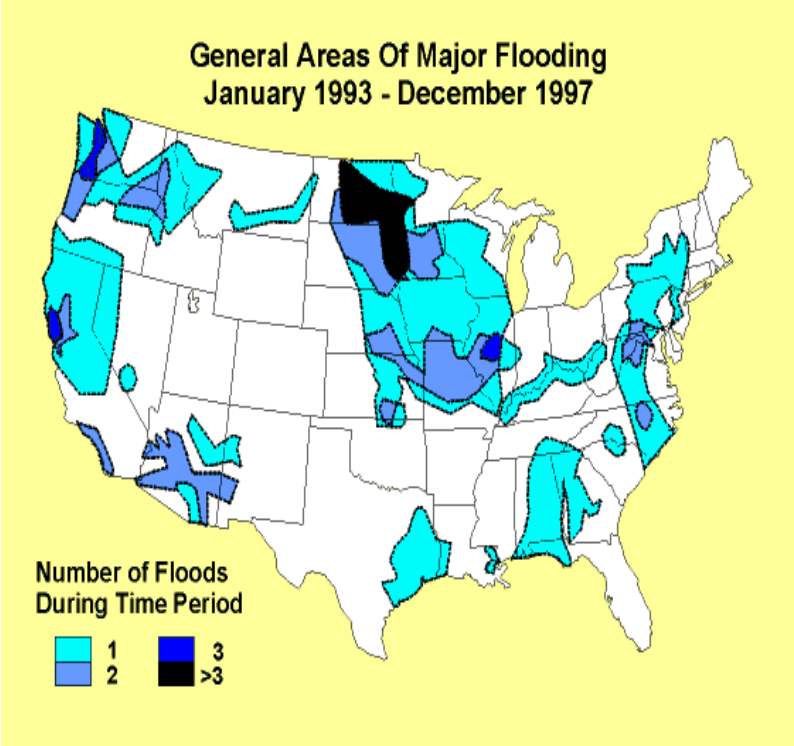
The severity of a flooding event is determined by a number of local factors, including river basin topography, precipitation patterns, recent soil moisture conditions and vegetative state. For coastal areas, flooding potential associated with hurricanes is mapped in Inundation Maps prepared as part of the Eastern North Carolina Hurricane Evacuation Study, aerial photographs of the coastal area (updated at five-year intervals by the North Carolina Coastal Resources Commission), and flood maps prepared for the National Flood Insurance Program.

Historical Impact

Durham County has few areas that have been historically impacted by floods. As indicated in Table 6: Repetitive Loss Properties, very few claims have been made for repeated flooding in the jurisdictions developing this Plan.

Statewide, all parts of North Carolina have been flooded with rainfall associated with tropical storms and hurricanes. The mountains were devastated by hurricane-induced rains in 1916, 1928, 1940, and 1995 (Opal); the Piedmont was impacted in those years plus 1945; and the Coastal Plain was adversely affected in 1945, 1954, 1955, 1996 (Fran), and 1999 (Floyd). *(www.ncem.org/mitigation)*

According to the National Climatic Data Center statistics, Durham County and the Municipality have been impacted by 36 flooding events between January 1,1950 and April 30, 2011. (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms).



General Areas of Major Flooding, January 1993-December 1997. This map shows the generalized outlines of watersheds affected by major floods, including flooding associated with Hurricanes Opal (1995) and Fran (1996). Colors indicate watersheds affected once, twice, three times or more than three times, during the period shown. The fact that entire watersheds are colored does not mean that these areas were entirely under water: it means that all major streams in the area were flooded. Furthermore, the map does not show all flood-prone areas in the contiguous US, only those where flooding has actually occurred in the last four years. *(www.usgs.gov)*

A flood, as defined by the National Flood Insurance Program is: "A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from:

- Overflow of inland or tidal waters,
- Unusual and rapid accumulation or runoff of surface waters from any source, or
- A mudflow.

[The] collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood."

Floods can be slow, or fast rising but generally develop over a period of days. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies. Investing in mitigation steps now, such as, engaging in floodplain management activities, constructing barriers, such as levees, and purchasing flood insurance will help reduce the amount of structural damage to your home and financial loss from building and crop damage should a flood or flash flood occur.

The Mitigation Division, a component of the Federal Emergency Management Agency (FEMA), manages the National Flood Insurance Program. The three components of the National Flood Insurance Program (NFIP) are:

- Flood Insurance
- Floodplain Management
- Flood Hazard Mapping

Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

The County of Durham and the City of Durham are both active participants in the National Flood Insurance Program. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance. And, every $3 paid in flood insurance claims saves $1 in disaster assistance payments.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the jurisdictions' floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

The effects of flooding may be more commonly identified as occurring in flood-prone areas (typically mapped floodplains). However, the entire jurisdiction may be impacted by flooding rains associated with severe thunderstorms, hurricanes and other tropical storms. Most flooding within the jurisdiction occurs from storm water run-off. Storm water management practices are strictly enforced.

The greatest magnitude reported in Durham County was a flood depth of 3 feet, which would be the greatest magnitude expected in a future event.

Table 6: Repetitive Loss Property Data as of 2/28/2011

Mitigated?	Insured?	Zip Code	Occupancy	Zone	Firm	Building Value	Tot Building Payment	Tot Contents Payment	Losses	Total Paid	Average Pay	As of Date
NO	NO	27712	SINGLE FMLY	AE	N	100,416	15,358.13	2,596.50	2	17,954.63	8,977.32	02/28/2011
NO	YES	27704	SINGLE FMLY	X	N	58,608	9,342.53	0.00	2	9,342.53	4,671.27	02/28/2011
NO	YES	27704	SINGLE FMLY	AE	N	81,972	8,693.06	0.00	2	8,693.06	4,346.53	02/28/2011
NO	YES	27704	SINGLE FMLY	AE	N	64,837	10,270.92	0.00	3	10,270.92	3,423.64	02/28/2011
NO	YES	27704	SINGLE FMLY	AE	N	73,500	15,622.07	0.00	2	15,622.07	7,811.04	02/28/2011
NO	YES	27704	SINGLE FMLY	A04	N	49,832	7,419.66	0.00	2	7,419.66	3,709.83	02/28/2011
NO	YES	27705	SINGLE FMLY	X	N	77,854	14,185.52	0.00	2	14,185.52	7,092.76	02/28/2011
NO	YES	27707	SINGLE FMLY	A03	Y	118,745	6,998.71	0.00	2	6,998.71	3,499.36	02/28/2011
NO	YES	27707	SINGLE FMLY	AE	N	181,026	17,905.74	0.00	2	17,905.74	8,952.87	02/28/2011
NO	YES	27704	SINGLE FMLY	A04	N	91,170	24,945.77	0.00	3	24,945.77	8,315.26	02/28/2011
NO	YES	27707	OTHER RESID	A03	N	774,000	89,904.87	20,888.39	2	110,793.26	55,396.63	02/28/2011
NO	NO	27707	SINGLE FMLY	X	N	250,000	7,087.70	0.00	2	7,087.70	3,543.85	02/28/2011
NO	NO	27705	NON RESIDNT	A04	Y	597,595	26,026.82	33,911.98	3	59,938.80	19,979.60	02/28/2011
NO	NO	27707	2-4 FAMILY	AE	N	149,100	29,787.29	0.00	2	29,787.29	14,893.65	02/28/2011
NO	NO	27703	NON RESIDNT	AO	N	4,999,999	18,102.02	0.00	2	18,102.02	9,051.01	02/28/2011
NO	NO	27701	ASSMD CONDO	B	N	526,680	14,241.16	0.00	2	14,241.16	7,120.58	02/28/2011
NO	NO	27701	ASSMD CONDO	X	N	526,680	32,938.32	0.00	2	32,938.32	16,469.16	02/28/2011
NO	NO	27707	OTHER RESID	X	N	368,940	68,768.13	0.00	2	68,768.13	34,384.07	02/28/2011
NO	NO	27712	SINGLE FMLY	X	N	141,415	46,747.38	26,433.13	7	73,180.51	10,454.36	02/28/2011
NO	YES	27713	SINGLE FMLY	AE	Y	218,880	23,366.93	7,529.66	2	30,896.59	15,448.30	02/28/2011
YES	NO	27712	SINGLE FMLY	A05	N	111,179	27,729.82	12,406.50	2	40,136.32	20,068.16	02/28/2011

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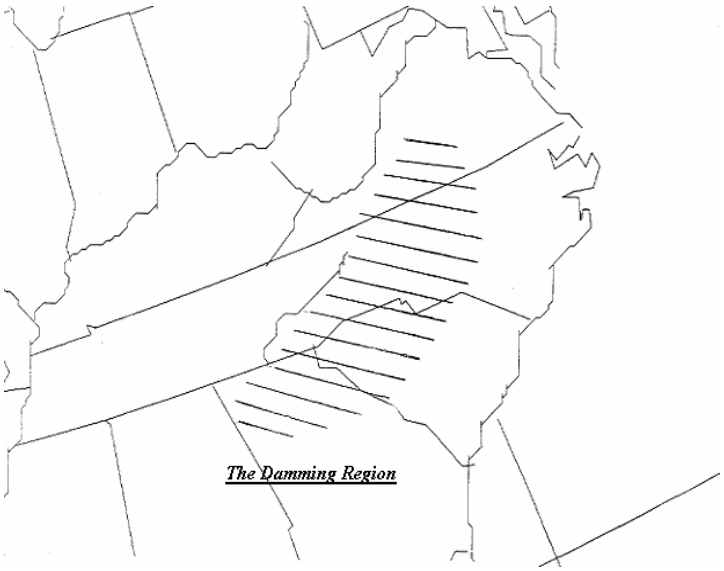
Severe Winter Storm:

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain, ice pellets, and extreme cold. Extreme snow events are the most potentially disruptive to society, for they can bring down power lines, trees, and lead to roof collapses. All forms of severe winter weather can make travel treacherous. Severe winter storms are extra-tropical cyclones *(storms that form outside of the warm tropics)* fueled by strong temperature gradients and an active upper-level jet stream. The winter storms that impact North Carolina generally form in the Gulf of Mexico or off the southeast Atlantic Coast. Few of these storms result in blizzard conditions, defined by the presence of winds in excess of 35 miles per hour, falling or blowing snow, and a maximum temperature of 20 degrees Fahrenheit.

While the frequency and magnitude of snow events are highest in the mountains due to elevation, the geographical orientation of the mountains and piedmont contribute to a regular occurrence of freezing precipitation events *(e.g., ice pellets and freezing rain)* in the piedmont. Such ice events *(up to and including ice storms)* are often the result of cold air damming. Cold air damming is a shallow, surface-based layer of relatively cold, stably-stratified air entrenched against the eastern slopes of the Appalachian Mountains. With warmer air above, falling precipitation in the form of snow melts, then becomes either supercooled *(liquid below the melting point of water)* or refreezes. In the former case, supercooled droplets can freeze on impact *(freezing rain)*, while in the latter case, the re-frozen water particles are ice pellets *(or sleet)*. The figure below shows the general location of cold air damming events.



Region where cold air damming occurs in the eastern U.S.

(Hartfield et al. 1996)

The entire state of North Carolina has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal areas typically face their greatest 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 sever snowstorms have been recorded occasionally in coastal areas.

As mentioned previously, cold air damming contributes to elevated freezing rain and ice storm events in the piedmont of North Carolina. These events occur at least as often as moderate or severe snow events in this region.

The mountains of North Carolina usually receive several snowfalls of four to six inches in a given winter weather season. There has been at least one severe winter storm at some location in the mountains each year during the 1984-1993 period. The western area of the state is more likely to experience greater and more frequent snowfalls and blizzards than other locations in the state. The mountains also have the highest number of extreme one-day snowfalls. *(NCEM: Keeping Natural Hazards From Becoming Disasters, May 2003)* The most obvious parameter in winter weather is snow. It is extreme snow that is the most potentially disruptive to society, for it can bring down power lines, trees and lead to roof collapses. *(www.ncem.org/mitigation)*

Durham County and the Municipality have experienced 42 snow and ice events during the years of 1950-2011 according to statistics from the National Climatic Data Center (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms). No property damages or crop damages were listed with these event statistics.

The greatest magnitude reported in Durham County was an overnight snow fall of 20 inches in January 2000, which would be the greatest magnitude expected in a future event.

The effects of severe winter storms are not bound by geopolitical boundaries. Thus, the entire jurisdiction may be impacted by freezing rain and ice on power lines, damaging winds, heavy snow and prolonged periods of dangerously cold temperatures which may injure people, damage buildings and property.

Hurricanes:

A hurricane is a tropical storm with winds that have reached a constant speed of 74 miles per hour or more. Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The "eye" is generally 20 to 30 miles wide, and the storm may extend outward 400 miles. As a hurricane approaches, the skies will begin to darken and winds will grow in strength. As a hurricane nears land, it can bring torrential rains, high winds, and storm surges. A single hurricane can last for more than 2 weeks over open waters and can run a path across the entire length of the eastern seaboard. August and September are peak months during the hurricane season that lasts from June 1 through November 30.

The center, or eye, of a hurricane is relatively calm. The most violent activity takes place in the area immediately around the eye, called the eye wall. At the top of the eye wall (about 50,000 feet), most of the air is propelled outward, increasing the air's upward motion. Some of the air, however, moves inward and sinks into the eye, creating a cloud-free area.

Tropical cyclones are classified as follows:

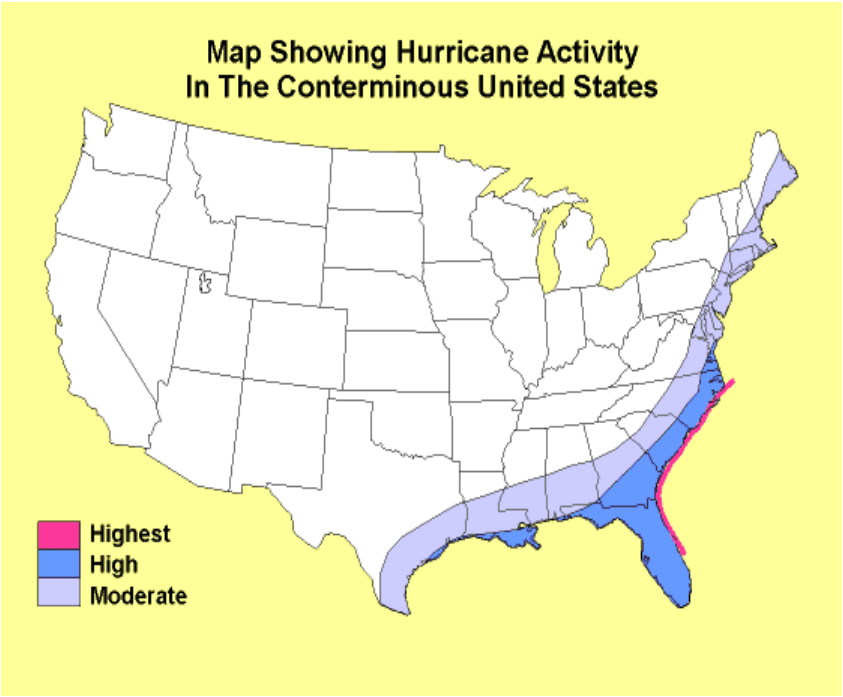
Tropical Depression An organized system of clouds and thunderstorms with a defined circulation and maximum sustained winds of 38 mph (33 knots) or less.

Tropical Storm An organized system of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 mph (34-63 knots).

Hurricane An intense tropical weather system with a well-defined circulation and maximum sustained winds of 74 mph (64 knots) or higher. Hurricanes are called "typhoons" in the western Pacific, while similar storms in the Indian Ocean are called "cyclones."

Hurricanes form in the Atlantic Ocean, Gulf of Mexico, Indian Ocean, Caribbean Sea and Pacific Ocean. Hurricane winds in the Northern Hemisphere circulate in a counterclockwise motion around the hurricane's center or "eye," while hurricane winds in the Southern Hemisphere circulate clockwise. Natural phenomena, which affect a storm, include temperature of the water, the Gulf Stream, and steering wind currents. Powered by heat from the sea, they are steered by the easterly trade winds and the temperate wester lies as well as by their own ferocious energy. Around their core, winds grow with great velocity, generating violent seas. Moving ashore, they sweep the ocean inward while spawning tornadoes and producing torrential rains and floods.

In the eastern Pacific, hurricanes begin forming by mid-May, while in the Atlantic, Caribbean, and Gulf of Mexico, hurricane development starts in June. For the United States, the peak hurricane threat exists from mid-August to late October although the official hurricane season extends through November. Over other parts of the world, such as the western Pacific, hurricanes can occur year-round. Areas in the United States vulnerable to hurricanes include the Atlantic and Gulf coasts from Texas to Maine, the territories in the Caribbean, and tropical areas of the western Pacific, including Hawaii, Guam, American Samoa, and Saipan.



(www.usgs.gov)

Map Showing Hurricane Activity in the Conterminous United States. The areas shown reflect the number of hurricanes per 100 years expected to pass within 75 nautical miles (159 km) of any point in the colored regions. The highest-risk area (red line) shows where 60 hurricanes per 100 years skim up the east coast. The high-risk area would see 40-60 hurricanes per 100 years, and the moderate-risk area would see 20-40 hurricanes per 100 years. The period of observation is 1888 to 1988.

Saffir-Simpson Hurricane Scale *(Simpson and Reihl, 1981)*

Saffir-Simpson Category	Maximum sustained wind speed			Minimum surface pressure	Storm surge	
	mph	meters/ sec	knots	Millibars (mb)	feet	meters
1	74-96	33-42	64-83	Greater than 980	3-5	1.0-1.7
2	97-111	43-49	84-96	979-965	6-8	1.8-2.6
3	112-131	50-58	97-113	964-945	9-12	2.7-3.8
4	132-155	59-69	114-135	944-920	13-18	3.9-5.6
5	156+	70+	136+	Less than 920	19+	5.7+

Table 7: Damage Classification

Cat.	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. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window 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 and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Flat terrain five feet of less above sea level flooded inland eight miles or more. Evacuation of low- lying residences within several blocks of shoreline possibly required.	**Hurricane Gloria (1985)**
4	**EXTREME**	Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. Flat terrain 10 feet of 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, and of single- story residences within 2 miles of shore.	**Hurricane Andrew (1992)**
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 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 five to 10 miles of shore possibly required.	**Hurricane Camille (1969)**

Hurricanes are considered to be major hurricanes (the most potentially dangerous) when the Saffir-Simpson classification is three or higher. These intense hurricanes cause over 70 percent of the damage in the USA, even though they account for only 20 percent of tropical cyclone landfalls. *(NCEM)*

By virtue of its position along the Atlantic Ocean adjacent to and protruding to the edge of the Gulf Stream, North Carolina is frequently impacted by hurricanes. In fact, North Carolina has experienced the fourth greatest number of hurricane landfalls of any state in the 20th century (after Florida, Texas and Louisiana).

Durham County and the Municipality have equal occurrence rates from storms entering from the Atlantic and from the Gulf of Mexico. The geographic location of the County and City make it vulnerable from both types of storms.

All areas of the state are vulnerable to hurricane hazards, but the greatest impact associated with storm surge is limited to the 18 counties bordering the shoreline and sounds. However, hurricane events have affected the mountains and the middle portions of our state.

North Carolina has had an extensive hurricane history dating back to colonial times, with notable nineteenth century storms occurring in 1837, 1846, 1856, 1879, 1883 and 1899. From 1960 to 1990,

there was a lull in land falling major hurricanes, with only one (Hurricane Donna in 1960). The 1950s were a busy time for hurricanes in North Carolina, including Hazel, Connie, Diane and Ione. Recent years have proven busy as well, with Hugo (1989), Emily (1993), Opal (1995), Bertha (1996), Fran (1996), Bonnie (1998), Dennis (1999), and Floyd (1999) all leaving their mark from the coast across the state of North Carolina.

Durham County and the Municipality, has been impacted by 5 hurricanes from 1950 – 2011. The following information was provided by the National Climatic Data Center:

Table 8 – Hurricanes Impacting Durham County

Date	Hurricane	Deaths*	Injuries
July 12, 1996	Bertha	0	0
September 5, 1996	Fran	7	2
September 4, 1999	Dennis	0	0
September 15, 1999	Floyd	0	0
September 18, 2003	Isabel	1	0

***Deaths - Statewide**

National Climatic Data Center

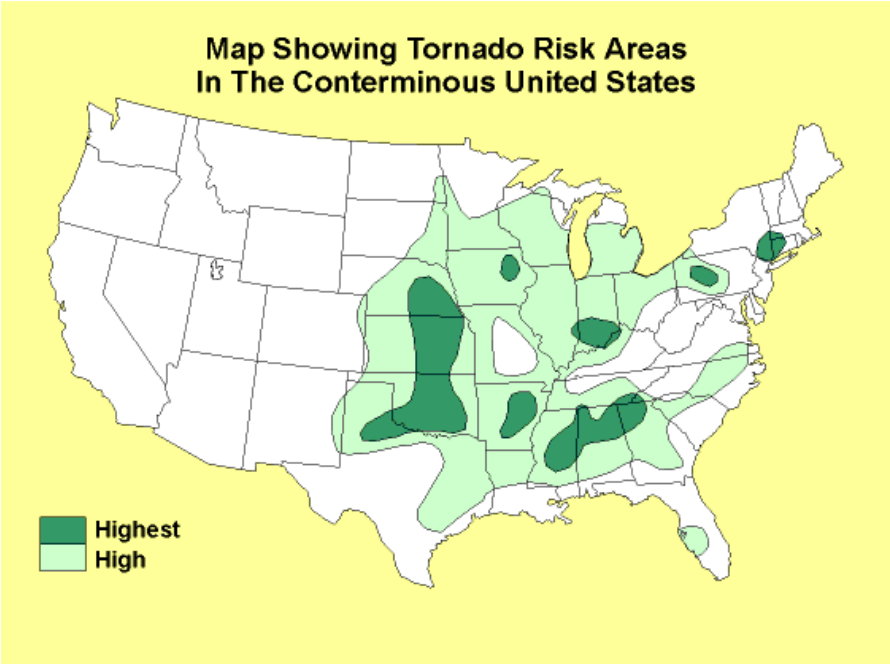
The greatest magnitude reported in past events in Durham County was a Category 3 (based on the Saffir-Simpson Hurricane Scale), which would be the greatest magnitude expected in a future event.

The effects of hurricanes and tropical storms are not bound by geopolitical boundaries. Thus, the entire jurisdiction may be impacted by flooding rains and damaging winds which may damage buildings and property.

Tornadoes:

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. 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. A 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 without a condensation runnel. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornadoes can occur at any time of year. They tend to occur in the afternoons and evenings. Over 80% of all tornadoes strike between noon and midnight. *(http://www.fema.gov)*

The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long. Even with advances in meteorology, warning times for tornadoes may be short or sometimes not possible. Tornadoes can occur in any state, but are more frequent in the Midwest, Southeast and Southwest. A ***tornado watch*** is issued by the National Weather Service when tornadoes are possible in your area. This is the time for people to relocate to the safest areas of their homes and listen to the radio or television for further developments. A ***tornado warning*** is issued when a tornado has been sighted or indicated by weather radar. (*National Weather Service*)

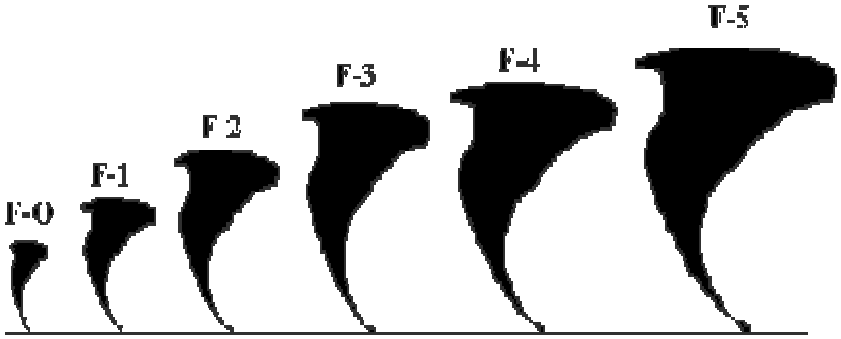


(www.usgs.gov)

Map Showing Tornado Risk Areas in the Conterminous United States*. The categories shown reflect the tornado recurrence interval at a single point. In the highest risk areas, a tornado of significant strength would be expected to occur once every 2000 years, at each point in the area shown. For the high-risk areas, the interval would be once every 5000 years. The data base is 800 cases of significant tornadoes for the period 1954-1992.*

The intensity, path length and width of tornadoes are rated according to a scale developed by T. Theodore Fujita and Allen D. Pearson. The Fujita-Pearson Tornado Scale is presented below. Tornadoes classified as F0-F1 are considered weak, those classified as F2-F3 are considered strong, while those classified as F4-F5 are considered violent.

Fujita - Pearson Tornado Scale



Fujita – Pearson Tornado Scale Description Table

F-Scale	Damage	Winds (mph)	Description
F-0	Light	40-72	• Chimney damage • Tree branches broken
F-1	Moderate	73-112	• Mobile homes pushed off foundation or overturned
F-2	Considerable	113-157	• Considerable damage • Mobile homes demolished • Trees uprooted
F-3	Severe	158-206	• Roofs and walls torn down • Trains overturned • Cars thrown
F-4	Devastating	207-260	• Well-constructed walls leveled
F-5	Incredible	261-318	• Homes lifted off foundation and carried considerable distances • Autos thrown as far as 100 meters
F-6	Inconceivable	319-379	• Unknown

(www.fema.gov and www.ncem.org)

The majority of tornadoes (71%) reported in North Carolina have been classified as weak, 28% as strong, and about 1% as violent. Weak tornadoes have caused 3% of North Carolina tornado deaths, similar to the national figure. Strong tornadoes were responsible for 49% of North Carolina deaths (compared to 70% for the nation). Based on state tornado statistics (SERC, 1996), North Carolina ranks 22nd in total number of tornadoes and 18th in tornado deaths for the period 1953-1995.

Although tornadoes have been reported in North Carolina throughout the year, most of them have occurred in the spring—13% in March, 11% in April, 22% in May, and 14% in June. The most severe tornadoes have also taken place during the spring, with more than half of all F2 or stronger storms occurring in that season.

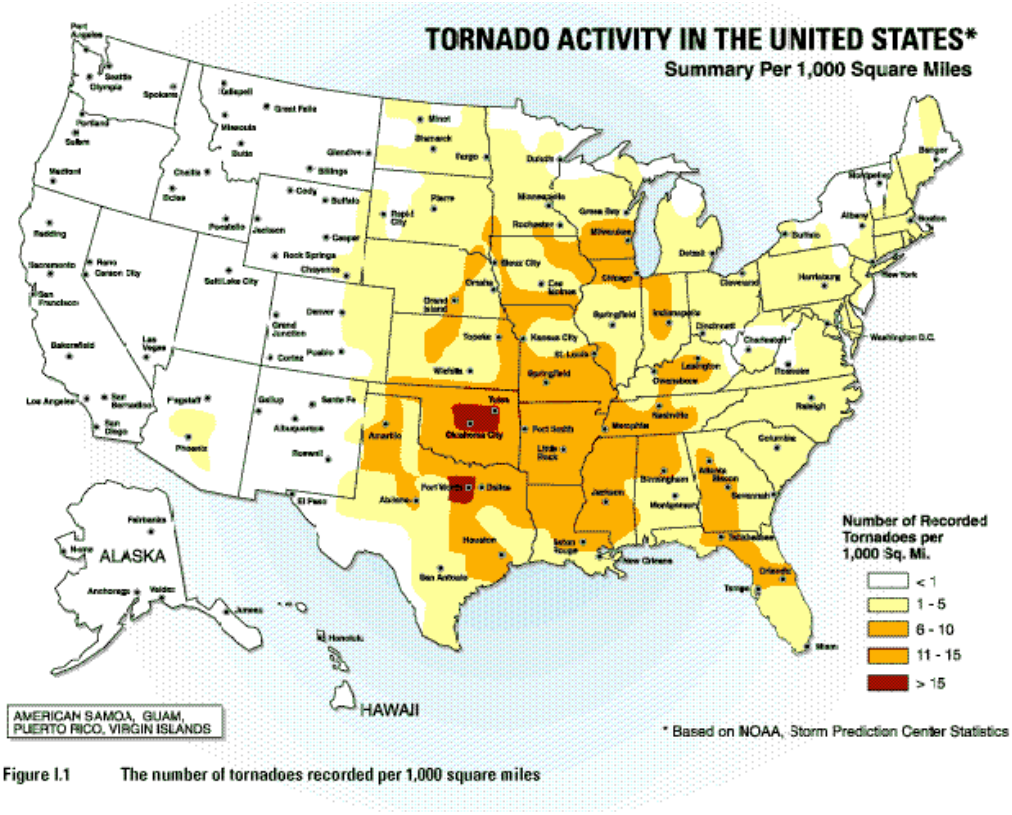


Figure I.1 The number of tornadoes recorded per 1,000 square miles

(www.fema.gov)

Tornadoes have occurred in Durham County and the Municipality. Based on information from the National Climatic Data Center, the recorded tornado events occurred in Durham County on the following dates and with the recorded damage totals listed:

Table 9: Tornadoes Impacting Durham County

December 31, 1975	**No Damages Recorded**
April 4, 1984	**$2,500,000.00**
May 5, 1989	**$25,000.00**
July 16, 1989	**$25,000.00**
March 20, 1998	**$600,000.00**
May 14, 2006	**No Damages Recorded**

(National Climatic Data Center)

The greatest magnitude reported in past events in Durham County had a magnitude of F3 (based on the Fujita - Pearson Tornado Scale), which would be the greatest magnitude expected in a future event.

The effects of tornadoes are not bound by geopolitical boundaries. Thus, the entire jurisdiction may be impacted by tornadoes and other extreme wind events associated with strong thunderstorms which may damage buildings and property.

Drought/Extreme Heat

A **drought** is defined by FEMA *(1997)* as being a water shortage caused by a deficiency of rainfall. It is a condition where and when the water supply is deficient enough for a long enough period of time to damage the growth of vegetation, industrial production, or domestic activities. The National Drought Mitigation Center states that in the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. Drought may or may not be accompanied by intense heat. Intense heat only expounds on the drought condition by increasing evaporation.

Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility. Droughts occur when a long period passes without substantial rainfall. A heat wave combined with a drought is a very dangerous situation.

National Weather Service Heat Index to Heat Disorders			
Level	Danger Category	Heat Disorder	Temperature
I	Caution	Fatigue possible with prolonged exposure and physical activity	80 – 90
II	Extreme Caution	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and physical activity	90 – 105
III	Danger	Sunstroke, heat cramps, or heat exhaustion likely, heat stroke possible with prolonged exposure and physical activity	105 – 130
IV	Extreme Danger	Heat stroke or sunstroke imminent	>130

The greatest magnitude reported in past events in Durham County was a magnitude of Level III (Danger) and D4 (Exceptional Drought), which would be the greatest magnitude expected in a future event.

The effects of drought and extreme heat are not bound by geopolitical boundaries. Thus, the entire jurisdiction may be impacted by the effects of drought and extreme heat in the way of health impacts on humans and animals, crops and water supplies.

As a result of an extended period of drought in the 2006-2008 period, the City of Durham developed a Drought - Water Emergency Plan. Further, the jurisdiction developed a tiered system of water restrictions which regulated the use of water for recreation, commercial and industrial purposes.

Drought intensity categories are based on six key indicators and numerous supplementary indicators. The accompanying drought severity classification table shows the ranges for each indicator for each dryness level. Because the ranges of the various indicators often don't coincide, the final drought category tends to be based on what the majority of the indicators show. The analysts producing the map also weight the indices according to how well they perform in various parts of the country and at different times of the year. Also, additional indicators are often needed in the West, where winter snowfall has a strong bearing on water supplies. *(National Drought Mitigation Center)*

Drought Severity Classification

		Ranges					
Category	Description	Possible Impacts	Palmer Drought Index	CPS Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Satellite Vegetation Health Index
DO	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	36-45
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	26-35
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	16-25
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	6-15
D4	Exception Drought	Exceptional & widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, & wells, creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	1-5

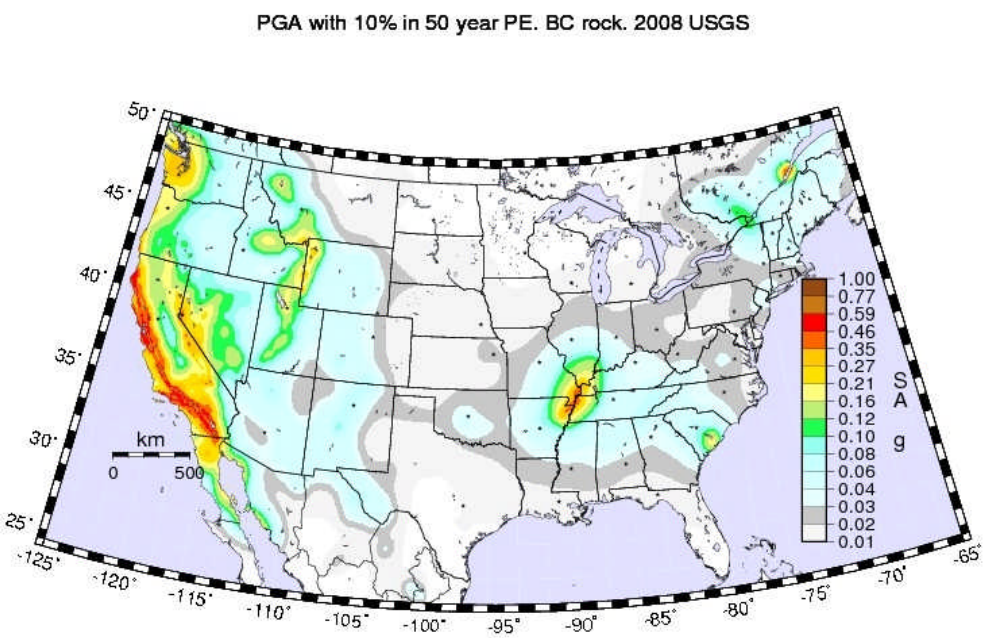
(National Drought Mitigation Center: Additional indices used, mainly during the growing season, include the USDA/NASS Topsoil Moisture, Crop Moisture Index (CMI), and Keetch Byram Drought Index (KBDI). Indices used primarily during the snow season and in the West include the River Basin Snow Water Content, River Basin Average Precipitation, and the Surface Water Supply Index (SWSI)

Earthquake:

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth as the huge plates that form the Earth's surface move slowly over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free causing the ground to shake. Most earthquakes occur at the boundaries where the plates meet; however, some earthquakes occur in the middle of plates.

Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and manufactured homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage.

Earthquakes strike suddenly, without warning. Earthquakes can occur at any time of the year and at any time of the day or night. Where earthquakes have occurred in the past, they will happen again. There are 45 states and territories in the United States at moderate to very high risk from earthquakes, and they are located in every region of the country. *(National Earthquake Hazards Reduction Program)*



Hazards from Earthquakes in the Contiguous United States.
This map shows in color those parts of the contiguous 48 states that have a 10% chance of experiencing an earthquake strong enough to cause appreciable damage in a 50-year period. In the yellow areas, maximum ground shaking would be 8-16% of the force of gravity, which is strong enough to damage unreinforced masonry buildings, even those built on bedrock. Darker colors are at the same risk for more intense shaking, while areas left blank would have less intense shaking.
http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/

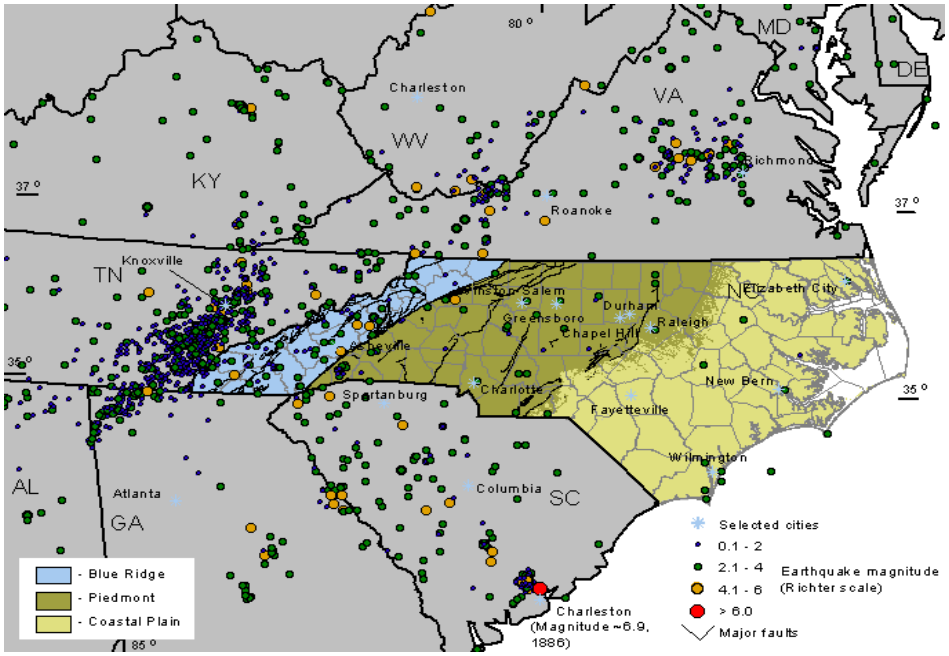
through a measure of shock wave amplitude. Each unit increase in magnitude on the Richter Scale corresponds to a 10-fold increase in wave amplitude, or a 244 - fold increase in energy. (*USGS, 1996*) Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale. It is a 12-level scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with a corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Scale of Earthquake Intensity (and its correspondence to the Richter Scale) is given in the table below:

Modified Mercalli Scale of Earthquake Intensity

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	Corresponding Richter Scale
I	Instrumental	Detected only on seismographs	<10	
II	Feeble	Some people feel it	<25	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<50	
IV	Moderate	Felt by people walking	<100	
V	Slightly Strong	Sleepers awake; church bells ring	<250	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<500	<5.4
VII	Very Strong	Mild alarm; walls crack; plaster falls	<1000	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	<2500	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	<5000	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7500	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	<9800	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	>9800	>8.1

The following figure shows the epicenters of earthquakes occurring in and around North Carolina between 1698 – 1997. *(www.geology.enr.state.nc.us/haz/quake.htm)* Epicenters are generally concentrated in the active Eastern Tennessee Seismic Zone, which is second in activity in the eastern US only to the New Madrid Fault.

Earthquake Epicenters in North Carolina
and Portions of Adjacent States
(1698-1997)



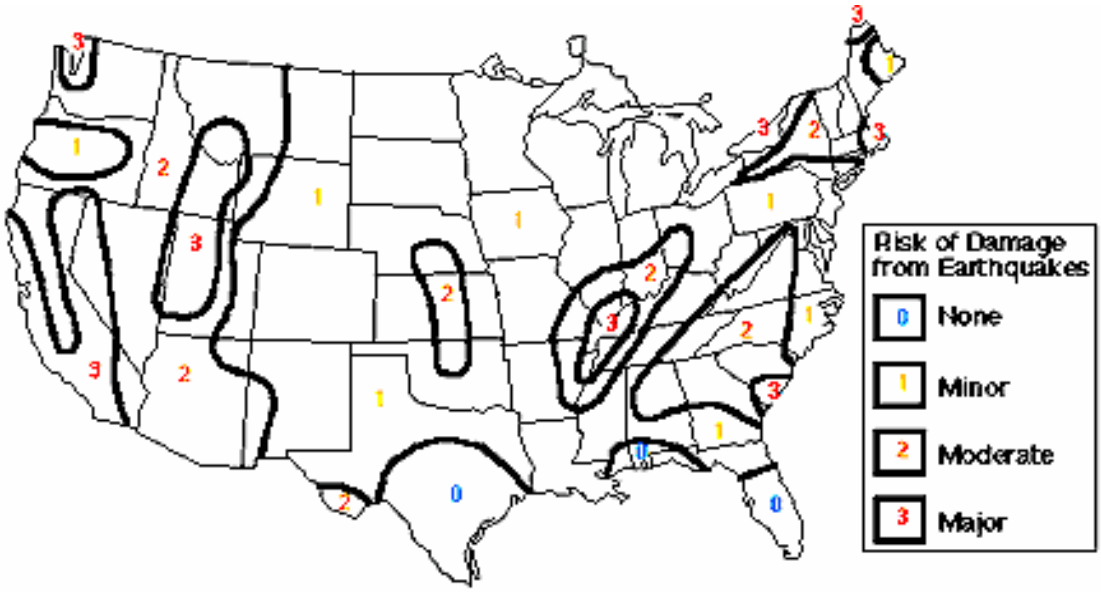
The Eastern Tennessee Seismic Zone is part of a crescent of moderate seismic activity risk extending from Charleston, South Carolina, northwestward into eastern Tennessee and then curving northeastward into central Virginia. While there have not been any earthquakes with a MMI intensity greater than IV since 1928 in this area, it has the potential to produce an earthquake of significant intensity in the future.

North Carolina's vulnerability to earthquakes decreases from west to east in relation to the Eastern Tennessee Seismic Zone. Generally, there are three different zones of seismic risk in North Carolina that correspond to different effective peak velocity-related accelerations of ground movement. The eastern portion of the state faces minimal effects from seismic activity. Locations in the middle and southeastern areas of the state face a moderate hazard from seismic activity, while the area from Mecklenburg County west through the Blue Ridge Mountains faces the greatest risk from seismic activity. These different levels of risk correspond to proximity to areas with historical seismic activity and changes in topography.

The steep topography of western North Carolina exacerbates the potential for damage from this area of seismic activity. There could be significant ground movement on steep slopes from seismic activity. This could result in human injuries, damage to property, and road closures, which would add difficulty to bringing in relief supplies and fire protection equipment. *(www.ncem.org/mitigation)*

MMI – Maximum Modified Mercalli Intensity at epicenter

Below is a map showing the risk of damage by earthquakes for the continental United States. As indicated by the map, Durham County and the Municipality are considered to be at minor risk for an earthquake.



(Modified from Stearns & Miller, 1977)

Earthquakes are relatively infrequent, but not uncommon in North Carolina. The earliest North Carolina earthquake on record is that of March 8, 1735, near Bath. This event was probably less than intensity V (Slightly strong; sleepers awake). The great earthquake of 1811 centered in the Mississippi Valley near New Madrid, Missouri, was felt throughout North Carolina. Intensity VI (Strong; trees sway) effects were observed in the western part of the state. The most property damage in North Carolina ever attributed to an earthquake, however, was caused by the August 31, 1886, Charleston, South Carolina shock. The quake left about 65 people dead in Charleston and led to chimney collapses, fallen plaster and cracked walls in Abbottsburg, Charlotte, Elizabethtown, Henderson, Hillsborough, Raleigh, Waynesville, and Whiteville. On February 21, 1916, the Asheville area was the center for a large intensity VI earthquake, which was felt in Alabama, Georgia, Kentucky, South Carolina, Tennessee, and Virginia - some 518,000 square kilometers in all. Subsequent minor earthquakes have caused damage in North Carolina in 1926, 1928, 1957, 1959, 1971, 1973 and 1976. *(www.ncem.org/mitigation/earthquake.htm).*

Additionally, the following information is provided to show the historically damaging earthquakes in North Carolina as well as additional information regarding smaller earthquakes that have occurred within North Carolina.

Table 10: EARTHQUAKES THAT HAVE CAUSED DAMAGE IN NORTH CAROLINA

DATE	LOCATION	Mag	MMI	MM in NC
1811 December 16 (a)	NE Arkansas	8.5	XI	VI
1811 December 16 (b)	NE Arkansas	8.0	X	VI
1811 December 16 (c)	NE Arkansas	8.0	X	VI
1812 January 23	New Madrid, MO	8.4	XI	VI
1812 February 7	New Madrid, MO	8.7	XII	VI
1852 April 29	Wytheville, VA	5.0	VI	VI
1861 August 31	Wilkesboro, NC	5.1	VII	VII
1875 December 23	Central Virginia	5.0	VII	VI

1886 August 31	Charleston, SC	7.3	X	VII
1897 May 31	Giles County, VA	5.8	VIII	VI
1913 January 1	Union County, SC	4.8	VII	VI
1916 February 21	Asheville, NC	5.5	VII	VII
1926 July 8	Mitchell County, NC	5.2	VII	VII
1928 November 3	Newport, TN	4.5	VI	VI
1957 May 13	McDowell County, NC	4.1	VI	VI
1957 July 2	Buncombe County, NC	3.7	VI	VI
1957 November 24	Jackson County, NC	4.0	VI	VI
1959 October 27*	Chesterfield, SC	4.0	VI	VI
1971 July 13	Newry, SC	3.8	VI	VI
1973 November 30	Alcoa, TN	4.6	VI	VI
1976 September 13	Southwest Virginia	4.1	VI	VI
1981 May 5	Henderson County, NC	3.5	VI	VI

**Conflicting reports on this event, intensity in North Carolina could have been either V or VI.*

Mag – Richter magnitude
MM in NC – Maximum Modified Mercalli Intensity within North Carolina

Dr. Kenneth B. Taylor from the following sources produced the "Earthquakes Which Has Caused Damage in North Carolina" table above:

- National Earthquake Center
- "Earthquakes of the US" by Carl von Hake, 1983
- A compilation of newspaper reports for earthquakes in the Eastern Tennessee Seismic Zone compiled by Arch Johnston, CERI, Memphis State University, 1983

The University of Tennessee regional seismic network and the US Geological Survey's National Seismic Network have collected additional earthquake information pertinent to Western North Carolina as follows:

DATE	LOCATION	DESCRIPTION	Mag
July 7, 2001	Swain County (2 miles SW of Cherokee)	Shaking felt, no damage recorded	2.4
July 9, 2001	Swain County (4 miles SW of Cherokee – between Cherokee & Bryson City)	Shaking felt, no damage recorded	2.4
July 9, 2001	Swain County (4 miles SW of Cherokee)	Shaking felt, no damage recorded	1.5
July 10, 2001	Swain County (4 miles SW of Cherokee)	Shaking felt, no damage recorded	2.3
May 8, 2002	Swain County (7 miles WSW of Bryson City)	No damage recorded	2.0
July 10, 2002	Swain County (7 miles WSW of Bryson City)	No damage recorded	2.0
September 8, 2002	Madison County (4 miles north of Marshall)	No damage recorded	2.2
April 29, 2003	Alabama (4 miles S of Mentone, AL/41 miles SSW of Chattanooga, TN)	Shaking felt as far east as Caldwell County	2.4
December 9, 2003	Richmond, Virginia (Approx 30 miles west of Richmond)	Shaking felt as far south as Orange County	4.5

Although there is no recent history of damaging earthquakes affecting either jurisdiction, a major earthquake occurring in other east coast areas could impact the entire area. Damages would be consistent with those effects realized in other areas – structural damage to buildings, roadways and underground utilities. Cascading effects could impact major systems within the jurisdictions. On August 23, 2011, a 5.8 quake centered in Mineral, Virginia, was felt across Durham County. Felt effects ranged from 3.9 in the North to 3.0 in the southern part of the County. No local damages were reported.

The risk for earthquakes in North Carolina is mostly moderate. Given this and past recorded events, a future event in Durham County could have an intensity of VI (Strong – Modified Mercalli Scale).

Wildfire:

A wildfire is an uncontrolled burning of grasslands, brush or woodlands. According to information provided by FEMA, people start more than four out of every five forest fires. Negligent human behavior such as smoking in forested areas or improperly extinguishing campfires is the cause of many fires. The other cause of forest fires is lightning.

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. *(http://www.ncem.org)*

A **wildland fire** is a wildfire in an area which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An **urban-wildland interface fire** is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels*. (NCEM: Keeping Natural Hazards From Becoming Disasters, May 2003)*

There are three different classes of wildland fires. A **surface fire** is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A **ground fire** is usually started by lightning and burns on or below the forest floor. **Crown fires** spread rapidly by wind and move quickly by jumping along the tops of trees. Wildland fires are usually signaled by dense smoke that fills the area for miles around. *(www.fema.gov)*

All of North Carolina is susceptible to wildfire; however, according to the NC Division of Emergency Management, Durham County is at "low" risk. Although wildfires are possible throughout the year, normal fire season peaks for central North Carolina are in the spring and fall months.

According to information attained from the NC Division of Forestry Resources for 2002, Durham County has 186,000 total acres. Of these 84,000 is classified as forestland. Therefore, 45% of the total land within Durham County is forest. Of these forest lands, 82,100 are privately owned; Federal government owns 5,300; State government owns 5,300; County and municipal governments own 5,300; and no property is owned by the forest industry;

From 2000-2010, Durham County reported no loss of life or property as a result of wildfires. A five-year summary (2003-2008) of wildfires in Durham County, by cause is provided below:

Table 11: 5-Year Record of Wildfires in Durham County

Five Year Summary of Wildfires in Durham County, By Cause		
Cause	**2008 Numbers**	**Average Number / 5 years**

Lightning	**0**	**0**
Campfire	**0**	**1**
Smoking	**1**	**5**
Debris	**6**	**11**
Incendiary	**6**	**7**
Machine Use	**2**	**1**
Railroad	**0**	**0**
Children	**2**	**3**
Miscellaneous	**1**	**6**
Total # of Fires	**18**	**34**

(NC Forest Service, Division of Forest Resources, *www.dfr.state.nc.us/contacts/durham.htm*)

There is a total of 84,000 acres of wild land in Durham County, which would be the total area damaged by a wildfire in a worst case scenario.

Dams/Levees

There are about 80,000 dams in the United States today, the majority of which are privately owned. Other owners are state and local authorities, public utilities, and Federal agencies. The benefits of dams are numerous: they provide water for drinking, navigation, and agricultural irrigation. Dams also provide hydroelectric power and create lakes for recreation. Most important, dams save lives by preventing or reducing floods.

If dams have many benefits, they also can pose a risk 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 loss of life and great property damage if there are people downstream of the dam. The National Dam Safety Program is dedicated to protecting the lives of American citizens and their property from the risks associated with the development, operation, and maintenance of America's dams. *(*http://www.fema.gov/plan/prevent/damfailure/ndsp.shtm*)*

A dam/levee is a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. *(FEMA, 1997)* Dams are typically constructed of earth, rock, concrete, or mine tailings. The North Carolina Dam Safety Program within Land Resources of the NC Department of Environment and Natural Resources defines event types of dams/levees within North Carolina:

Earth Dams
- Majority of dams/levees in North Carolina
- Safe if property designed, constructed, and maintained
- Not designed to be overtopped

Concrete Gravity
- Mass utilized to resist sliding and shape to resist overturning
- Used where a strong foundation is present
- Relatively resistant to overtopping and seismic events

Arch Dams
- Used to narrow sites with strong abutments
- Use less concrete than gravity dams & increase over the top spill capacity
- More difficult to design and construct than gravity dams

Gravity Arch
- Conservative design but uses more concrete

Buttress

- Requires a strong foundation but resistant to sliding, overturning, and overflowing
- Conserves concrete, but difficult to design and construct

Hazard Rating:

The NC Dam Safety Program classifies dams into three hazard categories within the state:

Low Hazard (Class A)

Failure of the dam would not be expected to result in loss of life, but may damage uninhabited low value non-residential buildings, agriculture land, or low volume roads.

Intermediate Hazard (Class B)

Failure of the dam would not be expected to result in loss of life, but may damage moderately traveled roads, interrupt use or service of public utilities, and may cause minor damage to isolated homes, commercial or industrial buildings in back water areas.

High Hazard (Class C)

Failure of the dam would likely cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, and heavily traveled roads.

It has been estimated that a future event in Durham County would have a magnitude of a High Hazard Potential.

North Carolina
Department of Environment and Natural Resources

The Division of Land Resources

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Dam Hazards Classification

Site Map

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

NOTE: Cost of dam repair and loss of services should be included in economic loss estimate if the dam is a publicly owned utility, such as a municipal water supply dam.

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Hazard Impacts:

Several of the 15 natural hazards identified by the State of North Carolina impact both masonry and earthen dams. These hazards focus on water hazards and include riverine flooding, dam and levee failure, and frozen precipitation hazards. In a meeting with representatives from Duke Energy, drought was also identified as a hazard of concern for dams. This is due to the need for a steady flow of water, which allows masonry dams to continue operations. Dams are not susceptible to several of the 15 identified hazards due to mitigation factors incorporated in construction. Of the 15 natural hazards identified by the State of North Carolina, an earthquake is the most hazardous to a dam. An earthquake of significant magnitude can cause structural damage that result in failure of the dam. Because a dam failure could be a major catastrophe and has the potential to cause property damage and loss of life, dams have undergone much scrutiny to ensure their continued safe operation.

The major hazard affecting dams is river flooding that generates more water than a dam can handle. Dam operators mitigate this type of hazard by releasing enough water to ensure the dam does not fail. Landslides could also be a concern because water releasing mechanisms can become blocked, causing water in the impoundment area to threaten the structural integrity of the dam.

DAMS IN DURHAM COUNTY

Although it is possible that a dam failure incident could occur within the boundaries of Durham County or the Municipality, the threat is relatively low. In the past there have been no reported injuries or deaths resulting from dam failures and no significant loss of property. Two farm dams failed as a result of heavy rains from Hurricane Fran in 1996.However, as the population grows and development continues the potential for future losses will rise.

The following table gives a breakdown of the number and types of dams located within the County/City boundaries:

Table 12: Dams in Durham County by Classification

Durham County Dam Classification Listing				
State Classification	**Class A**	**Class B**	**Class C**	**Total**
Number	42	18	24	84

As of August 10, 2009, the Department of Environment and Natural Resources lists 84 structures on the Dam Inventory List for all of Durham County. Many of these structures are in very rural areas with minimal risk to the public at large. Those identified by the state as being of low hazard have not been included in this analysis. However, within the County, 24 structures are deemed high hazard with another 18 identified as being of intermediate hazard. The remaining 42 structures are of low hazard. Those within unincorporated Durham County are depicted on the appropriate Critical Facilities Maps for the designated Geographic Planning Areas.

Dam failure would/could be caused by any of the aforementioned natural hazards. The City of Durham maintains two large drinking water reservoirs created by dams. Both dams are heavily monitored. The City has developed a Dam Safety program to further enhance their preventative maintenance programs for the dams, thus further protecting this critical infrastructure sector. Evacuation plans for the mapped risk areas are being developed (Fall 2011).

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Hazard Vulnerability Assessment

Durham County, and the municipality, following the intent of Senate Bill 300, and the Disaster Mitigation Act of 2000, has assessed their vulnerability to hazards.

The hazards identified include those listed below. Other natural or man-made hazards that could occur in other parts of the country (i.e.: volcanoes, tsunamis, aircraft accidents, etc.) were not analyzed because of (1) the location of our jurisdiction, (2) there was no history of any such occurrence and the likelihood of such an occurrence was less than, 1%, (3) there was no identification in any researched document that such events were ever likely to occur, therefore, the Hazard Mitigation Task Force felt it appropriate that time and very limited resources be used to identify and analyze those realistic hazards listed below.

Hazards were identified based upon (1) local reports, (2) state records, (3) Federal agency records, and (4) input from local staff, elected officials, administration, local volunteer response personnel and the public.

Assessing Risk: Risk for each identified hazard has been assessed across the entire jurisdictional area. Due to the nature of these hazards, all areas of the County and City have the potential to be affected to some degree. While only certain areas are in mapped flood hazard zones, any part of the jurisdiction could be impacted by locally heavy rain. Some areas have more trees and could, therefore, be impacted more by wild fire since both jurisdictions place great importance on retaining trees and natural ground cover. Therefore, risk is assessed across the entire jurisdictional area.

Table 13: Durham County Hazard Index

Levels = 5 High, 4 Moderate, 3 Moderate, 2 Low, 1 Low

DURHAM COUNTY THREAT / HAZARD INDEX	Potential / Probability for future occurrence	Potential Impact (Catastrophic, Critical, Limited, Negligible)	Risk Area (Countywide includes the Municipality)	Conclusion Rating (for planning purposes only)
Dam Failure	1	4	1	6
Drought	2	2	2	6
Earthquake	2	2	2	6
Floods	3	1	1	5
Forest Fires	4	2	1	7
Hurricanes	2	2	3	7
Severe Thunderstorms / Wind/Hail	4	3	1	8
Tornadoes	4	3	1	8
Winter Storms	3	2	2	7

Assessing Vulnerability: The hazards described in this plan generally impact large areas and cross jurisdictional boundaries, leaving all existing and future buildings, facilities, and populations exposed to the impact of this hazard. Given its inland location, the region would be expected to experience a lesser intensity impact than that of coastal areas. However, all areas of the county are still considered at risk. Many hazards, such as hurricanes and thunderstorms, can cause damage through numerous additional hazards such as flooding, erosion, high winds and precipitation, thus it is difficult to estimate total potential losses from these cumulative effects. Nevertheless, Table 14 lists the total number of structures located in the mapped hazard areas of both jurisdictions adopting this plan. In this assessment, all of the

structures in each jurisdiction are considered especially vulnerable to flood hazards described in the plan. Future development of areas within the mapped hazard areas is restricted based upon floodplain regulations within local ordinances and Federal guidelines.

Table 14: Structures* in the Mapped Floodplains

Hazards Areas	Building Count	Parcels	Total Properties	Property Value**
Flood zones: A, AE, AEFW, AO	2197	1474	1590	$1,199,893,676
500 Year Flood Area – Shaded X	558	468	530	$377,606,391
1% Future Conditions Area	186	166	189	$138,910,242

*The building counts above are estimates derived by GIS overlay techniques using City of Durham maintained building footprints, building footprints supplied by NC Floodplain Mapping, and State supplied FEMA flood hazard data. Based on the available data, it is impossible to determine the exact use of the identified structures. These numbers are estimates, based on best available data, and should be treated as such.

**Values are derived from Durham County tax records for parcels affected. These values only reflect total parcel value, not necessarily how much of the structure situated on said parcel would actually be damaged by flooding.

Hazard Vulnerability Assessment

Dams:

As of August 10, 2009, the Department of Environment and Natural Resources lists 84 structures on the Dam Inventory List for all of Durham County. Many of these structures are in very rural areas with minimal risk to the public at large. Those identified by the state as being of low hazard have not been included in this analysis. However, within the County, 24 structures are deemed high hazard with another 18 identified as being of intermediate hazard. The remaining 42 structures are of low hazard. Those within unincorporated Durham County are depicted on the appropriate Critical Facilities Maps for the designated Geographic Planning Areas.

Dams listed by FEMA in Durham County

Identification Number	Dam Name	Surface area	Across – body of water
DURHA-001	Crystal Lake Dam	9.0	Eno River-Tr
DURHA-002	Quail Roost Lake Dam #2		Mountain Creek-Tr
DURHA-003	Quail Roost Lake Dam #3		Mountain Creek-Tr
DURHA-004	Quail Roost Lake Dam #1	4.0	Mountain Creek
DURHA-005	Newcomb Lake Dam	20.0	Seven Mile Creek
DURHA-006	Lakewinds Dam	11.0	Flat River-Tr
DURHA-007	Mcfarland Lake Dam	7.0	Flat River-Tr
DURHA-008	Lake Michie Dam	460.0	Flat River
DURHA-009	Sykes Lake Dam	13.0	Cabin Branch-Tr
DURHA-010	Hester Pond Dam #2		Camp Creek-Tr
DURHA-011	Hester Lake Dam #1	6.0	Camp Creek-Tr
DURHA-012	Allen Lake Dam	8.0	Northeast Creek-Tr
DURHA-013	Twin Lake Dam #1	10.0	Little Lick Creek-Tr
DURHA-014	Twin Lake Dam #2	10.0	Little Lick Creek-Tr
DURHA-015	Bailey Lake Dam		Little Lick Creek-Tr
DURHA-016	Little Lake Unity Dam		Chunky Pipe Creek-Tr
DURHA-017	Lake Unity Dam		Chunky Pipe Creek-Tr
DURHA-018	Petty Lake Dam		Neuse River-Tr
DURHA-019	Lake Shore Dam	19.0	Stirrup Iron Creek-Tr
DURHA-020	Durham Wildlife Club Lake Dam	9.0	Kit Creek-Tr
DURHA-021	Lake Elton Dam	13.0	Northeast Creek-Tr
DURHA-022	Parkwood Lake Dam	25.0	Northeast Creek
DURHA-023	Lakehurst S/D Dam	5.0	Northeast Creek-Tr
DURHA-024	Straford Lake Dam #2	6.0	Third Fork Creek-Tr
DURHA-025	Straford Lake Dam #1	6.0	Third Fork Creek-Tr
DURHA-026	Cook Lake Dam	6.0	Third Fork Creek-Tr
DURHA-027	Eden Lake Dam	15.0	Little River-Tr
DURHA-028	Matthews Pond Dam	0.8	New Hope Creek-Tr
DURHA-029	Matthews Lake Dam	12.0	New Hope Creek-Tr
DURHA-030	Few Lake Dam	6.0	New Hope Creek-Tr
DURHA-031	Bay Meadows Lake	8.0	Morgan Creek-Tr

	Dam		
DURHA-032	Thompson Lake Dam		Little Creek-Tr
DURHA-033	Clark Lake Dam	4.0	New Hope Creek-Tr
DURHA-034	Cole Lake Dam	9.0	Eno River-Tr
DURHA-035	Willowhaven Lake Dam #2	7.0	Seven Mile Creek
DURHA-036	Willowhaven Lake Dam #1	5.0	Eno River-Tr
DURHA-037	Chandler Lake Dam	4.0	Little Lick Creek-Tr
DURHA-038	General Electric #1 Dam	3.0	Stirrup Iron Creek
DURHA-039	General Electric Dam #2	8.0	Stirrup Iron Creek
DURHA-040	Van Trine Lake Dam	2.0	New Hope Creek-Tr
DURHA-041	Quail Roost Fox Hound Lake Dam #1	2.0	Mountain Creek-Tr
DURHA-042	Quail Roost Fox Hound Lake Dam #2	2.0	Mountain Creek-Tr
DURHA-043	Quail Roost Fox Hound Lake Dam #3	2.0	Mountain Creek-Tr
DURHA-044	Dairy Pond Dam	3.6	Eno River-Tr
DURHA-045	Boles Lake Dam	6.4	Eno River-Tr
DURHA-046	Little River Dam		Little River
DURHA-048	Georgiade Dam	2.0	Sandy Creek-Os
DURHA-053	Page Dam	4.0	Lick Creek-Tr
DURHA-054	Perry Dam	3.5	Laurel Creek-Tr
DURHA-055	Edwards Pond Dam	1.5	Northeast Creek-Tr
DURHA-062	Spring Hill Dam		New Hope Creek-Tr
DURHA-067	I B M Pond Dam		Burden Creek-Tr
DURHA-068	Sykes Pond Dam		Stirrup Iron Creek-Tr
DURHA-069	Cotton Pond Dam		Stirrup Iron Creek-Tr
DURHA-070	Cornwall Pond	4.0	Lick Creek-Tr
DURHA-071	Parrish Pond Dam		Little Briar Creek-Tr
DURHA-089	Baldwin Dam		Ellerbe Creek-Tr
DURHA-092	John Shaw Pond	5.0	Lick Creek-Tr
DURHA-098	Jordan Dam	3.0	Dial Creek-Tr
DURHA-102	Waller Pond Dam	1.0	Mud Creek-Tr
DURHA-103	Page Dam	3.0	Little Briar Creek-Tr
DURHA-104	Stone Throw Apartments Pond Dam		Burdens Creek-Tr
DURHA-105	Niehs Lake Dam		Burdens Creek-Tr
DURHA-106	Eno West Point Dam		Eno River
DURHA-107	Infinity Rd Raw Water Res.	10.0	Cabin Branch-Tr
DURHA-108	Weaver Pond Dam		Ellerbe Creek-Tr
DURHA-109	Wrightenberry Pond Dam	4.0	Little Lick Creek-Tr
DURHA-110	R.L. Hicks Dam	3.0	Little Lick Creek-Tr
DURHA-111	C.B. Weatherly Pond	3.0	Lick Creek-Tr
DURHA-112	Hardscrabble Dam		Little River-Tr
DURHA-113	WDNC Dam	2.0	Ellerbe Creek
DURHA-114	Grove Park Dam		Crooked Creek
DURHA-115	N. Durham Quarry		

	East Dam		
DURHA-116	N. Durham Quarry West Dam		
DURHA-117	Hock Dam		Eno River-Tr
DURHA-118	Oxford Commons Dam		Eno River-Tr
DURHA-119	Glaxo Dam		Northeast Creek-Tr

Hazard Vulnerability Assessment

Drought:

Since 1999 Durham County, as well as the majority of North Carolina cities and towns, has faced a moderate to severe drought.

Drought has several meanings. Generally, drought reduces the amount of water available for agriculture, municipality, industry, commerce, tourism, fire suppression, and wildlife. Reduction of electrical power generation and water quality deterioration is likely.

As drought continued in North Carolina into the summer of 2002, it led to a declaration of disaster for agriculture drought. This led to funding becoming available for many farmers in the form of Small Business Administration low interest loans.

The Drought Management Advisory Council, a council of various state agencies, is organized to coordinate activities of state agencies in the assessment and the response to drought and activities the Drought Assessment and Response Plan, a part of the North Carolina Emergency Operations Plan. The Agriculture Assistance Act of 2003 *may* provide assistance to the agriculture community during times of crop or livestock losses during drought periods.

Drought effects are often severe. Drought can last for extended periods and drought effects all citizens, businesses and government. Durham County government has the authority to restrict use of certain water resources.

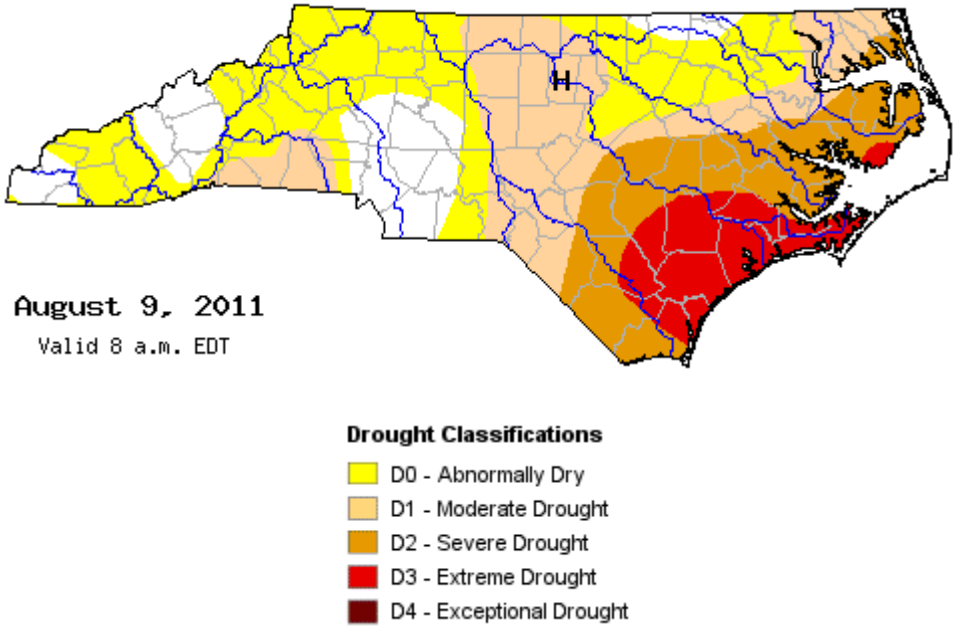
***Population**

Population	Per Capita Income	Total damages/costs in previous 10 year period
267,593	**27,698.00**	**$0.00**

** Estimated potential economic impact from a catastrophic, prolonged meteorological, agriculture, hydrological or socioeconomic drought.

EVENT	COST
Structural Damage (generally due to loss from fire or abandonment)	$13,440,000
Non-structural (i.e. crop damages, livestock losses, etc.)	$8,800,000
Contents	$1,000,000
Lost inventory (livestock losses, business losses – fire)	$3,050,000
Capital losses	$2,750,000
Wages lost (fire, agriculture loss, abandonment	$7,500,000
Water demand increased costs ($)	$6,282,279
Total Potential Losses	**$42,726,279**

($) Highest 25% of Water Bills for Households with Median Income



* Avg. income = **27,698**. Avg. household expense water = 1.0% $276.98 per annum) based on a median cost increase per household of 2.5% (Source: *Public Utility Consulting Selinsgrove,* PA)
**Based upon total tax value at a maximum loss of 1% of total tax value or actual estimated losses
*** NCDC and NOAA 2002

Hazard Vulnerability Assessment

Earthquakes:

Earthquakes are relatively infrequent but not uncommon in North Carolina. Earthquakes are also unpredictable. From 1568 to 2003, 159 earthquakes have occurred in North Carolina. North Carolina is affected by both the New Madrid fault in Missouri and the Charleston fault in South Carolina. Both of these faults have generated Earthquakes measuring greater than 8 on the Richter scale during the last two hundred years. Durham County has experienced at least three earthquakes and has been in proximity to others. While no significant damages have ever been recorded in Durham County, the proximity to earthquakes faults makes Durham County, as well as all the municipalities vulnerable to such damages.

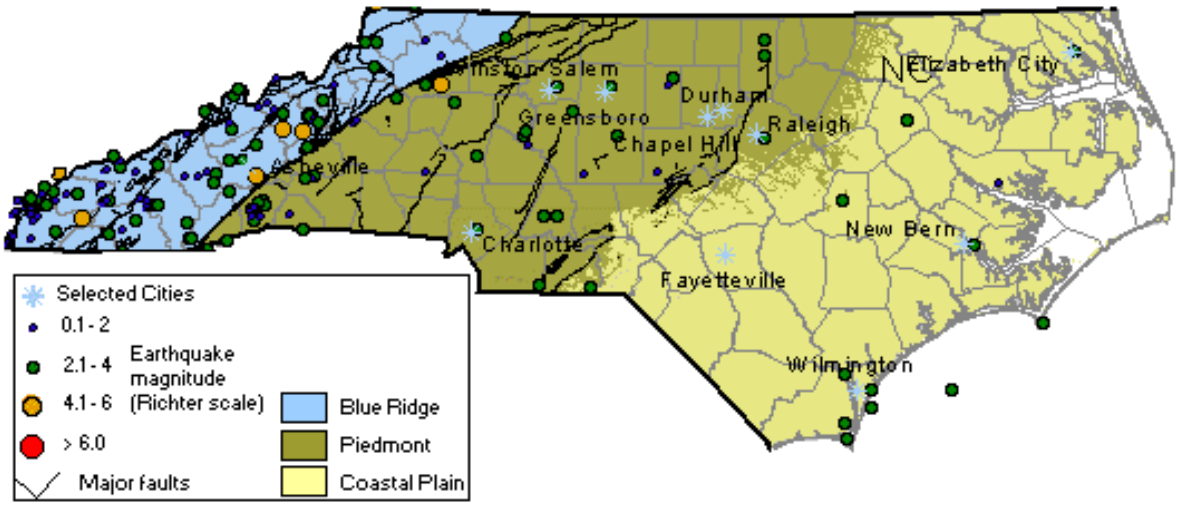
Note: An Earthquake's severity is expressed in both magnitude and intensity. The two terms are sometimes confused for one another. Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is measured using the Richter Magnitude Scale. Intensity is based on the observed effects on the earth's surface such as ground shaking or a building moving. These effects vary according to your location relative to the epicenter. Intensity is measured using the Modified Mercalli Intensity Scale.
The following is an abbreviated description of the 12 levels of Modified Marcalli intensity.

1.	Not felt except by a very few under especially favorable conditions.
2.	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
3.	Felt quiet noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
4.	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
5.	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned.
6.	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
7.	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
8.	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
9.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
10.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rail bent.
11.	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
12.	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Recent earthquake activity in North Carolina:

DATE	LOCATION	DESCRIPTION	Mag
July 7, 2001	Swain County (2 miles SW of Cherokee)	Shaking felt, no damage recorded	2.4
July 9, 2001	Swain County (4 miles SW of Cherokee – between Cherokee & Bryson City)	Shaking felt, no damage recorded	2.4
July 9, 2001	Swain County (4 miles SW of Cherokee)	Shaking felt, no damage recorded	1.5
July 10, 2001	Swain County (4 miles SW of Cherokee)	Shaking felt, no damage recorded	2.3
May 8, 2002	Swain County (7 miles WSW of Bryson City)	No damage recorded	2.0
July 10, 2002	Swain County (7 miles WSW of Bryson City)	No damage recorded	2.0
September 8, 2002	Madison County (4 miles north of Marshall)	No damage recorded	2.2
April 29, 2003	Alabama (4 miles S of Mentone, AL/41 miles SSW of Chattanooga, TN)	Shaking felt as far east as Caldwell County	2.4
December 9, 2003	Richmond, Virginia (Approx 30 miles west of Richmond)	Shaking felt as far south as Orange County	4.5

Seismic Information By Region, North Carolina
(Image courtesy: North Carolina Geological Survey)



Potential Economic Impact in Durham County (including municipality) from a greater than 6.0 (Richter scale) earthquake **

EFFECT	LOSS
Structural Damage	$56,330,000
Non-structural (i.e. power distribution systems, etc.)	$179,470,000
Contents	$74,670,000
Lost inventory	$3,930,000
Relocation losses (cost of relocating population)	$57,640,000
Capital losses	$26,200,000
Wages lost	$31,440,000
Retail income losses	$22,270,000
Total Potential Losses	**$451,192,000**

*Source – NC Department of Commerce Economic Development Information System
** HAZUS information Data base – FEMA – Dunn and Bradstreet 1994. Adjusted to 2002 by 31%. Worst-case scenario.

Hazard Vulnerability Assessment

Flooding:

Durham County and the municipality have all experienced the effects of flooding. Fortunately there are only a handful of areas that are subject to routine, repetitive, flash flooding and in these areas there are no known residential or commercial structures at this time.

To examine its vulnerability to flooding and make an appropriate assessment, the County and the municipality choose several sources for information. One is the HAZUS program offered by FEMA. HAZUS provides a computer model whereby certain data can be obtained based on local conditions. The flood loss estimation methodology consists of two basic analytical processes: flood hazard analysis and flood loss estimation module. Physical damage and economic loss is calculated based on the results of the hazard analysis. Another method was to examine currently available FIRMs (Flood Insurance Rate Maps) also provided by FEMA. The FIRM maps are available from Durham County GIS and were instrumental in providing data for the number of structures likely to be affected. This floodplain layer was then used to input data into the damages model. The results are listed below.

ZONE	DESCRIPTION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AE	Base flood elevations determined
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined
ANI	Area not included. No flood hazard data available
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one (1) square mile; or areas protected by levees from the base flood.
C	Areas of minimal flooding
D	Areas of undetermined, but possible, flood hazards
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined
X	Areas determined to be outside 100-year flood plain.
X1-X30	Areas of 500-year flood; areas of 100-year flood with average depths of less than one (1) foot.

For the purposes of planning, the vulnerability assessment to this hazard used Durham County GIS and the contour layer. Using this system allowed access to a footprint of every structure currently on maps and currently located in the flood plain. To be of maximum benefit to Durham County it was felt that listing structures by road name would be best. Emergency services may then use this information to enhance warning systems of persons in affected areas. Enhancement of that warning system, however, is not part of this analysis. There may be overlaps in population because a number of these waterways merge at various points. The Eno River flows through the County from West to East. The Eno and several tributaries feed Lake Michie, the Little River Reservoir, and Falls Lake – all of which are part of

the drinking water supply system. They also feed into the Neuse River Basin. On the South side of the County, the New Hope Creek and several tributaries feed Lake Jordan, which is part of the Cape Fear River Basin. All river levels are controlled by dams and flood gates. Therefore high water flooding in these areas is unlikely. Still, they are considered as having a potential threat from flooding. The majority of structures and population that could potentially be affected fall into this category. Digital images of the Durham County 100-year flood plain. FEMA Flood Insurance Rate Maps (FIRMs) are available from FEMA, Durham County Emergency Management and the Durham Planning Department.

Hazard Vulnerability Assessment

Wildfires/Forest Fires:

A wildfire is an uncontrolled burning of grasslands, brush or woodlands. According to information provided by FEMA, people start more than four out of every five forest fires. Negligent human behavior such as smoking in forested areas or improperly extinguishing campfires is the cause of many fires. The other cause of forest fires is lightning.

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. *(www.ncem.org)*

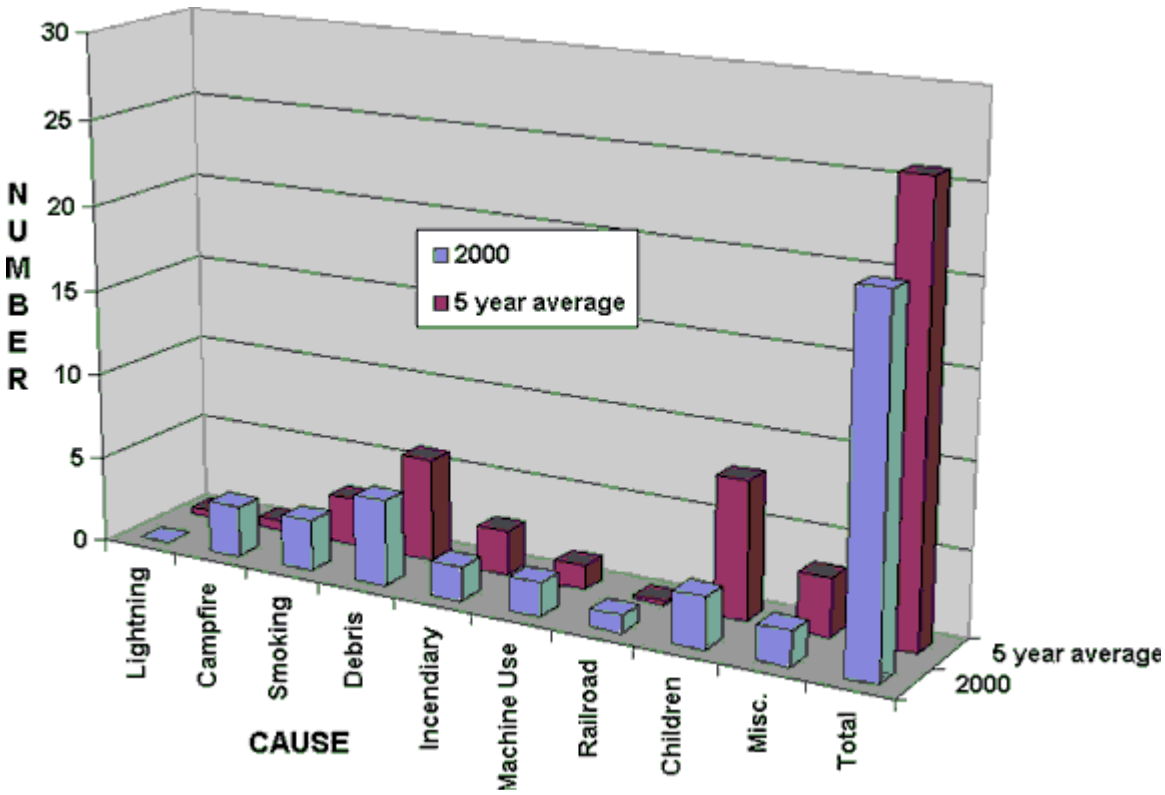
A **wildland fire** is a wildfire in an area which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An **urban-wildland interface fire** is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels*. (NCEM: Keeping Natural Hazards From Becoming Disasters, May 2003)*

There are three different classes of wildland fires. A **surface fire** is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A **ground fire** is usually started by lightning and burns on or below the forest floor. **Crown fires** spread rapidly by wind and move quickly by jumping along the tops of trees. Wildland fires are usually signaled by dense smoke that fills the area for miles around. *(www.fema.gov)*

All of North Carolina is susceptible to wildfire; however, according to the NC Division of Emergency Management, Durham County is at “low” risk. Although wildfires are possible throughout the year, normal fire season peaks for central North Carolina are in the spring and fall months.

According to information attained from the NC Division of Forestry Resources for 1990, Durham County has 186,538 total acres. Of these 89,242 is classified as forestland. Therefore, 48% of the total land within Durham County is forest. Of these forest lands, 73,928 are privately owned; 235 acres are owned by the forest industry; Federal government owns 7,891; state government owns 4,556; and County and municipal government own 2,632.

From 1996-2000, Durham County reported no loss of life or property as a result of wildfires. A five-year summary (1996-2000) of wildfires in Durham County, by cause is provided below:



Five Year Summary of Wildfires in Durham County, By Cause		
Cause	**2000 Numbers**	**Average Number / 5 years**
Lightning	**0**	**0.4**
Campfire	**3**	**0.6**
Smoking	**3**	**2.8**
Debris	**5**	**6**
Incendiary	**2**	**2.6**
Machine Use	**2**	**1.4**
Railroad	**1**	**0.2**
Children	**3**	**8**
Miscellaneous	**2**	**3.4**
Total # of Fires	**21**	**4.2**

(NC Forest Service, Division of Forest Resources, *www.dfr.state.nc.us/contacts/durham.htm*)

NCDFR FIRE CONTROL

The Division of Forest Resources has the responsibility for protecting state and privately owned forestland from forest fires. The program is managed on a cooperative basis with the counties. All one hundred counties participate in the forest fire protection Program. Emphases in the fire program include fire prevention Efforts; pre-suppression activities (including extensive training of Division and non-Division personnel); aggressive suppression efforts on all wildfires; and law enforcement follow-up.

Staff assistance in forest fire control is provided to the field units by the Forest Protection Section Fire Staff, consisting of a program Head, Senior Staff Forester for Training, Staff Forester for Operations & B.R.I.D.G.E, Staff Forester for Research and Development and a Law Enforcement Staff of four investigators.

The Division has a very extensive training program in forest fire protection. The National Interagency Incident Management System (NIIMS) training courses are used in all fire organization and fire behavior training. The Incident Command System (ICS) is used to organize and manage all forest fires. The ICS is an all risk organization designed to organize and manage all natural and man-caused disasters other than wars and civil disturbances. Maintaining a well trained, proficient forest fire control organization is very similar to maintaining a well-trained Army. New personnel are constantly being trained to replace veterans that are retiring or leaving the program due to promotions, transfers, or disability. Veteran fire fighters periodically undergo refresher training in suppression tactics, strategy, organization, and management.

Hazard Vulnerability Assessment

Hurricanes:

Durham County, and its municipality' have all experienced the inland effects of hurricanes. Perhaps the most memorable hurricane to directly affect the area was Hurricane Hugo in 1989. Other storms however have had other impacts ranging from flooding to "spin-off" tornadoes, storm surge, high winds and tropical storms and depressions. Generally these storms effect the entire population. Past effects have been direct devastation to homes and business as well as public buildings and utilities. Hurricane Hugo resulted in structural and non-structural (i.e. power distribution system) damages over $8 million dollars. Although no deaths have been recorded in Durham County as a direct cause of a hurricane, most deaths that occur from hurricanes occur from inland flooding. Freshwater floods accounted for more than half (59% of U.S. hurricane deaths over the past 30 years. Those floods are why 63% of U.S. hurricane deaths during that period occurred in inland counties.

This vulnerability assessment assumes worst case, Category 5 hurricane that travels the entire length or width of the County:

***Population**

Population	Per Capita Income	Average Housing value (2000)	Historical storm losses
267,593	27,698.00	$144,500.00	$0.00

** Potential Economic Impact from a Category 1 hurricane, or equivalent wind event 20% population affected

Structural Damage	$56,330,000
Non- structural (i.e. power distribution systems, etc.)	$179,470,000
Contents	$74,670,000
Lost inventory	$3,930,000
Relocation losses (cost of relocating population	$57,640,000
Capital losses	$26,200,000
Wages lost	$31,440,000
Retail income losses	$22,270,000
Total Potential Losses	**$451,192,000**

*** **Potential Debris generated from a Category 1 hurricane or equivalent wind event.**

TOTAL CUBIC YARDS	435,831
Total Acres needed to bury	45
Storage acres needed	27
Processing acres needed	18
Woody Debris (cubic yards)	130,749
Construction and demolition debris (cubic yards)	305,082
Burnable debris (cubic yards)	128,134
Soil debris (cubic yards)	15,254
Metals (cubic yards) – possible recycle	45,762

Land filled debris (cubic yards)	115,931
Minimum cubic yards potential (+/- 30%)	**305,082**
Maximum cubic yards potential (+/- 30%)	**566,580**

Source – NC Department of Commerce Economic Development Information System
** HAZUS Information Data base – FEMA – Dunn and Bradstreet 1994. Adjusted to 2002 by 31%. Worst-case scenario.
*** Debris management program mathematical formulas – FEMA – NCDEM – GCEM – 1999.

Hazard Vulnerability Assessment

Severe Thunderstorms:

Thunderstorms are underrated in the damage, injury, and death they can bring. Lightning precedes thunder because lightning causes thunder. As lightning moves through the atmosphere, it can generate temperatures up to 54,000 degrees Fahrenheit. This intense heating generates shockwaves, which turn into sound waves, thus generating thunder.

Warm, humid conditions encourage thunderstorms as the warm, wet air updrafts into the storm. As warm, moisture rich air rises; it forms cumulus nimbus clouds, thunderstorm clouds, usually with a flattened top or an anvil shape, reaching to 40,000 feet or more. If this air is unstable, the conditions are then there to cause hail, damaging winds and tornadoes.

As a thunderstorm grows, electrical charges build up within the clouds. Oppositely charged particles exist at the ground level. These forces become so strong that the air's resistance to electrical flow is overcome. The particles from both top and bottom then race towards each other to complete a circuit. Charge from the ground then surges upward at nearly one third the speed of light to produce lightning.

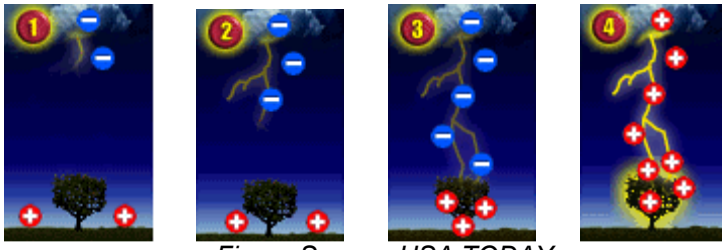


Figure Source: USA TODAY

Each year lightning kills between 50 and 60 people, mostly during the spring/summer season. Typical thunderstorms last anywhere from ½ to 1 hour. Most lightning strikes occur in the afternoon. 70% occur between noon and 6:00pm. This is because as air temperatures warm, evaporation increases. Sundays have 24% more deaths from lightning than any other day, followed by Wednesday. Lightning reports reach their peak in July.

In North Carolina, 18 deaths were recorded from 2001 – 2010. In the United States, the National Weather Service recorded 3,239 deaths and 9818 injuries due to lightning strikes between 1959 and 1994. Only 20% of lightning strikes cause immediate death. 70% of lightning strike victims that survive experience residual effects, most commonly affecting the brain (neuropsychiatric, visual, and auditory). These effects can develop slowly. Lightning strike victims have typically been walking in an open field or swimming before they are struck. Other lightning victims have been holding metal objects such as golf clubs, fishing poles, hayforks, or umbrellas.

Damage to property from direct or indirect lightning can take the form of an explosion, a burn, or destruction. Damage to property has increased over the last 35 years. This is probably due to increased population. The National Weather Service recorded 19,814 incidents of property damage between 1959 and 1994. Yearly losses are estimated at $35 million by the National Weather Service. This amount is compiled from newspaper reports, but many strikes are not reported. The National Lightning Safety Institute estimates from 2008 indicate that lightning is responsible for more than $5 billion in total insurance industry losses annually (Hartford Insurance Co. source: TMCNet Newsletter). This information is compiled from insurance reports and other sources that keep track of weather damages.

Thunderstorm winds also cause widespread damage and death. Thunderstorm 'straight line' wind occurs when rain-cooled air descends with accompanying precipitation. A thunderstorm is considered severe when winds exceed 57.5mph. At the very extreme, winds of 160mph have been recorded. These winds can smash buildings and uproot and snap trees, and are often mistaken for tornadoes.

'Downbursts' can occur during a thunderstorm. This is an excessive burst of wind that is sometimes confused with tornadoes. These are defined as a surface wind in excess of 125 mph caused by a small-scale downdraft from the base of a convective cloud. A downburst occurs when rain-cooled air within a convective cloud becomes heavier than its surroundings. Since cool air is heavier than warm air, it rushes toward the ground with a destructive force; exactly what triggers the sudden down rush is still unknown.

A downburst appears to strike at a central point and blow outwards. (Picture a bucket of water dashed against grass. If it hits straight on, the grass will be flattened in a circular pattern. If it hits at an angle, the grass will be flattened in a teardrop pattern). Downbursts resulted in 268 deaths and 8 related accidents between 1974 and 1982.

Downbursts can be further classified into two categories:

Microburst: Less than 2 1/2 miles wide at the surface, duration less than 5 minutes and winds up to 146 miles per hour.

Macroburst: Greater than 2 1/2 miles wide at the surface, duration of 5-30 minutes with winds up to 117 miles per hour.
Durham County has experienced severe thunderstorms. Many hazardous weather events are associated with thunderstorms. Fortunately, the area affected by any one of them is fairly small and – most of the time- the damage is fairly light. Lightning is responsible for many fires each year, as well as causing deaths when people are struck. Under the right conditions, rainfall from thunderstorms causes flash flooding. Hail up to the size of softballs damages cars and windows, and kills wildlife caught out in the open. Strong (up to more than 120 mph) straight-line winds associated with thunderstorms knock down trees and power lines. Straight-line winds are often thought to be tornadoes because of their often-violent destruction. Tornadoes (with winds up to about 300 mph) can destroy all but the best-built-man-made structures. Therefore the number of thunderstorms and the potential for a variety of other weather events makes this hazard one of the most potentially devastating.

To a limited degree, potential thunderstorm development is predictable, as is the possible track of storms likely to produce severe thunderstorms, or as depicted, super-cell thunderstorms. The National Weather Service in Greenville/Spartanburg, SC issues thunderstorm watches and warnings. While super-cell storms are very rare, they are possible. It is also possible that a super-cell or other severe thunderstorm can develop and strike any facility, business or residential area. The entire County, including the municipality are vulnerable, as is the entire population. Reasonable expectation however would be for storms of considerably less intensity, resulting in a considerable reduction in the calculations below. This assessment assumes multiple severe thunderstorms producing at least one super-cell producing straight-line winds of maximum magnitude of 120 miles per hour. It should be noted that these damages are approximate to an F2 tornado.

* **Population**

Population	Per Capita Income	Total storm losses in previous 10 year period
267,593	$27,698.00	$324,000.00

**** Estimated / Potential Economic Impact from a catastrophic wind event**

Structural Damage	$18,776,000
Non-structural (i.e. power distribution systems, etc.)	$59,823,000
Contents	$24,890,000

Lost inventory	$1,310,000
Relocation losses (cost of relocating population)	$19,213,000
Capital Losses	$8,733,000
Wages lost	$10,480,000
Retail income loss	$7,423,000
Total Potential Losses	**$150,648,000**

*** **Estimated / Potential Debris generated from a severe thunderstorm which generates a F2 tornado.**

TOTAL CUBIC YARDS	174,332
Total Acres needed to bury	18
Storage acres needed	11
Processing acres needed	7
Woody Debris (cubic yards)	52,299
Construction and demolition debris (cubic yards)	122,033
Burnable debris (cubic yards)	51,254
Soil debris (cubic yards)	6,102
Metals (cubic yards) – possible recycle	18,305
Land filled debris (cubic yards)	46,372
Minimum cubic yards potential (+/- 30%)	**122,033**
Maximum cubic yards potential (+/- 30%)	**226,632**

****** Potential Death and injury totals in a severe thunderstorm**

Deaths	Serious Injury
50	100

* Source – National Climatic Data Center
** HAZUS Information Data Base-FEMA – Dunn and Bradstreet 1994. Adjusted to 2002 by 31%. Worst-case scenario.
*** Debris Management program mathematical formulas – FEMA – NCDEM – GCEM – 1999
**** Based on historical information 1950 – 2000 – Tornado Project Online (www.tornadoproject.com).

Hazard Vulnerability Assessment

Tornadoes:

Durham County, like much of North Carolina, has had experience with tornadoes in recent history. The most recent outbreak of tornado activity was April 14 – 16, 2011. All tornadoes recorded or suspected in Durham County have been of the F0 and F1 class. Research into tornadoes in Durham County has shown that each "section" of the County (north, south, east and west) has experienced this violent type of storm. History has also shown the type of tornado-experienced displays a narrow path or track with duration of less than one (1) minute. Damage estimates have averaged less than $500,000 per storm. There have been no deaths or serious injuries in the ten-year period.

To a limited degree, the potential for tornado development is predictable, as is the possible track of storms likely to produce tornadoes. The National Weather Service office in Raleigh, watches and warnings.

While F5 Tornadoes are rare, they are possible. It is also possible that a tornado can develop and strike any facility, business or residential area. The entire County, including the municipality are vulnerable, as is the entire population. Reasonable expectation would be for tornadoes of considerably less intensity, resulting in a considerable reduction in the calculations below. A key point to remember is the size of a tornado is not necessarily an indication of its intensity.

This vulnerability assessment assumes worst case (F5) that travels the entire length or width of the County:

* **Population**

Population	Per Capita Income	Total storm losses in previous 10 year period
267,593	$27,698.00	$0.00

** **Potential Economic Impact from an F5 tornado, catastrophic wind event or earthquake**

Structural Damage	$56,330,000
Non-structural (i.e. power distribution systems, etc.)	$179,470,000
Contents	$74,670,000
Lost inventory	$3,930,000
Relocation losses (cost of relocating population)	$57,640,000
Capital Losses	$26,200,000
Wages lost	$31,440,000
Retail income loss	$22,270,000
Total Potential Losses	**$451,192,000**

*** **Potential Debris generated from an F5 tornado or catastrophic wind event.**

TOTAL CUBIC YARDS	435,831
Total Acres needed to bury	45
Storage acres needed	27
Processing acres needed	18
Woody Debris (cubic yards)	130,749
Construction and demolition debris (cubic yards)	305,082
Burnable debris (cubic yards)	128,134
Soil debris (cubic yards)	15,254

Metals (cubic yards) – possible recycle	45,762
Land filled debris (cubic yards)	115,931
Minimum cubic yards potential (+/- 30%)	**305,082**
Maximum cubic yards potential (+/- 30%)	**566,580**

Hazard Vulnerability Assessment

Winter Storms:

Durham County, as well as the municipality, has experienced severe winter storms. Some of the most memorable storms in recent history have been the ***ice storms*** of 1996 and 1998. The storm in 1996 left several thousand citizens without electric power for up to nine days. Shelters were opened and some roads were impassable for up to four days. Considerable disruption to business, industry, schools and government services occurred.

Starting on the evening of Jan. 24, 2000, 20.3 inches of ***snow*** fell at Raleigh-Durham International Airport, setting records for the largest 24-hour snowfall, biggest single storm and the most snow in a month. The buildup of ice and high winds caused trouble with power lines. At 10 p.m., CP&L reported 112,000 outages statewide, mostly in the Sandhills, down from a peak of 166,000. Duke Power had 118,000 customers without power across the state, with more than 10,000 of those customers in Durham and Chapel Hill. Local shelters were opened to the community due to areas being without power for several days.

Human lives are adversely affected by winter storms. Besides cold-weather injuries due to slips and falls, citizens also inappropriately use a variety of heating devices that can and do cause fires. Some even cause toxic fumes to build up in a residence that can lead to death. Inappropriate use of heating and cooking appliances (like charcoal and gas grills) can lead to illness and death.

<u>The entire County and the entire population is vulnerable to a severe winter storm.</u>

* **Population**

Population	Per Capita Income	Historical storm losses – 2001 - 2011
267,593	$27,698.00	$20,000.00

**** Estimated / Potential Economic Impact from catastrophic ice storm**

Structural Damage	$8,776,000
Non-structural (i.e. power distribution systems, etc.)	$18,823,000
Contents	$1,000,000
Lost inventory	$1,310,000
Relocation losses (cost of relocating population)	$2,213,000
Capital Losses	$8,733,000
Wages lost	$10,480,000
Snow and ice removal	$4,500,000
Total Potential Losses	**$55,835,000**

*** **General information regarding deaths from winter storms:**

Winter storms can kill without breaking climatological records. Their danger is persistent, year-to-year. Since 1936 snowstorms have caused, directly and indirectly, about one hundred deaths per year – and a year 200 deaths is not unusual. Of such deaths, usually just over a third are attributed to automobile and other accidents; just less than a third to overexertion, exhaustion, and consequent fatal heart attack; while only about 11% result from exposure and fatal freezing. The remaining number, about 20%, are deaths due to home fires, carbon monoxide poisoning in stalled cars, electrocution from downed wires, and building collapse. Large numbers of snow-related deaths – 345 and 354 – occurred in 1958 and 1960 respectively. About half of these deaths occurred in New England, New York, and Pennsylvania.

* Source – NC Department of Commerce Economic Development Information System
** Source – Durham County FEMA DSRs 94/96 adjusted to 2002 values.
*** Source – NOAA / Sunysuffolk.edu

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Hazard and Vulnerability Mitigation

Coordination, Maintenance and Approval:

Coordination shall be the responsibility of the Durham County Office of Emergency Management. In this role, EM is responsible for organizing meetings and agendas, arranging technical assistance, gathering pertinent documents for distribution and compiling recommendations for the Task Force. The County Emergency Manager serves as the Task Force Chair, unless it is determined that those duties need to be assumed by another member of the Task Force. The Emergency Manager will make the final presentation to the Board of Commissioners and to the City Council for adoption of the Hazard Mitigation Plan. It is the intent of the County and the municipality that this plan be a "living" document that can and will be updated and modified as often as necessary or required.

The plan will be reviewed annually and it shall be the responsibility of the Mitigation Task Force Chair to conduct this review. Administrative changes, wording corrections, hazard analysis or other such portions of the Mitigation Plan, do not require additional action by the County Board of Commissioners or City Council. However, changes that may have a significant impact or significant expenditure of non-budgeted funds may require action by the respective elected bodies. In such cases, it is the responsibility of the Mitigation Task Force Chair to render judgment whether the change or modification to the Hazard Mitigation Plan will require such action. Whenever possible, changes will be made electronically. A signed and dated approval sheet shall accompany each printed copy of the plan. Resolutions of adoption will be kept on file with the County Clerk to the Board of Commissioners and the respective municipal City Clerk. At a minimum, the plan will be updated every five (5) years by the Hazard Mitigation Task Force, and or as required under 44CFR201.6© (4) (i). Plan updates will be submitted to the NC Hazard Mitigation Officer and FEMA for approval.

The public will be kept informed of proposed changes, modifications, reviews and updates to the plan by advertising that such updates, modifications and reviews are being considered. The public will be invited to participate in accord with the open meeting laws of North Carolina. Public comments, suggestions, recommendations and other input will be received by the Durham County Emergency Management Coordinator or during public meetings, as local ordinance requires or as otherwise directed by the elected bodies.

Data Used and legal documents included:

A variety of documents, including legal measures, have been examined and included as part of the overall mitigation plan. Where appropriate, the source of information has been cited and included. To avoid duplicate of documents that currently exist on County or City websites, some of the references below are links to documents on City or County websites. A connection to the Internet *may* be necessary to access these documents. Some files require Adobe Reader to view. Documents listed below were used as reference and research documents. Among those documents are:

Durham County Code of Flood Plain Management
Critical facility and building information
Durham Growth Management Plan
Durham County Zoning Ordinance
Durham County Subdivision Ordinance
Durham County Watershed Protection Ordinance
NFIP (National Flood Insurance Program) maps
North Carolina Administrative Code (15A NCAC 02B.0243)
SBCCI Standard for Flood Plain Management (SSTD 4-89)
NCGS 162B Continuity of Local Government in an Emergency
Federal Requirements for Local Hazard Mitigation Plans (44 CRF 201.6)
NC Mitigation Plan Minimum Requirements 0 NCHMW – NCDEM
Durham County Flood Damage Prevention Ordinance

Durham Zoning Ordinance – Watershed Protection
City Zoning Ordinance
Subdivision Regulations

Data Developed:

Data has been developed via information from the County and municipal Planning Department and other organizations, including FEMA and the North Carolina Division of Emergency Management. The jurisdictions jointly developed information regarding critical facilities. This information included the address, the general function, back-up power availability, and approximate square footage of the main facility as well as approximate replacement cost, including contents. Durham County feels that with this data it can be better prepared to mitigate effects of potential hazards that may affect some or all of the operations of government. Additional data was developed regarding hazards and placed into a hazard matrix that can quickly be examined regarding the potential of the hazard and the efforts that need to be put forward to address each hazard level (high, medium, or low). Supporting information regarding these specific threats was also obtained from local records, map development, data development, Internet sources, the National Weather Service, the State of North Carolina, DOT, Forest Service, FEMA and others.

Vulnerability analysis was conducted with the best possible information available, using a number of sources for information such as HAZUS, NWS, Tornado Project, ChemInfo, HazardPro, Division of Emergency Management and Department of Transportation information. Legal data was obtained from Durham City-County Planning, Durham Code Enforcement, Durham City-county Inspections, and North Carolina General Statues (NCGS), North Carolina Administrative Code and from the codifying agency for Durham County and the respective municipality. Developing this information in a digital format was challenging but with assistance from the various departments including Administration it was carried out. Some legal data was retyped and or excerpted for sake of brevity. The entire mitigation plan was formatted into an interactive digital form and numerous documents that accompany this plan were formatted to operate seamlessly in the plan. This development includes the ability to update the plan and to print copies of the plan or otherwise reproduce it as appropriate as well as placing it on the internet or intranet computer servers, at the discretion of the County and the municipality.

Additional data regarding recommendations for strengthening local law or local building practices have been developed as a part of this plan and upon approval of the Durham County Board of Commissioners and the Durham City Council will become an active part of this plan. As part of the data that was developed, Durham County and municipality have examined their history and records and have determined, based upon this information, that there are known repetitive loss facilities or structures in the flood plain (100 and 500 year). There are no repetitive loss facilities or structures in other hazard concerns identified in this plan.

Durham County and the municipality developed or had developed a number of other documents relative to County and City plans. These included development plans, mitigation plans, growth plans, and projections, demographics and more. Many of these documents are unique to the respective jurisdiction. These documents, either by reference or in their entirety have been included as part of this plan.

Need to modify current measures:

Durham County feels it has strong measures to help mitigate many hazards. Most of these measures are found in local ordinances, North Carolina law or Federal code or regulations. County ordinances have been examined in detail by the Hazard Mitigation Task Force and are found adequate regarding flood damage mitigation, especially the adoption of The Durham County Flood Damage Prevention Ordinance. The County is an active participant in the National Flood Insurance Program (NFIP) (370085). Building codes are rigidly enforced.
There are no known hazardous chemical manufacturing facilities in Durham County. Many facilities (as listed in the Durham County Emergency Operations Plan, LEPC) are users of hazardous materials. Most

facilities involved in such activity or storing hazardous materials are required by the Superfund Authorization and Reauthorization Act (S.A.R.A) Title III to report quantities of such materials. Mitigation efforts have taken place for the past decade to (1) eliminate the use of such chemicals by the manufacturer or (2) encourage the manufacturer to use chemical alternatives that are less injurious and more environmentally favorable. *There is a need to closely monitor the importation of hazardous materials and their use.* Planning is mandated for all extremely hazardous substances reported under Title III. This has been carried out and reviews are held annually with companies that continue the use of such products. Mitigation efforts continue routinely to address this important task of reducing the amount and type of chemicals being used or stored.

At this time Durham County does not have an immediate need to alter its current mitigation measures, however, Durham County will continue its review of legal, regulatory or voluntary measures on an ongoing basis and modifications may be made accordingly. Changes to goals and objectives will be a coordinated effort and based on the planning process outline previously covered in this document. Recommendations for new goals and objectives are found in Mitigation Strategy.

City of Durham. The City of Durham has numerous strong mitigation measures in place and those have been incorporated into Current Mitigation Measures. Durham has gone to great lengths to insure that it has quality hazard mitigation and has developed some initiatives that are unique to the City as well as a joint mitigation strategy to develop and implement those initiatives. It has developed a flood plain management ordinance that is unique to the City. Its Zoning Ordinance, especially Article XII, which provides for Watershed Protection, provides numerous “built-in” mitigation efforts as well as penalties, including total stop work provisions.

City of Durham participates with the County on many levels and one of those is the area of Emergency Management. The Emergency Management coordinator for the County also serves the City. The City has and continues to participate in exercises for preparedness. The City is an active participant in the National Flood Insurance Program (NFIP) (370086) and has adopted a flood damage prevention ordinance that regulates many areas of development and reduces the vulnerability to this particular hazard.

Industries in the corporate limits of Durham that use chemicals, requiring reporting under S.A.R.A. Title III, report this information to Durham County Emergency Management and the Fire Department. There are facilities that report as EHS (extremely hazardous substances) facilities. These facilities are listed in the Durham County Emergency Plan and contingency plans, as required under Title III, are on file in the office of Emergency Management.

At this time the City of Durham feels that it does not have an immediate need to significantly alter its current mitigation measures. Periodic monitoring and reporting of progress is required to ensure that Plan goals and objectives are kept current and that local mitigation efforts are being accomplished. The Durham County Multi-Jurisdictional Hazard Mitigation Plan shall be reviewed annually, or more often as the local situation may require following a disaster declaration, to ensure that progress is being made on achieving stated goals and objectives. The Plan will also undergo periodic evaluation and updates as required by FEMA and the State.

Annual Review / Progress Report

The Hazard Mitigation Planning Team shall conduct an annual review. The annual review shall include the re-initiation of the hazard mitigation team planning process utilized during development of the plan. The team will include representatives of all affected County and City departments, as well as each of the participating jurisdictions.

The general public will be notified through a variety of media, including but not limited to the local newspaper, the Durham County and City websites, and mailed or emailed notices, of the review process and the opportunity to comment on the Plan review.

The annual review shall ensure:

1. That the Planning Team receives an annual report and/or presentation on the progress of Plan implementation. The report will include a status report on the implementation of mitigation actions.
2. That the County Board of Commissioners and City Council receives an annual report and/or presentation on the progress of Plan implementation along with a recommendation from the Planning Team regarding on-going implementation of the Plan.
3. The annual report will include an evaluation of the effectiveness and appropriateness of the mitigation actions included in the Plan.
4. The annual report will recommend, as appropriate, any necessary revisions or amendments to the Plan.

If the County Board of Commissioners or City Council determines that the recommendations warrant amendment of the Plan, the either board may initiate an amendment through the process described below.

Periodic Plan Review and Update

Periodic evaluation and revision of the Plan will help ensure that local mitigation efforts include the latest and most effective mitigation techniques. These periodic revisions may also be necessary to keep the Plan in compliance with Federal and State statutes and regulations. The Plan will need to be updated to reflect changes, such as new development in the area, implementation of mitigation efforts, revisions of the mitigation processes, and changes in Federal and State statutes and regulations.

In the context of a Federal disaster declaration, State and local governments are allowed to update or expand an existing plan to reflect circumstances arising out of the disaster. An updated plan in this circumstance might include a re-evaluation of the hazards and the jurisdiction's exposure to them, a re-assessment of existing mitigation capabilities, and new or additional mitigation recommendations.

The Plan shall be reviewed at a minimum every five (5) years to determine if there have been any significant changes that would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and changes to Federal or State legislation may affect the appropriateness of the Plan.

The plan will be updated at a minimum every five (5) years and will be forwarded to NCEM and FEMA for review and approval.

Review of the Plan

The procedure for reviewing and updating the Plan shall begin with a report prepared by the County Emergency Management coordinator and submitted to the HMP Planning Team for consideration and recommendation to the elected bodies (City and County). The report shall include a summary of progress

on implementation of hazard mitigation strategies and a recommendation, as appropriate, for any changes or amendments to the Plan.

The review shall include an evaluation of the effectiveness and appropriateness of the Plan. Specifically, the evaluation shall involve a review of the consistency of day-to-day land use decisions to determine if the hazard mitigation policies are being implemented. The review shall recommend if plan amendments are warranted and if any revisions to regulatory tools (zoning, subdivision regulation, etc.) are necessary to assist in implementing the policies of the Plan.

If the elected bodies determine that such report raises issues that warrant modification of the Plan, or if the Planning Team recommends that issues have been raised which warrant modification of the Plan, the elected bodies may initiate an amendment as delineated below, or may direct the HMP Planning Team to undertake a complete update of the Plan.

Procedure for Amending the Plan

An amendment to the Plan shall be initiated by the Board of Commissioners or City Council either at their own initiative or upon the recommendation of the Planning Team, the EM Coordinator, or any other Durham City or County agency who demonstrates that an amendment should be considered.

Upon initiation of a text or map amendment, the EM Coordinator shall re-convene the hazard mitigation planning team and notify other interested parties as described in the Annual Review/Progress Report subsection above. The team will consider any proposed amendment(s) which shall then be forwarded to affected parties, including, but not limited to, County departments, municipalities within the County, and other interested agencies such as the North Carolina Division of Emergency Management, the United States Army Corps of Engineers, and the Federal Emergency Management Agency for a ninety (90) day review and comment period.

At the end of the comment period, the proposed amendment(s) shall be forwarded along with all review comments to the Planning Team for consideration. If no comments are received from the reviewing department or agency within the specified review period, such shall be noted in the report to the Planning Team.

Planning Team Review and Recommendation

The Planning Team shall review the proposed amendment(s), the report and recommendation of the EM Coordinator, and any comments received from other local governments and State and Federal agencies. The Planning Team shall submit a recommendation on the proposed amendment to the Board of Commissioners and City Council within sixty (60) days. Failure of the Planning Team to submit a recommendation within this time period shall constitute a favorable recommendation.

In deciding whether to recommend approval or denial of an amendment request, the Planning Team shall consider whether or not the proposed amendment is necessary based upon one or more of the following factors:

A) There are errors or omissions made in the identification of issues or needs during the preparation of the original Plan;
B) New issues or needs have been identified which were not adequately addressed in the original Plan;
C) There has been a change in projections or assumptions from those on which the original Plan was based.

Board of Commissioners Review and Approval

Upon receiving the recommendation of the Planning Team, the Board of Commissioners and City Council shall hold public hearings. The Boards shall review the Planning Team recommendation (including the factors delineated above), the report and recommendation from the Emergency Management coordinator, and any oral or written comments received at the public hearing. Following that review, the Boards shall take one of the following actions:

A) Adopt the proposed amendment as presented or with modifications.
B) Deny the proposed amendment.
C) Refer the amendment request back to the Planning Team for further consideration.
D) Defer the amendment request for further consideration and/or hearing.

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A community's capability assessment gauges their current position in relation to hazard mitigation as well as their ability to implement future mitigation measures. This section of the hazard mitigation plan evaluates current ordinances, programs, policies, and procedures that relate to hazard mitigation in order to determine a community's strengths and weaknesses. By strengthening exiting policies and programs and/or implementing new ones requires examination of a community's legal, institutional, political, fiscal, and technical capabilities. *(NCDEM: Local Hazard Mitigation Planning Manual, November, 1998)*

Local governments possess only the legal authority that is delegated to them by the state in which they are located. The principle, known as "Dillon's Rule", applies to all political subdivisions in North Carolina. North Carolina grants a wide variety of powers to its local jurisdictions. However, local regulations enacted within the parameters of the State's enabling authority must conform to the constitutional framework, both state and Federal, within which all acts of government must take place. Examples of such limitations include the Fifth Amendment to the United States Constitution and its State counterpart, that require private property be taken for public purposes only after payment of just compensation and the Fourteenth Amendment requiring that all governmental activity be undertaken only within the procedural requirements of due process of law. *(NCDEM: Local Hazard Mitigation Planning Manual, November, 1998)*

All local governments power fall into one or more of the following categories:

- Regulation
- Acquisition
- Taxation
- Spending

Regulatory powers granted by the State to local government include general police power, building codes and inspections, and land use. Land use regulations can be further implemented into zoning, floodway regulation, planning, and subdivision regulation. *(NCDEM: Local Hazard Mitigation Planning Manual, November, 1998)*

The ability of existing policies, ordinances, and programs to help the community achieve its goals and reach its objectives will be the primary tools used to create hazard mitigation projects.

The following table lists the ordinances and policies that are in place in Durham County and the City of Durham at present. These plans, ordinances and policies are the legal authority through which mitigation actions can be taken. Further, these legal authorities are constantly reviewed and updated to incorporate changes required by other laws and regulations, changing community needs and changes driven by hazards within the community.

A stated mitigation goal shall be to include hazard risk assessments that affect mitigation strategies in future updates and revisions of the legal authorities listed below (i.e. Durham Comprehensive Plan, Uniform Development Ordinance, CRS Program).

Review of Policies, Programs, & Ordinances

Community Capability Review	
Jurisdiction	Ordinances, Policies, and Programs
Durham County	• Flood Damage Prevention Ordinance/CRS Program (Appendix B) • Unified Development Ordinance • Soil Erosion & Sedimentation Control Ordinance (Appendix B) • Water Protection Ordinance (Appendix B) • Safe & Sanitary Housing Ordinance (Chapter 6) • Fire Prevention/Hazardous Materials Permitting & Storage (Chapter 16) • Floodplain Management Program (Chapter 16) • Emergency Operations Plan Ordinance (Chapter 10) • Tree-Trimming Programs for Storm Damage Prevention (Appendix A) • Storm Water Management Plan (Chapter 14) • Durham Comprehensive Plan • Use of NC Building Code as standard w/additional more stringent local requirements (Chapter 6)
City of Durham	• Flood Damage Prevention Ordinance (Chapter 24) • Unified Development Ordinance • Soil Erosion & Sedimentation Control Ordinance (Chapter 24) • Water Protection Ordinance (Chapter 24) • Stormwater Management and Pollution Control (Chapter 70, Art.V) • Stormwater Performance Standards for Development (Chapter 70, Art.X) • Safe & Sanitary Housing Ordinance (Chapter 6) • Fire Prevention/Hazardous Materials Permitting & Storage (Chapter 9) • Floodplain Management Program (Chapter 23) • Tree-Trimming Programs for Storm Damage Prevention (Chapter 21) • Use of NC Building Code as standard w/additional more stringent local requirements (Chapter 6) • Durham Comprehensive Plan

The above mentioned ordinances were established to help the communities achieve goals and objectives relative to the health, safety, and welfare of it's citizens, as well as control development. Local ordinances, policies, and programs were not instituted as mechanisms for hazard mitigation projects; however, they have provided a means to create future projects.

The challenge of "strengthening" existing policies, ordinances, and programs is not to improve or increase them, but to clarify, simplify, and prioritize them in a way that placed more emphasis on implementing them. In addition, local programs designed to understand and take advantage of state and Federal funding opportunities should be emphasized. Finally, the appropriation of funds needs to maximize the reduction of costs to the community of future hazards.

As the population grows in Durham County and the City of Durham, hazard mitigation laws must prevent new structures from being built in areas susceptible to unusual occurrences. For example, new building construction in low lying flood areas must be prohibited, limited, or built in such a manner to withstand

flooding. Similarly, future construction sites of industry must have mechanisms in place that will self contain, or significantly limit, effects of potential catastrophic incidents.

Local government and the private sector must provide ongoing training and public information sessions to its citizens. Clear, unbiased, knowledge is a key ingredient for safety enhancement for the public. Ongoing training could include public information notices, ongoing training sessions at local libraries, hospitals, or schools. Part of the cost of this training should be borne by those private parties who ask or have businesses that may contribute to an unusual occurrence. For example, construction of a new electrical substation, a natural gas company building a new facility, a professional dry cleaning establishment, a new gas station, etc. potentially could have impact fees assessed to offset the mitigation training costs.

Training and equipment to prepare for and subsequently resolve hazard situations are necessary and vital. Alternative financial resources must be assessed and located in addition to including these costs in all respective budgets.

Periodic review and revision of the local government ordinances, policies, and programs must occur at least annually.

FORMS OF GOVERNMENT IN DURHAM COUNTY		
Government	**Form of Government**	**Details**
Durham County	**Commissioner-Manager**	**5 Commissioners – Elected At Large Board of Commissioners appoint a County Manager**
City of Durham	**Council-Manager**	**7 Council Members – Elected 3 At Large & 3 Wards plus a Mayor Council appoint a City Manager**

All emergency management operations for Durham County are coordinated through the Durham County Emergency Management Agency. Although the City of Durham may choose to have their own emergency management agency, the coordination of resources during an emergency will be managed through the Durham County Emergency Management Agency. The regulatory authority for emergency management in Durham County is set forth in the Durham County Emergency Management Ordinance and by North Carolina General Statute 166-A.

Technical & Fiscal Capability

The Durham County Emergency Management Agency is the coordinating agency for all resource needs and requests during an emergency or disaster. Emergency plans for the different agencies and department within the County and city are maintained by the Emergency Management Agency. After an emergency or disaster where damage assessment reports are required, the Emergency Management Agency will coordinate with all agencies within the jurisdictions to conduct on-site damage assessments to be forwarded to state or Federal agencies for consideration of a state or presidential declaration. Various agency personnel are utilized to perform the actual assessments to include inspection departments, emergency management staff, fire department personnel, private sector personnel, contract individuals, and/or other County personnel as required.

Durham County Emergency Management Agency also coordinates shelter operations, mass feeding, and evacuation of affected populations during emergencies or disasters. Durham County and the City of Durham stockpile some disaster supplies; however, shelter operations are usually a coordinated effort between County agencies and the local chapter of the American Red Cross.
Durham County maintains the Emergency Operations Plan which sets forth functional responsibilities within the County departments to ensure continuity of government during an emergency or disaster as well as effective emergency response and delivery of necessary services to victims. Activation of the Emergency Operations Plan is the responsibility of the Emergency Management Coordinator or their designee. Normal update of the Emergency Operations Plan occurs every two years or after an

emergency or disaster on an as needed basis. Additionally, Durham County also maintains a local level Resource Manual describing an inventory of all County and/or city resources and equipment that is available for utilization during an emergency or disaster. Local vendors and business information is also contained within the Resource Manual to enable the County and/or city to obtain resources locally when necessary.

Seven (7) fire departments, medical units, and rescue squads serve Durham County. The City of Durham's coverage is provided by the Durham Fire Department 16 fire stations distributed throughout the City. Information provided indicated 2 additional stations are planned for future development.

Community Goals

Durham County and the City of Durham have identified four mitigation goal statements for purposes of the Hazard Mitigation Plan. Each goal is general and broad in nature and will be achieved through long-term implementation of specific objectives. Mitigation objectives and actions determined in the Mitigation Strategies section of this plan will be addressed and evaluated.

Goal #1	Increase Durham County's and the City of Durham's capability to be able to mitigation the effects of natural and technological hazards.

Goal #2	Reduce vulnerability to the impacts of natural and technological hazards by implementing new and maintaining existing County and/or City policies, plans, and ordinances.

Goal #3	Provide more effective and efficient protection for populations and critical facilities by utilizing new and existing technologies and cost effective strategies to implement mitigation projects.

Goal #4	Protecting the community and citizens with the successful implementation of increased public awareness programs and preparedness information to allow personal accountability and responsibility so the public may protect their own health, safety, and welfare.

Goal #5	Hazard risk assessments that affect mitigation strategies will be included in future updates and revisions of the legal authorities (Durham Comprehensive Plan and Uniform Development Ordinance).

COMMUNITY GOALS ANALYSIS

Goals are statements of conditions that are desired to be achieved at sometime in the future. Goals are usually descriptive rather than quantified statements and should be expressed in general terms. A goal is not a tool for achieving something else. Goals should not be negative observations about the community but should be structured as positive statements that are attainable. *(NCDEM: Local Hazard Mitigation Planning Manual, November 1998)*

Reducing risks posed by natural disasters to people and property is the primary goal in hazard mitigation planning. Additionally, Durham County and the City of Durham have included manmade and technological hazards in their mitigation plan. However, goals are best structured when they represent a cross-section of public interests. When hazard mitigation goals are written in this way, it illustrates the ways in which mitigation is intermingled with other public concerns. For example, the goals of a hazard mitigation plan may support such interests as creating open space, preserving natural areas, improving water quality, or sustaining farmland. *(NCDEM: Local Hazard Mitigation Planning Manual, November 1998)*

The goals of Durham County and the City of Durham were reviewed for their relevance to hazard mitigation and are listed in the table below:

COMMUNITY GOALS	
Jurisdiction	**Goals**

Durham County	• Continue participation in the National Flood Insurance and Community Rating System programs • Support the initiatives outlined in the Land Use Plan in regards to zoning, subdivisions, tree-trimming programs, • Administer and enforce soil erosion and storm water ordinances • Ensure the continued safety and integrity of existing housing stock through implementation of the housing ordinance • Continue fire prevention programs and public education • Continue enforcement and implementation of hazardous materials permitting and storage • Protection of roadways, bridges, and other thoroughfares to provide for continuous movement of traffic as needed for effective and unencumbered provision of emergency services • Reduction and mitigation of rainstorm hazards and problems • Collection of flood data information and analysis. Completion of a Countywide database which incorporates a wider range of data for property, topographical, storm drainage, rainfall amounts, building permits, insurance, & history of flooding. • Protection of "critical facilities" vital to public safety and disaster response including Emergency Services structures and all other emergency related equipment and facilities involved with transportation, communication, and energy.
City of Durham	• Continue participation in the National Flood Insurance Program • Support the initiatives outlined in the Land Use Plan in regards to zoning, subdivisions, tree-trimming programs, • Administer and enforce soil erosion ordinance • Reduce fire loss through effective delivery of fire code enforcement services • Ensure the continued safety and integrity of existing housing stock through implementation of the housing ordinance • Continue fire prevention programs and public education • Continue enforcement and implementation of hazardous materials permitting and storage • Protection of roadways, bridges, and other thoroughfares to provide for continuous movement of traffic as needed for effective and unencumbered provision of emergency services • Reduction and mitigation of rainstorm hazards and problems • Collection of flood data information and analysis. Completion of a Countywide database, which incorporates a wider range of data for property, topographical, storm drainage, rainfall amounts, building permits, insurance, & history of flooding. • Protection of "critical facilities" vital to public safety and disaster response including Emergency Services structures and all other emergency related equipment and facilities involved with transportation, communication, and energy.

The Mitigation Planning Committee has developed a goal statement specifically focused on multi-hazards. Durham County and the City of Durham's mitigation goal statement are consistent with the North Carolina Division of Emergency Management's mitigation goals and mission statements.

MISSION STATEMENT
We promote and protect public health, safety, and the environment by identifying natural and technological hazards, increasing awareness of those hazards, and fostering teamwork among public and private agencies to mitigate our vulnerabilities to those hazards.

Although these goals and mission do not address hazard mitigation specifically, mitigation concepts are incorporated and represent the cross-section of public interest that the North Carolina Division of Emergency Management recommends be included in determining hazard mitigation goals. Improved water quality, effective application of technology in public safety, sustainable development, environmental stewardship, storm water management systems, code enforcement, fire prevention programs, and other goals listed all work together to produce jurisdictions that are dedicated to the health, safety, and quality of life for their citizens.

Land Use Overview

The Comprehensive Plan is Durham's statement of how we want to grow and develop. The Plan guides where and how private development should occur. It guides how the City and County should provide public facilities and services to support future growth. The Plan is long range in scope, focusing on the ultimate needs of the community rather than the pressing concerns of today. Chapter 2, the Land Use Element, of the Comprehensive Plan is appended to the end of this Hazard Mitigation Plan. The complete comprehensive plan and maps can be found at the local Library or at the city's website: http://www.durhamnc.gov/departments/planning/.

HAZARD MITIGATION STRATEGIES

Durham County and the City of Durham have worked to develop the mitigation actions shown on pages 120-124. Mitigation actions were developed with an eye toward reducing vulnerability to all natural hazards that can be addresses in a practicable way at the local level. The listed actions do, however, primarily focus on ways Durham County and the participating municipality can act to lessen and, ideally, eventually eliminate repetitive flood losses and prevent future flood losses from inappropriate new development.

The Mitigation Planning Task Force committee put an emphasis on three (3) areas of concern in the development of the mitigation strategies included in this plan. Considerations of all the mitigation actions have been determined to include an emphasis on:

1. Cost effective, i.e. (returns or savings produced by implementation of the action outweigh the cost of implementation);
2. Environmentally sound, i.e. (actions were designed to protect environmentally fragile areas as natural storm water storage areas); and
3. Technically feasible, i.e. (actions are to be undertaken by the County using current staff and resources except where grant funds are available.)

The Hazard Mitigation Committee developed the mitigation actions as described in this plan. Many proposed actions will have a positive effect on mitigating potential damages from most, if not all, natural hazards. The listed actions do, however, primarily focus on ways the jurisdictions can act to lessen and, ideally, eventually prevent future flood losses from inappropriate new development. Mitigation actions include a number of ongoing programs and other new or expanded programs that the jurisdictions will

undertake to ensure further reductions in community vulnerability during the 5-year implementation period.

Mitigation actions were developed and prioritized by the departmental staff responsible for implementation of the specific action. Each department categorized actions as low, moderate or high priority based on assessment of the need for the specific action, the projected cost of implementation, the potential beneficial effects from implementation of the action, and available funding sources. The implementation years were also determined by the responsible departments using projected resources (personnel, vehicles, etc.) and operating funds. The planning team determined that some potential actions were more appropriately addressed at the State level due to long established priorities and responsibilities assumed by the State of North Carolina and local governments.

The primary factor considered by the HMP committee for action prioritization was the cost-effectiveness of each action in the plan. To determine cost-effectiveness for each action, a cost-benefit review process was implemented by the HMP committee using local knowledge of the probable cost of each action. Actions were given a priority of High, Moderate, or Low based on this assessment. Actions considered a High priority are those that should be addressed first and which will receive a majority of the funding and effort from the local jurisdiction. Conversely, Low priority actions are those that will receive the least amount of time and effort from the local jurisdiction. Moderate priority actions fall in between High and Low priority in terms of resources and effort.

The mitigation actions were prioritized using the information provided by each individual staff for each of the following criteria:

1. Cost effectiveness, i.e., do returns or savings produced by implementation of the action outweigh the cost of implementation?
2. Environmental impact, i.e., are actions designed to protect environmentally fragile areas as natural stormwater storage areas? and,
3. Technically feasibility, i.e., can the action be undertaken by the Town using current staff and local funds, State, or Federal funds, or do other funding sources need to be identified?

Also, in developing actions, the Committee relied on the following six mitigation policy categories provided by FEMA:

1. Prevention - Preventative activities are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial.
2. Property Protection - Property protection measures enable structures to better withstand hazard events, remove structures from hazardous locations, or provide insurance to cover potential losses.
3. Natural Resource Protection - Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of natural systems. Examples of natural systems that can be classified as high hazard areas include floodplains, wetlands and barrier islands. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Parks, recreation or conservation agencies and organizations often implement these measures.
4. Structural Projects - Structural mitigation projects are intended to lessen the impact of hazards by modifying the environment or hardening structures. Structural projects are usually designed by engineers and managed or maintained by public works staff.
5. Emergency Services - Although not typically considered a mitigation technique, emergency services minimize the impact of a hazard on people and property.

6. Public Information and Awareness - Public Information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards and mitigation techniques they can use to protect themselves and their property.

A special emphasis on cost-benefit analysis will be placed on any physical mitigation projects arising from these mitigation strategies. These considerations will serve as the criteria by which all future physical mitigation projects and strategies are prioritized.

Mitigation strategies and actions serve as the means to achieve both County and City goals for mitigation. The following mitigation strategies were comprised after also examining the present and future ordinances, programs, and goals for both jurisdictions. North Carolina Division of Emergency Management planning tools and other sample hazard mitigation plans were used to develop the strategies. Upon review of the culmination of the area hazard identification, capability assessment, vulnerability assessment, and community goals, the following strategies were developed.

Incorporate hazard mitigation into the planning process of each jurisdiction.

As indicated earlier during the Community Capability Assessment positive steps have already been taken toward hazard mitigation through ordinances, policies, and procedures. The goals and principles of hazard mitigation often cross many aspects of public interest. The next step is to make a conscious effort to integrate hazard mitigation into the planning process of each jurisdiction. A standing Hazard Mitigation Planning Team will remain in place, including members from the Planning Department, Inspections Department, Emergency Management Division, the Public Works Department and any other individuals that will have input or participation in the hazard mitigation planning and projects process. The committee will evaluate the plan upon completion and also work together to revise the plan on a scheduled or as needed basis.

Although woven into the processes of code and ordinance development, specific mitigation goals and objectives are not listed. Future efforts will include integration of specific mitigation strategies in ordinances and community planning tool updates and revisions.

The North Carolina Division of Emergency Management documents listed below can be utilized for providing the committee with hazard mitigation concepts:

- *Tools & Techniques: Putting a Hazard Mitigation Plan to Work (October 1999)*
- *Keeping Natural Hazards From Becoming Disasters: A Basic Workbook for Local Governments (May 2000)*

Evaluate and strengthen existing ordinances as needed

Evaluation of policies, procedures, and ordinances in the Community Capability section determined the existing mitigation measures that are currently addressed—directly or indirectly. Local conditions are constantly changing due to increased development, technology advances, changes in local mitigation capabilities, or disaster events. Therefore, the evaluation of hazard mitigation strategies must be an ongoing process. The initial capability assessment will serve as a starting point rather than an end result. Because changing conditions know no timeline, it will be difficult to change policy when needed. An update schedule will need to be determined for evaluation of the policies, procedures, and ordinances. If a community realizes a significant and/or rapid change of conditions, the committee can meet and address the issues as they arise. Also, many times the opportunity for change presents itself during and after a disaster or emergency. The effectiveness of the policies, procedures, and ordinances can be evaluated at that time and changes can be made as appropriate.

Enforcement of policies, procedures, and ordinances.

Enforcement of policies, procedures, and ordinances is the most effective method to insure that the hazard mitigation goals are being met. Development of such policies, procedures, and ordinances is only the beginning. Effectiveness can be determined through enforcement. Each jurisdiction will need to determine a method by which to track enforcement. Plan acceptance or rejection, warnings, citations, permits issues, etc. are all methods and means to keep data necessary to determine if the policies, procedures, and ordinances are being keep in compliance.

Educate the public regarding hazard mitigation concepts.

Local governments take measures to protect the health and safety of their citizens. However, property owners also have a responsibility to protect their homes, families, and businesses. The citizens of Durham County can be more responsible if hazard mitigation information is provided to them through public education programs.

The Durham County website will include detailed information on hazard mitigation information and projects. The Emergency Management Division will be responsible for keeping the public informed via website venues about hazard mitigation issues and opportunities

National Flood Insurance Program, including the Community Rating System, participation will continue.

The Federal Emergency Management Agency (FEMA) issued new floodplain study and maps that became effective as of May 2, 2006 for the City and County of Durham. The City and County updated the Flood Damage Protection Ordinance to meet the current State and Federal National Flood Insurance Program (NFIP) regulations. This allowed the City and County to continue as participating communities in the NFIP and make Federally backed flood insurance available to all homeowners, renters, and business owners in these communities.. Under the CRS, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS:

1. Reduce flood losses
2. Facilitate accurate insurance rating
3. Promote the awareness of flood insurance

(www.fema.gov/nfip/)

Community Rating System requirements are revised every 3 years. New criteria may include giving CRS credit for multi-hazard mitigation planning. Floodplain management and community rating system criteria should be coordinated through the County's Floodplain Management Administrator or through the office that is tasked with NFIP coordination and implementation.

CID	Community Name	County	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date	Reg-Emer Date
370085#	DURHAM COUNTY *	DURHAM COUNTY	01/31/75	02/15/79	05/16/08	02/15/79
370086#	DURHAM, CITY OF	DURHAM COUNTY	01/25/74	01/03/79	05/16/08	01/17/79

Continuance of the hazard mitigation planning process and seeking of funds for emerging needs

The identification and development of hazard mitigation strategies are one step in a cyclical process. The Hazard Mitigation Plan is a constantly evolving document that will continue to change as conditions change within Durham County. The plan includes procedures for monitoring, evaluating, updating and revising the plan as situations and conditions change. An integral part of the plan process will be the search for hazard mitigation funding sources for current and future needs. Funding sources will need to be determined to address a number of needs to include:

- Staff training and certification
- Equipment
- Purchase of repetitive loss structures
- Purchase or mitigation of structures located within floodways and floodplains

Projects requiring funding are not limited to those listed above but will include any type of project that will allow Durham County to protect the County from the loss of lives and property. Suggestions for possible mitigation projects should be accepted from any source or person interested in making their community more disaster resistant. Hazard mitigation elements will be the responsibility of the Emergency Management and Planning Departments as needs emerge.

For the purposes of implementation and monitoring, these mitigation strategies have been translated into the following mitigation actions for the City of Durham and for Durham County:

City of Durham Hazard Mitigation Strategies

Mitigation Strategy	Geographic Planning Area	Hazard this Policy will Target	Funding Source	Responsible Party Start and Completion Dates	Benchmarks and Indicators of Progress (Monitoring and Evaluation)	Priority for Mitigation (High, Medium, Low)
Continued enforcement of Flood Damage Prevention Ordinance	City of Durham	Flood	Self-Funded	City-County Planning Dept Continuous	A decrease or no significant increase in flood damage	High
Continued enforcement of Subdivision Ordinance	City of Durham	Flood, all-hazards for ingress and egress.	Self-Funded	City-County Planning Dept Continuous	A decrease or no significant increase in flood damage	High
Continued enforcement of City Zoning Ordinance	City of Durham	Flood	Self-Funded	City-County Planning Dept Continuous	A decrease or no significant increase in flood damage	Medium
Continued enforcement of Soil Erosion and Sedimentation Control Ordinance	City of Durham	Flood, subsidence,	Self-Funded	City-County Planning Dept Continuous	A decrease or no significant increase in soil erosion or turbidity in streams	Medium
Continued enforcement of Safe and Sanitary Housing Ordinance	City of Durham	Primarily weather-related hazards	Self-Funded	Durham Housing Authority; City-County Insp. Continuous	A decrease or no significant increase in substandard housing	Medium

Continued enforcement of Fire Prevention/Hazardous Materials Permitting and Storage regulations	City of Durham	Hazardous Materials and possibly terrorism	Self-Funded	Durham Fire Dept. Continuous	A decrease or no significant increase in hazardous materials accidents	High
Continue all aspects of the Floodplain Management Program	City of Durham	Flood	Self-Funded	City-County Planning Continuous	A decrease or no significant increase in structures located in the floodplain	High
Continue tree-trimming programs for storm damage prevention	City of Durham	All weather-related hazards	Self-Funded	City General Services Dept Continuous	A decrease or no significant increase in tree-related damage and debris	High
Continued enforcement of state building codes and more stringent local building requirements	City of Durham	All hazards	Self-Funded	City-County Inspections Continuous	A decrease or no significant increase in damage to new structures from natural hazards	High
Look for opportunities to mitigate repetitive loss structures.	City of Durham	Floods	HMGP or PDM with local or state match	Durham County Emergency Mgt Continuous	A decrease or no significant increase in repetitive loss structures	Medium

Durham County Hazard Mitigation Strategies

Mitigation Strategy	Geographic Planning Area	Hazard this Policy will Target	Funding Source	Responsible Party Start and Completion Dates	Benchmarks and Indicators of Progress (Monitoring and Evaluation)	Priority (High, Medium, Low)
Continued enforcement of Flood Damage Prevention Ordinance	Durham County	Flood	Self-Funded	City-County Planning Continuous	A decrease or no significant increase in flood damage	High
Continued participation in the CRS program	Durham County	Flood	Self-Funded	City-County Planning Continuous	A decrease or no significant increase in flood damage	High
Continued enforcement of Subdivision Ordinance	Durham County	Flood, all-hazards for ingress and egress.	Self-Funded	City-County Planning Continuous	A decrease or no significant increase in flood damage	High
Continued enforcement of County Zoning Ordinance	Durham County	Mainly technological hazards but also natural hazards, indirectly.	Self-Funded	City-County Planning Continuous	A decrease or no significant increase in zoning-related public safety issues	Medium
Continued enforcement of County Soil Erosion and Sedimentation Control Ordinance	Durham County	Flood, subsidence,	Self-Funded	County Engineering Continuous	A decrease or no significant increase in soil erosion or turbidity in streams	Medium

Continued enforcement of Safe and Sanitary Housing Ordinance	Durham County	Primarily weather-related hazards	Self-Funded	City-County Inspections Continuous	A decrease or no significant increase in substandard housing	Medium
Continued enforcement of Fire Prevention/Hazardous Materials Permitting and Storage regulations	Durham County	Hazardous Materials and possibly terrorism	Self-Funded	Durham County Fire Marshal Continuous	A decrease or no significant increase in hazardous materials accidents	High
Continue tree-trimming programs for storm damage prevention	Durham County	All weather-related hazards	Self-Funded	Durham County Forestry Continuous	A decrease or no significant increase in tree-related damage and debris	High
Continued implementation of Stormwater management Plan	Durham County	Flood	Self-Funded	County Engineering Continuous	A decrease or no significant increase stormwater flooding and non-point source water pollution	High
Continued implementation of Comprehensive Plan	Durham County	Mainly flood but also all geographical hazards such as erosion or subsidence.	Self-Funded	City-County Planning Continuous	A decrease or no significant increase stormwater flooding and non-point source water pollution	Medium

Continue all aspects of the Floodplain Management Program	Durham County	Flood	Self-Funded	City-County Planning Continuous	A decrease or no significant increase in structures located in the floodplain	High
Continued enforcement of state building codes and more stringent local building requirements	Durham County	All hazards	Self-Funded	City-County Inspections Continuous	A decrease or no significant increase in damage to new structures from natural hazards	High
Look for opportunities to mitigate repetitive loss structures.	Durham County	Floods	HMGP or PDM with local or state match	Durham County Emergency Mgt Continuous	A decrease or no significant increase in repetitive loss structures	Medium
Continue all-hazards public information campaigns	Durham County	All-Hazards	Self-Funded but will look for add'l support and partners	County Emergency Management Continuous	A increase or no significant decrease in local hazard awareness	Medium

Strategies are identified as "continuing" in that these processes will be monitored to ensure that the community continues to make progress toward increasing resilience against all hazards impacting the jurisdiction.

Planning Mechanisms Evaluated for 2011 Update

Available Planning Mechanisms:	How Durham County incorporated the mitigation strategy and other information contained in the plan into the planning mechanisms:	Process by which Durham County will incorporate the Hazard Mitigation Plan into other planning mechanisms:
Durham County Emergency Operation Plan	The Hazard Mitigation Plan was evaluated during the EOP update to ensure hazards addressed were relevant and consistent amongst plans, for both preparedness and hazard mitigation efforts.	Durham County will continue incorporating the mitigation strategy and other information contained in the plan into other planning mechanisms in the future. Durham County and the City will provide mitigation recommendations for consideration and will incorporate these plans/actions into local decisions relevant to ordinance compliance. Multi-jurisdictional processes will be incorporated when practical to enhance continuity of compliance and to enhance the effectiveness of the plans implementation. Also, public awareness will be stressed at every level of jurisdiction thru public meetings, conferences, municipal organizations, and public service organizations.
Durham City-County Planning and Zoning ordinances	The Zoning Ordinance was reviewed in conjunction with the Durham County Hazard Mitigation Plan to make sure that they both strongly facilitate hazard loss reduction, and to strengthen the zoning ordinance through proposed mitigation actions as part of this Plan.	
Durham Flood Damage Prevention Ordinance	The Hazard Mitigation Plan was not incorporated in this planning mechanism.	
Other Disaster Plans	The Hazard Mitigation Plan was not incorporated into other planning mechanism.	

Administrative Process

ADOPTION & IMPLEMENTATION

The Hazard Mitigation Plan planning team, as described in Hazard Mitigation Strategies, will review a completed draft of the plan and recommend any needed changes. The draft of the Durham County Hazard Mitigation Plan will then be submitted to the North Carolina Division of Emergency Management Mitigation Section for review. If the NCDEM Mitigation Section recommends changes, the Committee will meet in order to discuss and implement their recommendations. Upon approval of a draft plan by NCDEM Mitigation Section, each jurisdiction will adopt the plan according to their standard adoption procedures. Such procedures include providing notice of a public hearing in the local newspaper, availability of the document for review by the public, conducting a public hearing, and adopting the plan at the governing body's next meeting following the public hearing.
Periodic monitoring and reporting of progress is required to ensure that Plan goals and objectives are kept current and that local mitigation efforts are being accomplished. The Durham County Multi-Jurisdictional Hazard Mitigation Plan shall be reviewed annually, or more often as the local situation may require following a disaster declaration, to ensure that progress is being made on achieving stated goals and objectives. The Plan will also undergo periodic evaluation and update as required by FEMA and the State.

Annual Review / Progress Report

The Hazard Mitigation Planning Team shall conduct an annual review. The annual review shall include the re-initiation of the hazard mitigation team planning process utilized during development of the plan. The team will include representatives of all affected County and City departments, as well as each of the participating jurisdictions.

The general public will be notified through a variety of media, including but not limited to the local newspaper, the Durham County and City websites, and mailed or emailed notices, of the review process and the opportunity to comment on the Plan review.

The annual review shall ensure:

1. That the Planning Team receives an annual report and/or presentation on the progress of Plan implementation. The report will include a status report on the implementation of mitigation actions.
2. That the County Board of Commissioners and City Council receives an annual report and/or presentation on the progress of Plan implementation along with a recommendation from the Planning Team regarding on-going implementation of the Plan.
3. The annual report will include an evaluation of the effectiveness and appropriateness of the mitigation actions included in the Plan.
4. The annual report will recommend, as appropriate, any necessary revisions or amendments to the Plan.

If the County Board of Commissioners or City Council determines that the recommendations warrant amendment of the Plan, the either board may initiate an amendment through the process described below.

Periodic Plan Review and Update

Periodic evaluation and revision of the Plan will help ensure that local mitigation efforts include the latest and most effective mitigation techniques. These periodic revisions may also be necessary to keep the Plan in compliance with Federal and State statutes and regulations. The Plan will need to be updated to

reflect changes, such as new development in the area, implementation of mitigation efforts, revisions of the mitigation processes, and changes in Federal and State statutes and regulations.

In the context of a Federal disaster declaration, State and local governments are allowed to update or expand an existing plan to reflect circumstances arising out of the disaster. An updated plan in this circumstance might include a re-evaluation of the hazards and the jurisdiction's exposure to them, a re-assessment of existing mitigation capabilities, and new or additional mitigation recommendations.

The Plan shall be reviewed at a minimum every year to determine if there have been any significant changes that would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and changes to Federal or State legislation may affect the appropriateness of the Plan.

The plan will be updated at a minimum every five (5) years and will be forwarded to NCEM and FEMA for review and approval.

Review of the Plan

The procedure for reviewing and updating the Plan shall begin with a report prepared by the County Emergency Management coordinator and submitted to the HMP Planning Team for consideration and recommendation to the elected bodies (City and County). The report shall include a summary of progress on implementation of hazard mitigation strategies and a recommendation, as appropriate, for any changes or amendments to the Plan.

The review shall include an evaluation of the effectiveness and appropriateness of the Plan. Specifically, the evaluation shall involve a review of the consistency of day-to-day land use decisions to determine if the hazard mitigation policies are being implemented. The review shall recommend if plan amendments are warranted and if any revisions to regulatory tools (zoning, subdivision regulation, etc.) are necessary to assist in implementing the policies of the Plan.

If the elected bodies determine that such report raises issues that warrant modification of the Plan, or if the Planning Team recommends that issues have been raised which warrant modification of the Plan, the elected bodies may initiate an amendment as delineated below, or may direct the HMP Planning Team to undertake a complete update of the Plan.

Procedure for Amending the Plan

An amendment to the Plan shall be initiated by the Board of Commissioners or City Council either at their own initiative or upon the recommendation of the Planning Team, the EM Coordinator, or any other Durham City or County agency who demonstrates that an amendment should be considered.

Upon initiation of a text or map amendment, the EM Coordinator shall re-convene the hazard mitigation planning team and notify other interested parties as described in the Annual Review/Progress Report subsection above. The team will consider any proposed amendment(s) which shall then be forwarded to affected parties, including, but not limited to, County departments, municipalities within the County, and other interested agencies such as citizens, business owners, the North Carolina Division of Emergency Management, the United States Army Corps of Engineers, and the Federal Emergency Management Agency for a ninety (90) day review and comment period.

At the end of the comment period, the proposed amendment(s) shall be forwarded along with all review comments to the Planning Team for consideration. If no comments are received from the reviewing department or agency within the specified review period, such shall be noted in the report to the Planning Team.

Planning Team Review and Recommendation

The Planning Team shall review the proposed amendment(s), the report and recommendation of the EM Coordinator, and any comments received from other local governments and State and Federal agencies. The Planning Team shall submit a recommendation on the proposed amendment to the Board of Commissioners and City Council within sixty (60) days. Failure of the Planning Team to submit a recommendation within this time period shall constitute a favorable recommendation.

In deciding whether to recommend approval or denial of an amendment request, the Planning Team shall consider whether or not the proposed amendment is necessary based upon one or more of the following factors:

A) There are errors or omissions made in the identification of issues or needs during the preparation of the original Plan;
B) New issues or needs have been identified which were not adequately addressed in the original Plan;
C) There has been a change in projections or assumptions from those on which the original Plan was based.

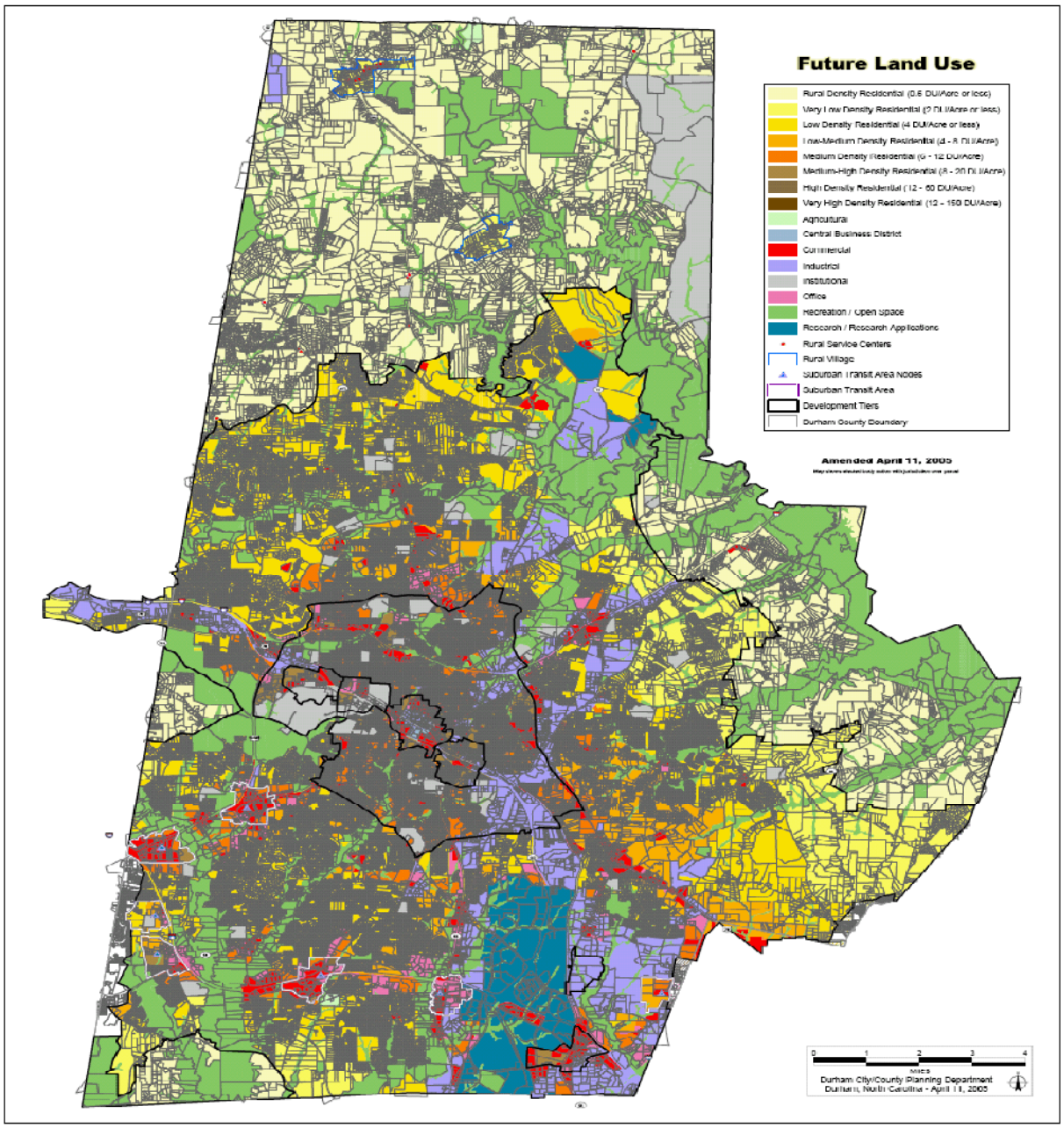
Board of Commissioners Review and Approval

Upon receiving the recommendation of the Planning Team, the Board of Commissioners and City Council shall hold public hearings. The Boards shall review the Planning Team recommendation (including the factors delineated above), the report and recommendation from the Emergency Management coordinator, and any oral or written comments received at the public hearing. Following that review, the Boards shall take one of the following actions:

A) Adopt the proposed amendment as presented or with modifications.
B) Deny the proposed amendment.
C) Refer the amendment request back to the Planning Team for further consideration.
D) Defer the amendment request for further consideration and/or hearing.

Appendix I – Land Use and Comprehensive Plan

DURHAM COUNTY LAND USE



Adopted, February 28, 2005

Durham Comprehensive Plan

Chapter 2
Land Use Element

Durham City-County Planning Department

The Durham Comprehensive Plan

Contents

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Chapter 2,
Land Use Element

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Durham's land is finite. How we use this land determines the number of homes and the amount of goods and services that will be available to Durham's citizens. Different strategies produce different results. This Plan proposes a flexible approach to the interaction of land uses but limits intensities and densities depending on location. The Plan balances the predicted demand for specific land uses with the need to protect our natural resources and to move towards a more efficient development pattern.

Land Use Element

Summary of Issues
Goal 2.1, Development Tiers
Goal 2.2, Land Uses
Goal 2.3, Tiers Defined

Summary of Issues

1. **Accommodating Future Growth.** Future increases in population and employment will increase demand for land development. Housing demand will be reflected in proposals for new subdivisions, apartment complexes and adaptive reuse of older structures. Businesses will need land and buildings for retail activities, offices, personal and professional services, research and manufacturing. How Durham plans for the changing uses of land to accommodate our expected growth will significantly influence our community's future quality of life.

2. **The Urban Growth Area.** Durham has used the Urban Growth Area (UGA) boundary as a tool to manage its physical growth. Watershed protection policies and adjacent jurisdictions represent real limits to Durham's physical expansion. Some capacity exists to expand in eastern and northwestern Durham, but that may mean the loss of some rural areas to more suburban patterns of development with attendant increases in infrastructure and service delivery costs. Balancing these growth issues will affect the lives of future residents.

3. **Different Community Types.** Durham may find that a more complex approach better serves its growth management needs. A hybrid of growth tiers and special growth areas is being evaluated through the Unified Development Ordinance to implement Durham's Smart Growth Audit completed in 2001. Durham could build its future plans around distinct community types, such as downtown, urban neighborhoods, suburban neighborhoods, rural areas and natural resource protection areas. Defining how this system can work for Durham, which community types work best and the specific objectives, policies and regulations that might apply to each should be a focus of the Durham Comprehensive Plan.

4. **Land Use and Alternative Transportation Modes.** The Triangle Transit Authority is proceeding with plans to construct Phase I of the Regional Rail project. Compact Neighborhoods around regional transit stations would be characterized by higher intensity and mixed land uses, exceptional pedestrian and bicycle accessibility, interconnections with local transit services, a network of urban open spaces and community design appropriate to their

General Land Uses

intensity and location. How Durham responds to this new transportation mode will shape its future.

Land Uses

5. **Conflicting Land Use Plans.** Durham has in the past prepared and adopted various land use plans to guide local government decisions about new development. Some small area plans are significantly out of date, having been prepared and adopted almost 15 years ago. Other small area plans remain in conflict with the general directions of the Durham 2020 Comprehensive Plan and its designation of Compact Neighborhoods. Addressing this issue of relevancy and consistency should result in a new Comprehensive Plan that represents a clear, concise and unambiguous guide for future decisions about land use and development.

Tiers Established

Development Tiers

6. **The Comprehensive Plan and the Unified Development Ordinance.** A community's comprehensive plan lays out the overall goals, objectives and policies that guide the growth and development of the community. Development regulations are a significant tool (one of many) for achieving aims of the Comprehensive Plan. Durham is working to update and meld its zoning, subdivision and other development-related ordinances into a Unified Development Ordinance (UDO). The UDO represents another step in improving Durham's development regulations, this time applying the principles of smart growth. How the Comprehensive Plan and the UDO work together will be critical to crafting a future for Durham that is attractive, efficient and respectful of its natural environment.

Unified Development Ordinance
The Unified Development Ordinance project is an effort to combine and integrate into a single development code the variety of different ordinances regulating development.

Provide a framework to direct development in Durham in a way that creates and reinforces a range of housing choices and lifestyles. Establish a series of development Tiers to guide growth and development in distinctive parts of the Durham community. Promote new development and redevelopment activities appropriate to each Tier by establishing policies and development regulations that recognize their distinct character.

Tiers. **Establish the following development Tiers to reflect a diversity of patterns of development and ensure opportunities for choice in Durham (See Map 2-1, Tiers):**

i. Rural;

Suburban;

Urban;

Compact Neighborhood; and

Downtown.

Prescribe a set of land uses that includes existing and future

Office Development

development, and recognizes the variety of development patterns

General Residential Densities

throughout Durham.

Establish a set of generalized land uses to encompass the distinct uses found throughout Durham.

Future Land Use Map. **Use the Future Land Use Map of the Durham Comprehensive Plan in conjunction with the text to guide the location and character of development. (See Map 2-2, Future Land Use Map.)**

Land Use Categories. **Establish the following Land Use Categories:**

Natural Resource and Open Space;

Agriculture;

Residential;

Commercial;

Office;

Institutional;

Research and Research Applications; and

Industrial.

Establish a set of residential densities to encompass the diversity of residential densities found

throughout Durham.

Residential Densities. **Through the Unified Development Ordinance, establish and maintain densities of Residential development consistent with Table 2-1, Summary of Residential Densities.**

Summary of Residential Densities

Nonresidential Development	Residential Density	Tier							
					Compact Neighborhood		Downtown		
Industrial Development	Density	Rural	Suburban	Urban	Support	Core	3	2	1
Rural	0.75 DU/Acre or Less	☐							
Very Low	2 DU/Acre or Less	☐	☐						
Low	4 DU/Acre or Less		☐						
Low-Medium	4-8 DU/Acre		☐						
Medium	6-12 DU/Acre		☐	☐					
Medium-High	8-20 DU/Acre			☐	☐		☐		
High	12-60 DU/Acre					☐		☐	
Very High	12-150 DU/Acre								☐

Note: Achievement of these densities may require utilization of development plans and/or density bonuses for such things as provision of affordable housing or location on major transportation corridors, as further provided for in the Unified Development Ordinance.

Demand for Residential Land. **In designating land for residential uses and evaluating Plan Amendments, the Governing Boards and the City-County Planning Department shall consider the demand for residential land and the capacity of the transportation, water, and sewer systems, and other public facilities and services.**

Provide a framework to direct development in Durham in a way that creates and reinforces a range of nonresidential intensities.

Height. **Through the Unified Development Ordinance, establish standards for building heights by uses and tiers.**

Building Coverage. **Through the Unified Development Ordinance, establish standards for building coverage by uses and tiers.**

Designate sufficient land in appropriate places for office development.

Demand for Office Land. **In designating land for office uses and evaluating Plan Amendments, the Governing Boards and the City-County Planning Department shall consider the demand for office land and the capacity of the transportation, water, and sewer systems, and other public facilities and services.**

Office Uses as Transition. **Through the Future Land Use Map, utilize office space as a complement to commercial space, providing a transition between commercial and residential areas.**

Designate sufficient land in appropriate places for commercial development.

Demand for Commercial Land. **In designating land for commercial uses and evaluating Plan Amendments, the Governing Boards and the City-County Planning Department shall consider the demand for commercial land and the capacity of the transportation, water, and sewer systems, and other public facilities and services. In evaluating demand, consider a market area consistent with Table 2-2. Commercial Node Spacing.**

Development Rights

Compatible Infill Development

Table 2. Commercial Node Market Area

Type	Urban Tier	Suburban Tier
Neighborhood Node	1½ Miles	3 Miles
Community Node	3 Miles	5 Mile

Spacing of Commercial Development. **The City-County Planning Department shall use the following standards when evaluating requests for new commercial development:**

Strip Commercial Development
Strip commercial development is development on lots of shallow depth with multiple curb cuts in linear patterns along major roads.

ii. **Cluster commercial uses at intersections of major thoroughfares to create nodes and discourage encroachment into residential areas;**

iii. **Apply the spatial separation criteria in Table 2-3. Summary of Commercial Separation Criteria to protect the function of the roadway system and avoid "strip commercial development"; and**

iv. **Restrict new, isolated, mid-block commercial uses.**

Table 3. Summary of Commercial Separation Criteria

Tier	Separation
Urban	¼ Mile
Suburban	½ Mile
Rural	1½ Miles

Strip Commercial Development. **Using Map 2-2, Future Land Use Map, discourage strip commercial development through application of the Spacing of Commercial Development Policy and requirements for access management plans on Major Thoroughfares.**
Designate sufficient land in appropriate places for industrial development.

Demand for Industrial Space. **In designating land for industrial uses and evaluating Plan Amendments, the Governing Boards and the City-County Planning Department shall consider the demand for industrial land and the capacity of the transportation, water, and sewer systems, and other public facilities and services.**
Location of Industrial Uses. **Through the Future Land Use Map, ensure that new industrial uses have direct access to Major Thoroughfares, Minor Thoroughfares, or Collector Streets to protect the character of neighborhoods.**

Provide a framework to direct development in Durham.

Impervious Surface Credit Transfer. Through the Unified Development Ordinance, allow and establish procedures for the transfer of impervious surface credit from a donor parcel to a receiver parcel, provided that:

v. The donor parcel and the receiver parcel shall be within the same water supply watershed;

Tiers Defined

Rural Tier

The impervious surface credit transfer shall not be from a donor parcel in the Protected Area to the receiver parcel in the Critical Area; and

The portion of the donor parcel which is restricted from development shall remain in a vegetated or natural state and shall be placed in a permanent conservation easement granted to the City or County, or a land trust or similar conservation-oriented nonprofit organization.

Use of this tool should allow a project to increase its impervious surface above the limits that would otherwise be required, but would not reduce the requirements to provide engineered stormwater systems for the receiver sites. (See Policy 9.1.4c. Impervious Surface Credit Transfer.)

Ensure compatible infill development throughout Durham.

Infill Development Standards. **Through the Unified Development Ordinance, establish standards for infill development within the Urban, Compact Neighborhood, and Downtown Tiers to ensure that new development occurs in the context of the area, considering site and building design, factors such as lot dimensions, building dimensions, building location and orientation, parking, landscaping, and historic character (where applicable).**

Neighborhood Protection Overlay. **Through the Unified Development Ordinance, create and implement a Neighborhood Protection Overlay to limit the flexibility of underlying zoning within existing established neighborhoods to more effectively match the design, density, intensity, and/or established character of these developed areas.**

Transitions to Nonresidential Uses. **Ensure the maintenance of established neighborhoods in areas beginning to transition to nonresidential uses by protecting their residential design and character in architectural details as well as the location of parking.**

Neighborhood Involvement. **Through the Unified Development Ordinance, establish procedures to ensure that neighborhoods and community groups are advised of and provided opportunities to be involved in development decisions at the earliest stages of planning and throughout the approval process.**

Define a development focus, land uses, and design features appropriate for development in each Tier.

Provide sufficient land in the Rural Tier appropriately zoned for agricultural, rural residential, small-scale commercial and industrial purposes. The Rural Tier shall include land in the Durham Planning Area outside the Urban Growth Area.

Rural Tier Development Focus. **Ensure that new development promotes agricultural uses and single-family residential development on large lots to minimize demands for public infrastructure. Commercial areas shall be small scale and neighborhood oriented.**

Rural Tier Land Uses. **Land uses that shall be allowed in the Rural Tier include:**

vi. Natural Resource Areas and Open Space;

vii. Agriculture, related activities;

viii. Rural Residential, single-family development;

ix. Institutional;

x. Commercial, limited to neighborhood oriented uses; and

xi. Industrial, limited to resource extraction.

Rural Tier Residential Density. **Through the Unified Development Ordinance, establish and maintain densities of residential development consistent with Table 2-1, Summary of Residential Densities. In watershed protection areas in the Rural Tier, the density allowed shall be 0.33 dwelling units per acre or less and in non-watershed protection areas in the Rural Tier, the density allowed shall be 0.5 dwelling units per acre.**

Rural Tier Subdivisions. **Through the Unified Development Ordinance, establish and apply conservation subdivision provisions, such as conservation-by-design methods, to protect environmentally sensitive lands, preserve historic and archeological sites, protect scenic views, and conserve prime agricultural lands while encouraging more efficient use of the land and permitting up to a one-third increase in the density for projects that utilize these provisions.**

Urban Growth Area. **Use the Urban Growth Area boundary to delineate the boundary between Suburban and Rural Tiers.**

Farmland Preservation. **The Board of County Commissioners shall employ conservation easements to assist in the preservation of farmland.**

xii. The Farmland Protection Board shall review all requests for conservation easements to determine if the property is prime farmland; and

xiii. Any property identified as prime farmland by the Farmland Preservation Board that is purchased by a Governing Body shall be designated Agriculture on the Future Land Use Map with a maximum development potential as a farmstead.

Rural Tier Agricultural Activities. **Through the Unified Development Ordinance, ensure that land use regulations allow agricultural activities by right within the Rural Tier. (See Policy 7.2.3g. Rural Tier Agricultural Activities.)**

Rural Tier Compatibility of Uses. **Recognizing the potential conflicts between agricultural uses and more intense development over issues such as odors and dust, the City-County Planning Department shall consider as part of the review process the compatibility of any proposed**

development in the vicinity of Voluntary Agricultural Districts or lands designated for Agriculture with those agricultural uses.

Rural Service Centers. **Establish Rural Service Centers in the Rural Tier to provide locations for small-scale commercial uses and community services. Standards for Rural Service**

Suburban Tier

Centers include:

Located at intersections of Major and/or Minor Thoroughfares;

Contain two or more neighborhood-oriented uses;

Maximum of 20,000 square feet of nonresidential uses per area;

Maximum size for any single establishment of 10,000 square feet; and

New, isolated, mid-block commercial uses shall be discouraged.

Rural Villages. **Durham shall maintain and support the rural villages of Bahama and Rougemont.**

Maximum Residential densities in Rural Villages shall be Residential, Very Low (2 units per acre or less);

Encourage compatible infill in both Rural Villages;

Modify Durham's watershed protection provisions through the Unified Development Ordinance to allow for limited growth through the use of a transfer of impervious surface credit to permit more impervious surface intensities in Rural Villages;

Develop plans to ensure the continued economic viability of Bahama and Rougemont; and

Locate community-oriented facilities and services to enhance the vitality of Rural Villages.

Cost of Community Services Study. **The County Engineering Department shall prepare a cost-of-community-services study to examine the economic benefits of retaining active farming.**

Incompatible Zoning in the Rural Tier. **The Board of County Commissioners shall initiate rezoning procedures on any property in the Rural Tier with incompatible zoning to bring those properties into compliance with the Durham Comprehensive Plan.**

Provide sufficient land in the Suburban Tier appropriately zoned for residential, commercial, institutional, office, research/research applications, and industrial purposes. The Suburban Tier shall include all land within the Urban Growth Area that is not included in the Urban, Compact Neighborhood or Downtown Tiers.

Suburban Tier Development Focus. **Through the Future Land Use Map, ensure that the Suburban Tier has sufficient land to accommodate anticipated population growth and its attendant demands for housing, employment, and goods and services, including opportunities for affordable housing and recreation.**

Suburban Tier Land Uses. **Land uses that shall be allowed in the Suburban Tier include:**

xiv. Natural Resource Areas and Open Space;

xv. **Agricultural;**

xvi. **Residential;**

xvii. **Institutional;**

xviii. **Commercial;**

xix. **Office;**

xx. **Research/Research Application; and**

xxi. **Industrial.**

Suburban Tier Residential Density. **Through the Unified Development Ordinance, establish and maintain densities of Residential development consistent with Table 2-1, Summary of Residential Densities.**

Suburban Tier Housing Types. **Through the Unified Development Ordinance, provide for a broad variety of housing types, lot sizes and design elements to encourage diversity within communities, achieve efficient use of infrastructure, and generate a foundation of support for neighborhood centers and transit.**

Suburban Tier Mixed Use. **Through the Unified Development Ordinance, encourage mixed uses by allowing mixed use developments where one of the uses is shown on the Future Land Use Map, except that industrial uses shall not be allowed in mixed use developments. Through the Unified Development Ordinance, provide incentives for vertical integration of residential and nonresidential uses in order to achieve true mixed-use projects rather than the multiple use projects that typically result from only horizontal integration.**

Suburban Transit Areas. **The City and County shall allow the application of the Compact Neighborhood Support Area standards, as defined in the Durham Comprehensive Plan and the Unified Development Ordinance, in Suburban Transit Areas shown on the Future Land Use Map to encourage development supportive of transit. Additional Suburban Transit Areas shall be designated as further transit studies are completed and approved with existing Suburban Transit Areas re-designated to the Compact Neighborhood Tier as the locations of transit stations are established.**

Suburban Transit Area Phasing. **Development in Suburban Transit Areas shall not be permitted to utilize the residential designations shown on the Future Land Use Map unless they utilize phasing provisions, which shall be incorporated into the Unified Development Ordinance to ensure that, at build-out, minimum required densities in a transit-supportive form shall be achieved. Phases shall be limited to the development permitted by the adequacy of the available infrastructure. Development that cannot comply with these phasing requirements shall be restricted to the residential land use designation immediately less dense than shown on the Map (i.e., medium density residential becomes low medium density residential) with the Planning Department processing corresponding amendments to the Future Land Use Map as part of the annual Evaluation and Assessment Report.**

Suburban Tier Open Space. **Through the Unified Development Ordinance, require that new residential developments include useable open space which is appropriate to the size and nature of the development, accessible from the street and within a ½ mile walking distance from the majority of homes within the development. Open space design should use Crime Prevention Through Environmental Design (CPTED) principles, if appropriate.**

Suburban Tier Parking Standards. **Through the Unified Development Ordinance, establish vehicle and bicycle parking standards for the Suburban Tier that require parking spaces to meet but not exceed the needs of the development. Provide for alternative parking arrangements where appropriate because of transit services or unique site conditions. Design parking lots and landscaping considering environmental issues, such as heat and glare, aesthetics, and Crime Prevention Through Environmental Design (CPTED) principles.**

Suburban Tier Landscaping. **Through the Unified Development Ordinance, establish standards for landscaping that emphasize preservation of tree cover and both natural and manicured visual appearance. The standards shall encourage the use of native species and water-wise landscaping to minimize the impacts of drought events on the suburban landscape. Require measures to ensure the long-term stability and survival of required landscape materials.**

Suburban Tier Buffers. **Through the Unified Development Ordinance, establish standards for buffers that minimize potential adverse impacts associated with differing uses by focusing on opacity and physical separation of uses.**

Neighborhoods in Transition. **Identified neighborhoods, such as Kentington Heights, seeking an area-wide change in land use shall develop through single ownership or as a single project**

Urban Tier

employing unifying design elements, roadways, and buffers.

Roxboro Road Zoning Changes. **The City-County Planning Department shall recommend denial of commercial and industrial zoning changes along Roxboro Road between West Club Boulevard and Maynard Avenue in order to prevent strip development and to protect the character of the surrounding neighborhood.**

Suburban Tier Nonconforming Uses. **Through the Unified Development Ordinance, establish and enforce amortization periods for nonconforming uses that contribute to visual blight and inhibit redevelopment of areas within the Suburban Tier.**

Suburban Tier Traditional Neighborhood Development District. **The City-County Planning Department shall propose amendments to the Unified Development Ordinance to establish a Traditional Neighborhood Development District.**

Provide sufficient land in the Urban Tier appropriately zoned for residential, commercial, institutional,

office and industrial purposes. The Urban Tier shall include land surrounding the Compact

Neighborhoods.

Urban Tier Development Focus. **Ensure that new development enhances the street level experience by requiring that development within the Urban Tier have an urban form with small lot sizes and proximity of uses.**

Urban Tier Land Uses. **Land uses that shall be allowed in the Urban Tier include:**

xxii. Natural Resource Areas and Open Space;

xxiii. Residential;

xxiv. Institutional;

xxv. Commercial;

xxvi. Office; and

xxvii. Industrial.

Urban Tier Residential Density. **Establish and maintain densities of Residential development consistent with Table 2-1, Summary of Residential Densities.**

Urban Tier Housing Types. **Provide for a variety of housing types with varying setback requirements to encourage a more urban form and efficient use of infrastructure.**

Urban Tier Mixed Use. **Encourage Mixed Use zoning to create more "24-hour" places by permitting such developments regardless of the land use designation shown on the FLUM so as long as one of the proposed uses is designated on the FLUM. Provide incentives for vertical integration of residential and nonresidential uses in order to achieve true**

mixed-use projects rather than the multiple use projects that typically result from only horizontal integration.

Urban Tier Build-To Lines. **Establish and apply "build to" lines rather than setbacks to bring projects close to the street and encourage walkability.**

Compact Neighborhood Tier

Urban Tier Open Space. **Require that new residential developments include useable open space that is visible from the street and within a ¼ mile walking distance from the majority of homes within the development.**

Urban Tier Parking. **Establish and apply parking provisions to direct new surface lots to the side and rear of buildings rather than to street yards to avoid creating expanses of surface parking and encourage more walkable communities.**

Urban Tier Landscaping. **Provide standards for landscaping that result in a more formal and manicured visual appearance. Such standards shall rely less on preservation of trees and vegetation in areas where they are not visible from rights-of-way, but focus on the visual appearance of the community from the streets.**

Urban Tier Buffers. **Establish alternative buffer standards that focus on issues, such as opacity rather than physical separation of uses, respecting the urban form in these areas.**

Urban Tier Nonconforming Uses. **Establish amortization periods for nonconforming uses that contribute to visual blight and inhibit redevelopment.**

Provide sufficient land in the Compact Neighborhood Tier appropriately zoned for residential, commercial, institutional, office and industrial purposes. The Compact Neighborhood Tier shall include land surrounding the designated regional transit stations.

Compact Neighborhood Development Focus. **Ensure that the Station Areas Plans enhance the street level experience and provide a mixture of goods and services near transit stations by requiring that development within the Compact Neighborhood Tier be transit-, bicycle- and pedestrian-oriented. Auto-oriented and low intensity uses shall be discouraged.**

Compact Neighborhood Tier Land Uses. **Land uses that shall be allowed in the Compact Neighborhood Tier include:**

xxviii. Natural Resource Areas and Open Space;

xxix. Residential;

xxx. Institutional;

xxxi. Commercial;

xxxii. Office; and

xxxiii. Industrial, limited to Light Industrial uses.

Compact Neighborhood Residential Density. **Establish and maintain densities of Residential development consistent with Table 2-1, Summary of Residential Densities.**

Compact Neighborhood Housing Types. **Through the Unified Development Ordinance, provide for a variety of housing types to encourage density and the diversity within communities required to**

achieve efficient use of infrastructure and to generate a foundation of support for neighborhood centers and transit.

Compact Neighborhood Tier Mixed Use. **Encourage Mixed Use zoning regardless of the underlying land use within the Core Areas in order to create alternatives to driving and create more "24-hour" places. Provide incentives for vertical integration of residential and nonresidential uses in order to achieve true mixed-use projects rather than the multiple use projects that typically result from only horizontal integration.**

Downtown Tier

Core Area. **The Core Area, the land immediately surrounding the transit station, may extend approximately one-quarter mile from the station as indicated on the Future Land Use Map.**

Support Area. **The Support Area shall be the land in the Compact Neighborhood Tier outside of the Core Area, as indicated on the Future Land Use Map.**

Station Area Plans. **The City-County Planning Department, in conjunction with the Triangle Transit Authority and other interested parties, shall develop or participate in the development of Station Area Plans.**

Compact Neighborhood Build-To Lines. **Establish and apply "build-to" lines rather than setbacks to bring projects close to the street and encourage walkability.**

Compact Neighborhood Tier Passenger Terminals. **Ensure that passenger terminals are a permitted use in the zoning districts in the Compact Neighborhood Tier.**

Compact Neighborhood Open Space. **Through the Unified Development Ordinance, establish alternative standards for open space to ensure public space in a defined setting with plazas and urban public places, as well as green spaces, located in Core Areas.**

Compact Neighborhood Parking. **Through the Unified Development Ordinance, establish and apply maximum parking provisions, encourage structured parking, and encourage shared parking to avoid creating expanses of surface parking and encourage more walkable communities. Develop standards for parking lots that promote safety (considering CPTED principles) and aesthetic appeal.**

Compact Neighborhood Tier On-Street Parking. **Allow on-street parking within Core Areas where road rights-of-way can accommodate on-street parking.**

Compact Neighborhood Tier Buffers. **Do not require buffers in the Compact Neighborhood Tier except when abutting residential development in the Suburban or Urban Tier.**

Provide sufficient land in the Downtown Tier appropriately zoned for residential, commercial, institutional, and office purposes. The Downtown Tier shall include land surrounding the designated Downtown regional transit station.

Downtown Tier Development Focus. **Ensure that the Downtown Plan enhances the street level experience and provides a mix of goods and services near transit stations by requiring that development within the Downtown Tier be transit and pedestrian oriented. Auto-oriented and low intensity uses shall be discouraged.**

Downtown Tier Land Uses. **Land uses that shall be allowed in the Downtown Tier include:**

xxxiv. Natural Resource Areas and Open Space;

xxxv. Residential;

xxxvi. Institutional;

xxxvii. Commercial; and

Future Land Use Plan Updates

xxxviii. Office.

Downtown Tier Residential Density. **Establish and maintain densities of Residential development consistent with Table 2-1, Summary of Residential Densities.**

Downtown Tier Housing Types. **Provide for a variety of housing types to encourage density and diversity within communities, achieve efficient use of infrastructure, and generate a foundation of support for neighborhood centers and transit.**

Downtown Development Areas. **The Downtown Tier shall be subdivided into three development areas to provide for a transition of uses between Downtown and nearby neighborhoods.**

Downtown Station Area Plan. **The City-County Planning Department, in conjunction with the Triangle Transit Authority and other interested parties, shall develop or participate in the development of a station area plan to direct growth and redevelopment for the Downtown regional transit station that enhances Downtown's characteristics, reflects its focus, and fosters distinctive and attractive places.**

Downtown Tier Build-To Lines. **Through the Unified Development Ordinance, establish and apply "build to" lines rather than setbacks to bring projects closer to the street and encourage walkability.**

Downtown Tier Passenger Terminals. **Ensure that passenger terminals are a permitted use in the Zoning Districts in the Downtown Tier.**

Downtown Tier Open Space. **Through the Unified Development Ordinance, establish alternative standards for open space to ensure public space in a defined setting with plazas and urban public places, as well as green spaces, located in Core Areas.**

Downtown Tier Parking. **Through the Unified Development Ordinance, establish and apply maximum parking provisions, encourage structured parking and encourage shared parking to avoid creating expanses of surface parking and encourage more walkable communities. Develop standards for parking lots that promote safety (considering Crime Prevention Through Environmental Design (CPTED) principles) and aesthetic appeal.**

Downtown Tier Buffers. **Do not require buffers except when abutting residential development in Urban Tier.**

Downtown Tier City-Initiated Zoning Changes. **The City shall consider initiating zoning changes in the downtown area to ensure consistency between zoning designations and the land use pattern shown on Map 2-2, Future Land Use Map.**

Update the Future Land Use Map as needed to maintain its relevancy as a guide to the location and

character of development.

Updates. The City-County Planning Department shall ensure that the Future Land Use Map is updated over time to reflect the best available information.

Corridor Plans. The City-County Planning Department, in conjunction with the Appearance Commission, shall prepare corridor plans to improve the function and appearance of major roadways into and through Durham. Corridor plans shall recommend appropriate land uses, design standards, development controls, landscaping, signage regulation, access management strategies, public facilities capital improvements, underground utilities and/or other measures. The highest priority shall be given to the following roadway corridors.

xxxix. Duke Street, from I-85 to Roxboro Road;

xl. Guess Road, from Club Boulevard to the Eno River;

xli. Hillsborough Road, from Fulton Street to Cole Mill Road;

xlii. Roxboro Road, from Duke Street to Milton Road;

xliii. NC 98, from US 70 Bypass to Lynn Road;

xliv. US 70, from NC 98 to the Wake County line;

xlv. Martin Luther King, Jr. Parkway, from University Drive to NC 55;

xlvi. NC 54, from the Orange County line to the Wake County line;

xlvii. NC 55, from the NC 147 to the Wake County line;

xlviii. Fayetteville Street from NC 147 to Renaissance Parkway; and

xlix. US 15-501, from Orange County to University Blvd.

(See Chapter 4, Community Character and Design Element, Policy 4.4.1a. Corridor Plans.)

Land Use Plan Updates. The City-County Planning Department shall prepare detailed land use plan updates for the following areas, considering the capacity of infrastructure and the demand for specific land uses:

l. The area bounded by the Wake County line, South Miami Boulevard, T. W. Alexander Parkway, and I-40;

The area bounded by Burdens Creek, NC 55 and South Alston Avenue;

The area bounded by NC 147, Ellis Road, the East End Connector and the railroad;

The area along Junction Road between US 70 and Ferrell Road;

The intersection of NC 54 and NC 751 between New Hope and Third Fork Creeks;

The area around North Carolina Central University;

The area around Duke University; and

The area around Durham Technical Community College.

The Arrowhead area.

Table 4. Land Demand and the Future Land Use Map

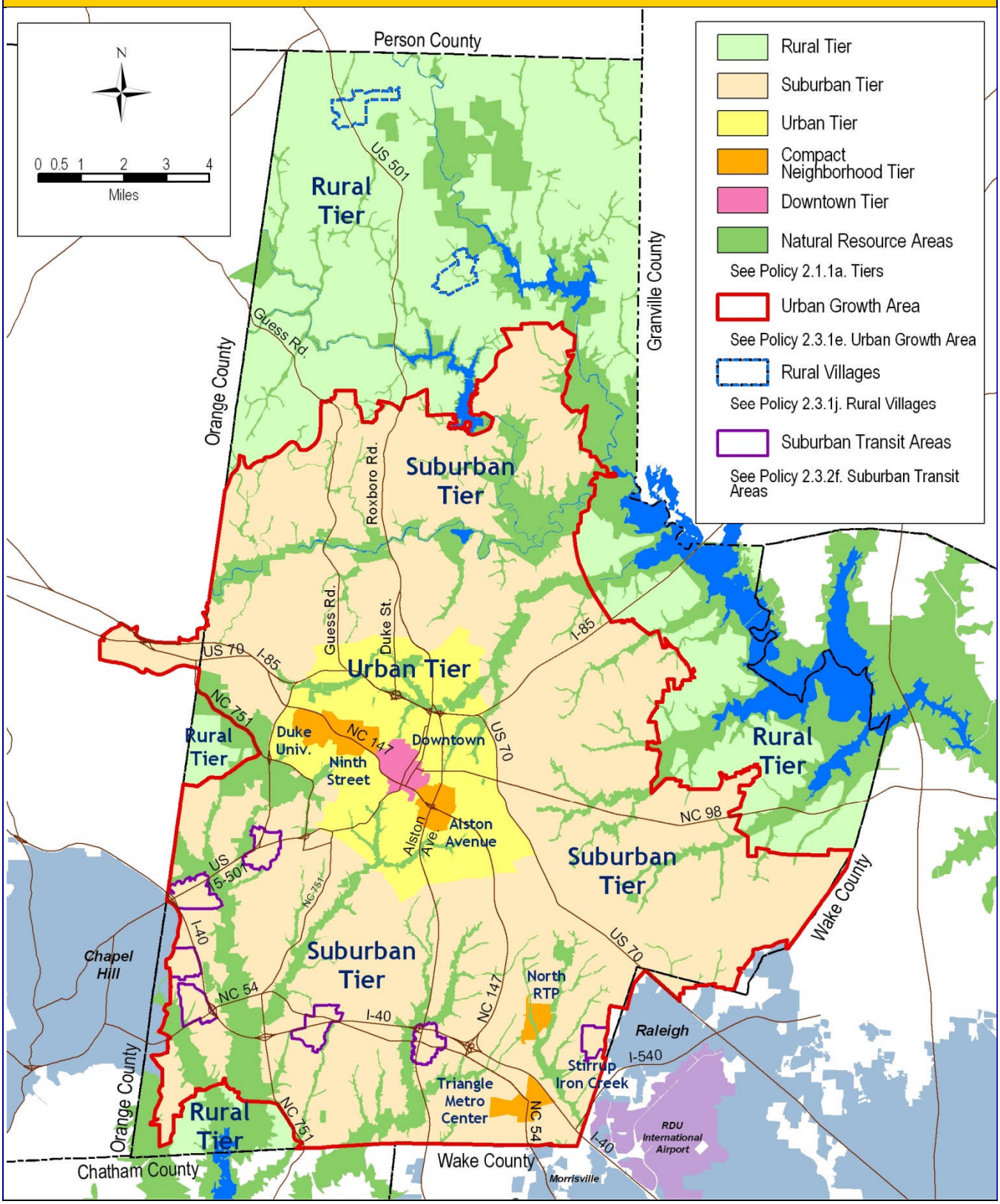
Sector	Projected Demand, 2030	Accommodated by the Future Land Use Map
Residential	167,000 Dwelling Units	210,000 Dwelling Units
Office	2,900 Acres	2,800 Acres
Commercial	5,300 Acres	6,500 Acres
Industrial	16,000 Acres	17,000 Acres

Note: Source is Durham City-County Planning Department, April 2004.

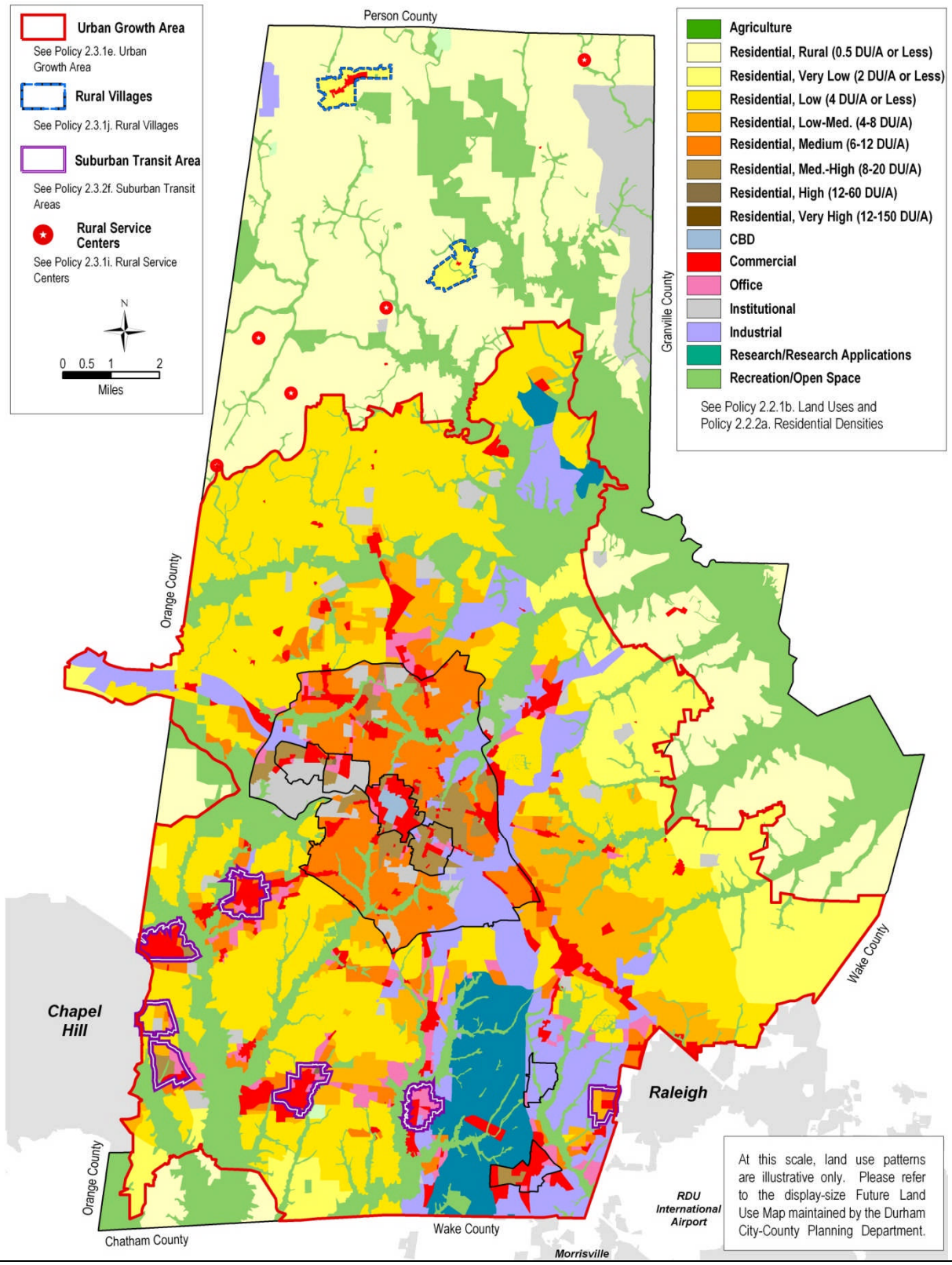
Land Demand Projections and the Future Land Use Map

An important Smart Growth principle embraced by the Durham Comprehensive Plan is to provide sufficient land for future needs. Future demand for residential units is based on projected size of the population and an estimate of the number of persons per household. Future demand for commercial land is based on the projected size of the population and an estimate of needed square feet per person. Future demand for office and industrial land is based on projected employment in those sectors and an estimate of needed square feet per employee. (Warehouse and non-warehouse demand is projected separately.) Projected demand for these land uses and the amount of land accommodated by the Comprehensive Plan's Future Land Use Map is shown in Table 2-4. The Map provides sufficient land for the anticipated needs.

Map 2-1, Tiers


N
0 0.5 1 2 3 4
Miles
Person County
Granville County
Orange County
Wake County
Chatham County
Rural Tier
Suburban Tier
Urban Tier
Compact Neighborhood Tier
Downtown Tier
Natural Resource Areas
See Policy 2.1.1a. Tiers
Urban Growth Area
See Policy 2.3.1e. Urban Growth Area
Rural Villages
See Policy 2.3.1j. Rural Villages
Suburban Transit Areas
See Policy 2.3.2f. Suburban Transit Areas
Rural Tier
Suburban Tier
Urban Tier
Rural Tier
Rural Tier
Suburban Tier
Suburban Tier
Rural Tier
Duke Univ.
Ninth Street
Downtown
Alston Avenue
North RTP
Stirrup Iron Creek
Triangle Metro Center
Chapel Hill
Raleigh
RDU International Airport
Morrisville
US 501
Guess Rd.
Roxboro Rd.
Guess Rd.
Duke St.
US 70
I-85
NC 751
NC 147
US 70
I-85
NC 98
US 70
US 15-501
I-40
NC 54
I-40
NC 147
I-540
NC 751
NC 54
I-40

Map 2-2, Future Land Use Map



APPENDIX II

Structures in 100-Year Flood Plain

Hazard Areas	Building Count
Flood zones: A, AE, AEFW, AO	2197
500 Year Flood Area – Shaded X	558
1% Future Conditions Area	186