Orange County Hazard Mitigation Plan Update

Plan Partners:
Orange County
Town of Carrboro
Town of Hillsborough

FEMA Approval Pending Adoption: March 16, 2010
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I. Introduction

Orange County is blessed with an abundance of rich natural resources, as varied and as vital as the people who live here. This bounty provides the county's residents with a wonderful place to call home, but there are also inherent dangers. From time to time, hurricane winds topple trees, severe winter storms immobilize streets, and heavy rains from thunderstorms cause flooding.

Storms, floods and wildfires are a part of the natural balance of the environment. But when such events occur where people have made their homes and built their businesses, the results can be devastating. Natural and technological hazards can wreak havoc in towns, communities and counties disrupting the flow of goods and services, destroying property and unsettling people's lives.

In recent years, the frequency and impact of natural disasters has increased not because natural hazards occur more frequently but because more people are choosing to live and work in locations that put them and their property at risk. While natural hazards cannot be prevented, local communities can use various ways to reduce the vulnerability of people and property to damage. Communities can reduce exposure to future natural hazards by managing the location and construction of both the existing and future built environment. By using location and construction techniques, a community can mitigate negative impacts and reduce future damage to both human lives and property.

A. Why Hazard Mitigation Planning

As the costs of disasters continue to rise, local governments must find ways to reduced hazard risks to their communities. The efforts made to reduce hazard risks are compatible with community goals; protection of life, health and property for safer communities. As communities plan for new development and improvements to existing infrastructure, mitigation can and should be an important component of the planning effort. This means taking action to reduce or eliminate long-term risk from hazards and their effects.

Hazard Mitigation is the practice of reducing risks to people and property from natural hazards. It includes both structure interventions such as building codes and nonstructural measures such as preventing development in flood areas.

B. Purpose of the Plan

The essential purposes of Hazard Mitigation Planning are: to protect the health, safety, and economic security of residents by reducing the impacts of natural hazards, influence decision-making in both public and private sectors, and prove community eligibility for government aid and grant programs.

The President of the United States, in October of 2000, signed into law the *Disaster Mitigation Act of 2000* (PL 106-390) to amend the *Robert T. Stafford Disaster Relief and Emergency Act of 1988* which among other provisions requires local governments to adopt a mitigation plan in order to be eligible for hazard mitigation funding. In June of 2001, the North Carolina General Assembly passed Senate Bill 300: *An Act to Amend the Laws Regarding Emergency Management as Recommended by the Legislative Disaster Response and Recovery*

Commission. Among other provisions, this bill requires that local governments have an approved hazard mitigation plan in order to receive state public assistance funds (effective for state-declared disasters after November 1, 2004).

C. Orange County and the Towns of Carrboro and Hillsborough

Orange County is centrally located in the piedmont of North Carolina and contains approximately 400 square miles. The County includes the Town of Carrboro and Town of Hillsborough, partner jurisdictions on this Hazard Mitigation Plan Update. The 2000 Census recorded a population of 115,531 with 66,330 of these residents in the Towns of Carrboro, Hillsborough, and Chapel Hill. Located in Chapel Hill, a unique feature of Orange County is the University of North Carolina at Chapel Hill. The student population of the university adds approximately 25,000 people to the County's population during the school year. Orange County has several major highways which include I-40/85, US 70, 15/501, and NC 54, 57, 86, and 157. There are portions of three major river basins – Cape Fear, Neuse, and Roanoke - that are located in the county.

The Town of Carrboro is approximately 4.5 square miles and located at the southern portion of Orange County. The 2000 Census recorded a population of 16,782 persons in Carrboro, giving the town the distinction of having the highest population density in the State of North Carolina.

The Town of Hillsborough is located in the central portion of Orange County and is the county seat. The town is approximately 4.3 square miles and boasts a 2000 Census population of 5,446 residents.

The Town of Carrboro and the Town of Hillsborough are located entirely within Orange County. References to 'Orange County' throughout this plan update include unincorporated Orange County, as well as the Town of Carrboro and Town of Hillsborough, unless otherwise noted.

II. The Planning Process

A. Overview

This section shall serve as the documentation of the planning process utilized to develop the update of the Orange County Hazard Mitigation Plan in accordance with the requirements of Code of Federal Regulations, Title 44, Part 201 for local mitigation plans (44 CFR §201.6, Local Mitigation Plans).

This is an update of the Orange County Hazard Mitigation Plan, which was approved and ultimately adopted in October of 2004. The original plan and this update encompass the unincorporated areas of Orange County, the Town of Carrboro, and the Town of Hillsborough. In accordance with the approved plan, the Orange County Planning Department has served as the coordinator of the hazard mitigation plan update. However, the Orange County Hazard Mitigation (OCHM) Team consists of members representing the Town of Carrboro, Town of Hillsborough, as well as the County.

B. Plan Update Process

The OCHM Team kicked off the update process the latter half of 2008. Orange County Planning staff attended a hazard mitigation plan update session. Individually, team members reviewed the *Local Multi-Hazard Mitigation Planning Guidance* (FEMA, July 1, 2008) and began the evaluation of the approved Orange County Hazard Mitigation Plan. The plan update tracks the guidance provided for in FEMA's *Local Multi-Hazard Mitigation Planning Guidance*, published in July 2008.

The Orange County Planning Department managed the plan update process, organizing meetings and coordinating agendas, updating plan data, and developing drafts of updated plan sections. Representatives from the participating municipalities evaluated their respective Community Capability Assessments and made revisions, as necessary. The OCHM Team met periodically to review and comment on the draft plan updates and discuss possible modifications to methods, goals, and mitigation strategies. Collectively, the OCHM Team evaluated current conditions, hazard occurrences within Orange County since the original plan was adopted, and the mitigation goals included within that plan. The team determined the risk assessment previously adopted was still applicable to the County and participating municipalities and changes were not necessary. In addition, the previously developed goals were determined to remain valid. The majority of the revisions made in the updated plan were modifications to data tables and values, incorporating the most current and best available data. Additionally, the OCHM Team modified the formatting in the updated plan to be more consistent with the most recent adopted State Hazard Mitigation Plan Update from October 2007. The following subsections outline the OCHM Team's specific methods for evaluating and editing specific sections of the Hazard Mitigation Plan Update:

> The Planning Process: Collectively, the OCHM Team reviewed 'The Planning Process' section of the adopted plan and determined the methodology was relevant only to the adoption of the original hazard mitigation plan. The language in the adopted plan was outdated and was not applicable to the plan update methods. The OCHM determined 'The Planning Process' section of the update would be re-written to outline the current

conditions. In addition, the team determined the overall format of the adopted plan, including 'The Planning Process' section, was difficult to follow and should be re-worked for ease of use and to be more consistent with the most recent adopted State Hazard Mitigation Plan Update from October 2007.

Risk Assessment: As the adopted plan included the best available data from 2004, the OCHM Team determined that the data outlined in the Risk Assessment should be updated to reflect the best data available currently. The OCHM Team reviewed the adopted State Hazard Mitigation Plan Update (2007), as well as data provided by the National Weather Service, NOAA, and the State of North Carolina for more up to date information on severe weather occurrences and natural disasters affecting the United States, as well as the plan area. The majority of the revisions determined necessary by the team reflect the most current data available. In addition, the OCHM Team evaluated the hazards described within the Risk Assessment section of the plan. While several of the hazards discussed are unlikely to affect Orange County and the municipalities party to the Hazard Mitigation Plan (i.e. volcanoes, earthquakes, tsunamis), the team determined the description of the hazards included in the original adopted plan should remain in the update. The hazards described in the adopted plan were specifically required to be included in the original document by previous authorities and elected officials. While they remain in the update, additional analysis of those hazards was deemed unnecessary. Also, based on comments received, the OCHM team elected to revise the likelihood of Tornadoes potentially impacting Orange County and the Towns of Carrboro and Hillsborough, from "Unlikely" to "Possible". In addition, earthquakes were determined to be "Unlikely", versus "Possible". Finally, the OCHM Team determined the property information and values included in the adopted plan were also outdated. The Risk Assessment was revised to reflect the most current property value data for Unincorporated Orange County, the Town of Carrboro and the Town of Hillsborough.

Mitigation Strategy: The OCHM Team reviewed the mitigation strategies and Action Items included in the original Orange County Hazard Mitigation Plan. After much discussion, the team determined the mitigation strategies for the hazard designated as "Moderate" and "High" remained valid. Minor revisions were made to the text but the strategies remained the same. The Team also determined further analysis and strategies were not necessary for the hazards identified as "Low" in the plan update. In addition, each jurisdiction updated their Capability Analyses shown in Appendices B, C and D to reflect the most current regulations and programs in place for each participating jurisdiction.

Plan Maintenance: The OCHM Team discussed the Plan Maintenance procedures included in the approved Orange County Hazard Mitigation Plan and determined the overall processes were still appropriate. Minor changes to the text were made to make the language more current.

The plans, studies and technical data sources reviewed by the OCHM Team and incorporated in the plan update are listed below. These sources are noted throughout the plan update.

- National Oceanic and Atmospheric Administration (NOAA) - Top 20 States for Number of Tornadoes, Fatalities, and Damages, 1950 to 2007
- National Transportation Safety Board – Accident Database & Synopses

- ”The Deadliest, Costliest, and Most Intense United States Tropical Cyclones from 1851 to 2006 (and Other Frequently Requested Hurricane Facts)”by Eric S. Blake, Edward N. Rappaport,and Christopher W. Landsea, National Weather Service – National Hurricane Center, Miami FL, 2007
- Hazards & Vulnerability Research Institute (2008). The Spatial Hazard Events and Losses Database for the United States, Version 6.2 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org "
- State Hazard Mitigation Plan, Final 2007
- National Climatic Data Center - "Storm Data and Unusual Weather Phenomena
- Dam Safety Program, NC Division of Land Resources
- Orange County 2030 Comprehensive Plan
- Orange County Zoning Ordinance
- Orange County Subdivision Regulations
- Orange County Economic Development District Design Manual
- Orange County Soil Erosion and Sedimentation Control Ordinance
- Carrboro Vision 2020, Policies Through the Year 2020
- Town of Carrboro Land Use Ordinance
- North Carolina Flood Mapping Program
- Hillsborough Zoning Ordinance
- Hillsborough Subdivision Regulations
- Hillsborough Vision 2010 Revised Plan
- Hillsborough Floodplain Ordinance
- Agreement Between Town of Hillsborough and Orange County to provide Soil and Erosion Control

The Orange County Hazard Mitigation Plan Update received FEMA ‘Approval Pending Adoption’ on March 16, 2010. The plan was then presented to the Orange County Board of County Commissioners, the Carrboro Board of Alderman, and the Hillsborough Board of Commissioners for review and adoption. The resolutions of adoption for each jurisdiction are included in Appendix F.

C. Public Involvement

Over the past several years, Orange County and the Towns of Carrboro and Hillsborough have held numerous public meetings to gain citizen input into planning topics and programs. Although hazard mitigation has generally not been the topic per se, programs and regulations that directly mitigate hazard vulnerability have been implemented. For example, both Orange County and Carrboro do not allow any new construction within floodplain areas, regardless of finished elevation. In addition, both of these jurisdictions have implemented regulations that limit development in areas with steep slopes.

Citizens were invited to comment on the draft of the original Orange County Hazard Mitigation Plan on February 25, 2002. The Orange County Board of Commissioners held a public hearing on this date at the Orange County Courthouse located in Hillsborough. The meeting was advertised in the *News of Orange* and *Chapel Hill Herald* newspapers. No public comments were received during the plan development process.

The Town of Carrboro's Board of Aldermen held a public meeting on May 18, 2004 to receive public comments on the draft of the Hazard Mitigation Plan. Notice of the public hearing ran in the *Chapel Hill News*. No public comments were received.

As required by the North Carolina Division of Emergency Management, a public meeting notice was sent to neighboring communities, agencies, business interests, academic interests, nonprofits, and other interested parties on August 6, 2004 inviting them to a public meeting held on August 26, 2004. In addition, notice of the meeting was published in the *Chapel Hill News*, *Chapel Hill Herald*, and *News of Orange* informing the general public of the meeting regarding the draft Hazard Mitigation Plan and inviting public comment on the plan. The only meeting attendees were local government employees who had worked on the plan.

Following adoption, the Orange County Hazard Mitigation Plan was posted on the Planning and Inspections page of the official Orange County Government website. Contact information for the Planning staff member involved in the development and adoption of the plan is also provided to allow interested parties to comment on the plan or ask questions of staff. The plan has remained posted continually since 2004. Once approved and adopted, the Hazard Mitigation Plan Update will be added to the County's website. The Town of Carrboro will also provide a link to the most up-to-date hazard mitigation plan on its website.

Orange County, the Town of Carrboro and the Town of Hillsborough revise ordinances as needed. Many ordinance revisions involve policies which are both directly and indirectly related to hazard mitigation within each jurisdiction. For example, Orange County recently amended the Official Zoning Ordinance to incorporate the previously adopted Flood Damage Prevention Ordinance. This amendment involved meetings with local advisory boards, advertised public hearings and citizen input. This specific case is not isolated. Each jurisdiction processes similar cases on a regular basis, all of which involve citizen advisory boards, public hearings and community outreach. Each jurisdiction maintains transparency in policy development and adoption and requires the opportunity for public involvement.

III. Risk Assessment

A. Hazard Identification and Analysis

Orange County, including the Town of Carrboro and the Town of Hillsborough, is vulnerable to a number of natural hazards. Although each hazard cannot be predicted, they can be less disruptive to communities with hazard mitigation planning. Each hazard is unique to Orange County in terms of types, likelihood of occurrence, location, and impact. Each of these terms is explained below.

1. Types Of Hazards

Orange County has experienced or could experience many different types of natural hazards. Some are more likely than others to occur. Different hazards call for different hazard mitigation measures. The OCHM Team considered all of the hazards that threaten Orange County and focused on those that pose the greatest risk. The hazards considered for this plan were: Hurricanes, Floods, Tornadoes, Droughts and Heat Wave, Nor'easters, Thunderstorms, Severe Winter Storm, Wildfire, Chemical Spills, River Basins Dam Failure, Earthquake, Tsunamis, Volcano, Landslide, Plane Crash.

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Hurricanes

Because of Orange County's inland location, hurricanes have not historically been a significant threat. Hurricanes that have reached as far inland as Orange County have historically been greatly weakened as they neared and passed over the area. Hurricanes are cyclonic storms originating in tropical ocean waters and fueled by latent heat from the condensation of warm water. Heavy precipitation, high winds and tornadoes are all typically associated with hurricanes.

Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from 1 (minimal) to 5 (catastrophic) based on wind speeds, surface pressure, and height of storm surge, as shown in the Table below. Major hurricanes are categorized as 3, 4, or 5 on the Saffir-Simpson Scale. While hurricanes within this range comprise only 20% of total tropical cyclone landfalls, they account for over 70% of the damage in the United States. Maximum sustained winds of category 3, 4 and 5 hurricanes range from 112 mph to over 156 mph. This wind intensity topples trees and causes severe damage to structures.

Saffir-Simpson Hurricane Scale (Simpson and Reihl, 1981)			
Saffir-Simpson Category	**Maximum Sustained Winds (mph)**	**Minimum Surface Pressure (mb)**	**Height of Storm Surge (in feet)**
1	74-96	>980	3-5
2	97-111	979-965	6-8
3	112-131	964-945	9-12
4	132-155	944-920	13-18
5	156+	<920	19+

Source: North Carolina Division of Emergency Management, 1998: Local Hazard Mitigation Planning Manual.

History of Hurricanes in North Carolina

"North Carolina has a long and notorious history of destruction by hurricanes. Ever since the first expeditions to Roanoke Island in 1586, hurricanes are recorded to have caused tremendous damage to the state. Reliable classification of the intensity of tropical cyclones began in 1886. Since that time, there have been 951 tropical cyclones recorded in the Atlantic Ocean and the Gulf of Mexico. Approximately 166 or 17.5% of those tropical cyclones passed within 300 miles of North Carolina. The coast of North Carolina can expect to receive a tropical storm or a hurricane once every four years, while a tropical cyclone affects the state every 1.3 years" ("Preventing Disasters through Hazard Mitigation", Ana K. Schwab, *Popular Government*, Spring 2000, p.4).

Since 1886, eighty-two hurricanes have passed through North Carolina. Of these, twenty-eight made direct landfall on the North Carolina coast. The worst hurricane to impact North Carolina was Hurricane Hazel, a Category 4, in 1954. In the past 50 years, two hurricanes have passed over Orange County; both of which sustained wind speeds of less than 50 miles per hour by the time they reached Orange County. Hurricane Fran (a 1996 Category 3 hurricane) did not pass directly over Orange County but structures in the county sustained some damage from the high winds (approximately 75 miles per hour) Hurricane Fran sustained in inland areas. Seven deaths and two injuries were reported in Orange County due to Hurricane Fran. The table below displays major hurricanes that have impacted the United States.

30 Costliest Mainland United States Tropical Cyclones 1900-2006

Rank	Name or Location	Year	Category	Damage* (Millions)
1	Katrina	2005	3	$84,645
2	Andrew	1992	5	$48,058
3	Wilma	2005	3	$21,527
4	Charley	2004	4	$16,322
5	Ivan	2004	3	$15,451
6	Hugo	1989	4	$13,480
7	Agnes	1972	1	$12,424
8	Betsy	1965	3	$11,883
9	Rita	2005	3	$11,808
10	Camille	1969	5	$9,781
11	Frances	2004	2	$9,684
12	Diane	1955	1	$7,700
13	Jeanne	2004	3	$7,508
14	Frederic	1979	3	$6,922
15	New England	1938	3	$6,571
16	Allison	2001	TS	$6,414
17	Floyd	1999	2	$6,342
18	NE U.S.	1944	3	$5,927
19	Fran	1996	3	$4,979
20	Alicia	1983	3	$4,825
21	Opal	1995	3	$4,758

30 Costliest Mainland United States Tropical Cyclones 1900-2006				
Rank	**Name or Location**	**Year**	**Category**	**Damage* (Millions)**
22	Carol	1954	3	$4,345
23	Isabel	2003	2	$3,985
24	Juan	1985	1	$3,417
25	Donna	1960	4	$3,345
26	Celia	1970	3	$3,038
27	Bob	1991	2	$2,853
28	Elena	1985	3	$2,848
29	Carla	1961	4	$2,604
30	Dennis	2005	3	$2,330

Source: "The Deadliest, Costliest, and Most Intense United States Tropical Cyclones from 1851 to 2006 (and Other Frequently Requested Hurricane Facts)"by Eric S. Blake, Edward N. Rappaport,and Christopher W. Landsea, National Weather Service – National Hurricane Center, Miami FL, 2007
**Using 2006 Deflator: 2006 $ based on U.S. DOC Implicit Price Deflator for Construction*

Floods

Flooding is normally the result of a larger event such as a hurricane, nor'easter or thunderstorm. Flooding is caused by excessive precipitation and can be generally considered in two categories: flash floods and general floods. Flash floods are the product of localized, high-intensity precipitation over a short time period in small drainage basins. General floods are caused by precipitation over a longer time period and over a given river basin.

A combination of river basin physiography, local thunderstorm movements, past soil moisture conditions, and the degree of vegetative clearing determine the severity of a flooding event. Flooding is typically most severe in areas of the floodplain immediately adjacent to major streams and rivers.

Flooding can be as frequent as the occurrence of a spring rain or summer thunderstorm. The amount of precipitation produced by storm events determines the type of flooding. Flash floods, which typically occur more frequently than general floods, occur along small streams and creeks.

The undermining or washing out of roads is typically associated with flash floods. General flooding occurs less frequently and as the result of much larger storm events such as hurricanes. These larger storm events occur along the East Coast of the United States most often in the late summer and fall.

Orange County is located at the headwaters of three major river basins (the Roanoke, Neuse, and Cape Fear Rivers). Because of this, floodplains in the county tend to be much narrower than floodplains found further downstream. The total economic and loss of life impact due to flooding depends greatly on the amount of development within the area. Orange County prohibits new construction in floodplain areas and the Town of Carrboro

has significant restrictions on new development in floodplain areas. The Town of Hillsborough allows construction within floodplains provided the finished building elevation is high enough to sufficiently prevent flooding.

Flooding is normally associated with other types of events such as hurricanes and thunderstorms. Past occurrences of flooding in Orange County is documented in the appropriate hazard section with which the flooding occurred.

Tornados

Many times severe storms, such as thunderstorms and hurricanes, can produce smaller, more localized storms. Tornados, typically the by-product of a larger storm, are violently rotating columns of air that come in contact with the ground. Tornados have a more localized impact than a hurricane or nor'easter. Tornados generally produce a narrow path of concentrated destruction from 0.01 mile wide to greater than 1 mile wide. Tornados may also produce paths of destruction from less than 1 mile in length to greater than 100 miles in length.

The destruction caused by tornados may range from light to severe depending on the path of travel. Typically, structures of light construction, such as residential homes, suffer the greatest damage from tornados. Tornados are generally rated according to the Fujita-Pearson Scale as shown in the table below.

The Fujita-Pearson Tornado Scale

F-Scale	Damage	Winds (mph)	Path Length (miles)	Mean Width (miles)
F0	Light	40-72	<1.0	<0.01
F1	Moderate	73-112	1.0-3.1	0.01-0.03
F2	Considerable	113-157	3.2-9.9	0.04-0.09
F3	Severe	158-206	10-31	0.1-0.3
F4	Devastating	207-260	32-99	0.32-0.99
F5	Incredible	261-318	100+	1.0+

Source: North Carolina Division of Emergency Management, 1998: Local Hazard Mitigation Planning Manual.

Because tornados are typically a by-product of thunderstorms, they have a higher likelihood of occurrence. In North Carolina, tornados and thunderstorms are most likely to occur during the spring months (March through June). Tornados during these months have also been strongest, resulting in the greatest amount of harm or damage. Tornados can occur at any time of day but are mostly likely to form between the hours of 3 p.m. and 9 p.m.

Historic Impact of Tornados in Orange County

North Carolina ranks 20th out of the 50 states for frequency of tornados, 19th for number of tornado related deaths, 17th for injuries and 20th for cost of damages (source: Top 20

States for Number of Tornadoes, Fatalities, and Damages, 1950 to 2007; NOAA). Tornados in North Carolina are typically less severe than in other parts of the country, and the North Carolina Division of Emergency Management has rated Orange County as a "moderate" risk for tornados.

According to available records, six tornados impacted Orange County between 1956 and 2008. The most violent was an F3 tornado that occurred on November 23, 1992, which caused two (2) deaths, ten (10) injuries, and $500,000 in property damage.

Droughts and Heat Waves

Droughts are not rare or random events but normal, recurrent features of climate. Droughts occur in virtually all climatic zones, but drought characteristics vary significantly from one region to another.

Drought is a temporary aberration and differs from aridity, which is restricted to low rainfall regions, and is a permanent feature of climate. Drought originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector.

Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e.- evaporation + transpiration) in a particular area, a condition often perceived as "normal". It is also related to the timing (i.e.- principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e.- rainfall intensity, number of rainfall events) of rain events. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with drought and can significantly aggravate drought severity.

The more recent understanding that a deficit of precipitation has different impacts on groundwater, reservoir storage, soil moisture, snowpack, and streamflow led to the development of the Standardized Precipitation Index (SPI) in 1993. The SPI was designed to quantify the precipitation deficit for multiple time scales. These time scales reflect the impact of drought on the availability of the different water resources. Soil moisture conditions respond to precipitation irregularities on a relatively short scale. Groundwater, streamflow, and reservoir storage reflect longer-term precipitation inconsistencies.

Sequence of Drought Impacts

When drought begins, the agricultural sector is usually the first to be affected because of heavy dependence on stored soil water. Soil water can be rapidly depleted during extended dry periods. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface water (reservoirs and lakes) and subsurface water (ground water), for example, are usually the last to be affected. A short-term drought that persists for 3 to 6 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use requirements.

When precipitation returns to normal and meteorological drought conditions have abated, the sequence is repeated for the recovery of surface and subsurface water supplies. Soil water reserves are replenished first, followed by streamflow, reservoirs and lakes, and ground water. Drought impacts may diminish rapidly in the agricultural sector because of its reliance on soil water, but linger for months or even years in other sectors dependent on stored surface or subsurface supplies. Ground water users, often the last to be affected by drought during its onset, may be the last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the episode terminates.

Severe Droughts in the United States

The period of drought that has been the most well documented in both text and photographs occurred in the 1930s when drought covered virtually the entire Plains area of the U.S. for almost a decade. The most common effect of droughts often involves large amounts of agricultural land. Crops were damaged by deficient rainfall, high temperatures, and high winds, as well as insect infestations and dust storms that accompanied these conditions. The resulting agricultural depression contributed to the Great Depression with bank closures, business losses, increased unemployment, and other physical and emotional hardships. Although records focus on other problems, the lack of precipitation would also have affected wildlife and plant life, and would have created water shortages for domestic needs.

Effects of the Plains drought sent economic and social ripples throughout the country. Millions of people migrated from the drought-stricken areas, often heading west, in search of work. These newcomers were often in direct competition for jobs with longer-established residents, which created conflict between the groups. In addition, because of poverty and high unemployment, migrants added to local relief needs, sometimes overburdening relief and health agencies.

To reduce the impact of future droughts, proactive measures were developed and implemented including an increase in conservation practices and irrigation, average farm size, and crop diversity. Federal crop insurance was established and the regional economy was diversified. Many other proactive measures taken after the 1930s drought also reduced rural and urban vulnerability to drought, including new or enlarged reservoirs, improved domestic water systems, changes in farm policies, new insurance and aid programs, and removal of some of the most sensitive agricultural lands from production.

History of Drought in North Carolina and the U.S.	
Year	**Description**
1980	The drought/heat wave summer of 1980 caused over $20 billion in damages to agriculture and related industries and an estimated 10,000 heat stress-related deaths in the United States.
1986	$1 - $1.5 billion in damages and an estimated 100 deaths nationwide.
1988	Over $40 billion in damages and 5,000 to 10,000 deaths across central and eastern United States.
1993	During June-July 1993 most of the Southeast received less than 50% of normal rainfall along with temperatures 3 – 6 degrees above normal. Eighty-nine of the one hundred counties in NC were declared disaster areas. Crop losses for NC were estimated at $165 million. During this period, North Carolina also recorded the second driest summer (June-August) on record (since 1895) with a statewide average precipitation of only 9.43 inches. The Raleigh-Durham area recorded the driest June on record with 0.33 inches of rain. Estimated damages for the United States exceeded $1 billion in damages to agriculture and at least 16 deaths.
1998	Severe drought/heat wave from Texas/Oklahoma eastward to the Carolinas resulted in $6 - $9 billion in damages to agriculture and at least 200 deaths. 1999 Summer drought/heat wave of 1999 resulted in extensive agricultural losses estimated at over $1.0 billion in damages and an estimated 502 deaths in the United States. The east coast was hardest hit by the drought, with record and near-record short-term precipitation deficits occurring on a local and regional scale resulting in agricultural losses and drought emergencies being declared in several states. Drought was especially severe in the mid-Atlantic states, where local water restrictions were in effect and drought emergencies were declared by several governors. February-August 1999 ranked as the fifth driest such period in the 105-year record.
2000	Severe drought and persistent heat over south-central and southeastern states caused significant losses to agriculture and related industries estimated at over $4.0 billion in damages and 140 deaths.
2002	According to the National Climatic Data Center, moderate to extreme drought affected more than 45% of the United States June through August of 2002. Nationwide, the summer of 2002 was the third hottest on record after the summers of 1934 and 1936. The 12 months that ended with August 2002 were the driest on record for North Carolina. Local water restrictions were in effect throughout central and western North Carolina.
2003 - 2004	A period of dry weather that began in Aug. 2003 resulted in moderate drought conditions across portions of western North Carolina by late spring of 2004. Streamflow and lake levels began to run below normal, and a few communities instituted water restrictions.

Sources: National Climatic Data Center; State Hazard Mitigation Plan, Final 2007.

North Carolina experienced dry weather again in 2007 and 2008, resulting in a statewide drought. Lake and reservoir levels were below normal and communities across the state instituted water restrictions.

Heat Waves

Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. Among large natural hazards, only the cold of winter – not lightning, hurricanes, tornadoes, floods, or earthquakes – takes a greater toll. In the 40-year period from 1936 through 1975, nearly 20,000 people in the United States were killed by the effects of heat and solar radiation. In the disastrous heat wave of 1980, more than 1,250 people died as a direct result of the heat wave. People at higher risk, e.g., with aging or diseased hearts, are especially susceptible to excessive heat. In recent years, the National Weather Service (NWS) has stepped up efforts to more effectively alert the general public and appropriate authorities to the hazards of heat waves and prolonged excessive heat/humidity episodes. *(Source: National Oceanic and Atmospheric Administration (NOAA))*

How Heat Affects the Body

Human bodies dissipate heat by varying the rate and depth of blood circulation, by losing water through the skin and sweat glands, and -- as the last extremity is reached -- by panting, when blood is heated above 98.6 degrees. As heat rises, the heart begins to pump more blood, blood vessels dilate to accommodate the increased flow, and the bundles of tiny capillaries threading through the upper layers of skin are put into operation. Blood is circulated closer to the skin's surface, and excess heat drains off into the cooler atmosphere. At the same time, water diffuses through the skin as perspiration. The skin handles about 90 percent of the body's heat dissipating function. Sweating, by itself, does nothing to cool the body, unless the water is removed by evaporation -- and high relative humidity retards evaporation. Heat disorders generally have to do with a reduction or collapse of the ability of the body to shed heat by circulatory changes and sweating, or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat related illness may develop.

Ranging in severity, heat disorders share one common feature: the individual has overexposed or over exercised for his/her age and physical condition in the existing thermal environment. Sunburn, with its ultraviolet radiation burns, can significantly retard the skin's ability to shed excess heat. Studies indicate that, other things being equal, the severity of heat disorders tend to increase with age -- heat cramps in a 17-year-old may be heat exhaustion in someone 40 and heat stroke in a person over 60.

Heat Index

The heat index, given in degrees Fahrenheit, is an accurate measure of how hot it really feels when the relative humidity is added to the actual air temperature (see Heat Index Chart below). If the air temperature is 95°F (found on the left side of the chart), and the relative humidity is 50% (found at the top of the chart), the heat index - or how hot it really feels - is 105°F. This is at the intersection of the 95° row and the 50% column. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase these values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous. The shaded zone above 95°F in the chart corresponds to a heat index

level that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

Heat Index Chart						
Temperature (F) versus Relative Humidity (%)						
°F	**90%**	**80%**	**70%**	**60%**	**50%**	**40%**
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95	>130	133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

Heat Index	Possible Heat Disorder
80°F - 90°F	Fatigue possible with prolonged exposure and physical activity.
90°F - 105°F	Sunstroke, heat cramps and heat exhaustion possible.
105°F - 130°F	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
130°F or greater	**Heat stroke highly likely with continued exposure.**

Source: National Weather Service Heat Index Program, NOAA.

Nor'easters

Nor'easters (or northeasters) are wind or gale storms with winds predominantly from the northeast. Nor'easters typically impact the eastern United States and are similar to hurricanes in respect to their effects. Unlike hurricanes, however, nor'easters are extra-tropical storms, deriving their strength from horizontal gradients in temperature - they form as a result of a drop in temperature.

Nor'easters affect the state in a similar fashion as hurricanes in that they produce heavy surf and high winds. A nor'easter occurring during winter months may also produce ice hazards and effects similar to those of a severe winter storm.

Orange County, including the Town of Carrboro and Town of Hillsborough, would typically suffer the same effects from a nor'easter as from a hurricane. Because of Orange County's inland location, the impact of a nor'easter would not be expected to be exceptionally severe. The occurrence of a nor'easter often produces substantial amounts of precipitation and strong winds. Nor'easters occurring in the winter may result in accumulation of snow and/or ice.

According to an analysis of nor'easter frequency, fewer nor'easters occurred during the 1980's. However, the frequency of major nor'easters (Class 4 or 5) has increased in recent years. From 1987 to 1993 at least one class 4 or 5 storm occurred each year along the

Atlantic seaboard of the United States, a situation duplicated only once in the last 50 years. Nor'easters are rated by the Dolan-Davis Intensity Scale. The scale is not included in this document because it is based upon beach and dune erosion and overwash, none of which are relevant to Orange County, the Town of Carrboro or the Town of Hillsborough.

Thunderstorms

Severe thunderstorms can occur alone or in clusters, but affect relatively small areas compared to those affected by hurricanes or nor'easters. In eastern North Carolina, thunderstorms most frequently occur in the late afternoon or during the evening or night hours during the summer months. Summer thunderstorms involve lightning, strong winds, heavy rains and hail that can result in wildfires, localized wind damage and flash flooding.

According to the North Carolina State Climate Office, thunderstorms typically are 15 miles or less in diameter and last an average of 20 to 30 minutes. Downbursts and straight-line winds associated with thunderstorms can produce winds of 100-150 miles per hour - enough to flip large trucks and endanger airplane landings and takeoffs.

The National Weather Service considers a thunderstorm severe if it produces hail at least three-quarters of an inch in diameter, has winds of 58 miles per hour or greater or produces a tornado. Of the estimated 100,000 thunderstorms in the United States each year, only about 10% are classified as severe.

Lightning, a major threat during a thunderstorm, is responsible for more deaths each year in the United States than are tornadoes. Since lightning strikes are very unpredictable, the risk to individuals and property can be significant.

Historic Impact of Thunderstorms in Orange County (including Carrboro & Hillsborough)

As the Hazard History table at the end of this section shows, a number of thunderstorm/high wind storm events and thunderstorm related events (hail and lightning) have been reported in Orange County.

Severe Winter Storm

Severe winter weather is typically associated with much colder climates; however, winter storms involving extremely cold temperatures, ice storms, and/or heavy snow have occurred in Orange County. The impact of a winter storm in Orange County can be significant. Although equipment such as snow plows is available in the region, winter storms can produce an accumulation of snow and ice on trees and utility lines resulting in loss of electricity and blocked transportation routes. Frequently, loss of electric power means loss of heat for residential customers, which poses an immediate threat to human life.

As the Hazard History table at the end of this section indicates, ice storms, heavy snow, and extreme cold has impacted Orange County, including Carrboro and Hillsborough, several times from 1956 to 2008.

Wildfire

Wildfires occur in North Carolina during the dry spring and summer months of the year. The potential for wildfires depends upon recent climate conditions, surface fuel characteristics, and fire behavior. Wildfires can destroy precious natural resources and forestry essential to the survival of wildlife.

Increased development in Orange County, including the Town of Carrboro and Town of Hillsborough, in recent years has increased the potential impact of wildfires as structures that locate near vulnerable woodlands become vulnerable themselves. Because wind fuels wildfires, structures in close proximity to potential wildfire fuels are at risk of damage as wind direction and velocity change.

The frequency and extent of wildfires in Orange County has historically been quite low.

Chemical Spills

A chemical spill or HAZMAT (Hazardous material) spill is an accidental and unwanted release of a hazardous chemical from its container. Chemical spills can occur at chemical storage sites or while chemicals are in transit via roadways or railways. Approximately 6,774 HAZMAT events occur each year nationwide. On average, there will be 991 events. Trucks are responsible for most of the remainder of events. The average distance for trip lengths for gasoline transport is 28 miles; 260 miles is the average trip length for chemical trucks. Even though trucks account for most accidents, it is railway transport that has the greatest potential for concern in many areas. Collisions and derailments can cause very large spills as it is rare that a single car will be damaged. Extremely hazardous substances, as defined by the EPA, can pose a serious threat, whether by rail or other ground transportation.

HAZMAT spills occur at fixed sites each year. Natural disasters, such as floods and earthquakes can cause HAZMAT releases or disturb old HAZMAT release sites (Superfund sites). These same disasters can make it difficult to contain these events once they occur. Also, natural disasters can limit access to the spill, waterlines for fire suppression may be broken, and response personnel and resources may be limited. Flooding and high winds can quickly spread the contaminant, threatening agriculture, water supply and air.

HAZMAT releases pose short and long term threats to people, wildlife, vegetation, and the environment. HAZMAT materials can be absorbed through inhalation, ingestion, or direct contact with the skin.

Orange County Emergency Services maintains an inventory of chemical storage sites within the county and has developed plans to rapidly notify the public of situations involving those sites and have personnel and equipment to effectively respond to incidents involving those sites. Orange County Emergency Services, and the fire departments that serve those sites maintain contact with the site owners and exchange information as

necessary to provide for the safety of the public and those that may have to respond to an incident at those locations.

River Basins Dam Failure

There are approximately 80,000 dams listed in the National Inventory of Dams. This number includes impoundment structures greater than or equal to 25 feet in height or impounding 50 acre-feet (an acre-foot equals water 1 foot deep across one acre of land) or more of water, or structures above 6 feet in height whose failure would potentially cause damage downstream. Nine thousand dams nationwide have been designated as high hazard dams. For purposes of this report, dams meeting these criteria, shall be termed regulated dams.

The high hazard designation does not indicate the inherent stability or instability of a dam but instead measures the potential threat posed to downstream populations in the event of a dam failure.

Background Information on Dams

Dams provide a life-sustaining resource to people in all regions of the United States. Unlike most infrastructure, dam owners are solely responsible for the safety and the liability of the dam and for financing upkeep, upgrade and repair. While most infrastructure facilities (roads, bridges, sewer systems, etc.) are owned by public entities, the majority of dams in the United States are privately owned. Across the nation, about 58% of dams are privately owned, 16% are owned by local governments, 4% by states, and the rest by the federal government and public utilities.

Manmade dams are classified according to the type of construction material used, the methods used in construction, the slope or cross-section of the dam, the way the dam resists the forces of water pressure, the means used for controlling seepage and, occasionally, according to the purpose of the dam.

The materials used for construction of dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, miscellaneous materials (such as plastic or rubber) and any combination of these materials. Embankment dams, the most common type of dam, are usually constructed of natural soil or rock or waste materials obtained from mining or milling operations. An embankment dam is termed an “earthfill” or “rockfill” dam depending on whether it is comprised of compacted earth or mostly compacted rock. The ability of an embankment dam to resist water pressure is primarily a result of the mass, weight, type and strength of the materials from which the dam is made.

Overtopping of an embankment dam is very undesirable since embankment materials may be eroded away. Water normally passes through the main spillway or outlet works; it should pass over an auxiliary spillway only during periods of high reservoir levels and high water inflow. All embankment and most concrete dams have some seepage; however, it is important to control the seepage to prevent internal erosion and instability. Proper dam construction, maintenance, and monitoring of seepage provide this control.

Intentional release of water is confined to water releases through outlet works and spillways. A dam typically has a principal or mechanical spillway and a drawdown facility. Additionally, some dams are equipped with auxiliary spillways to manage extreme floods. Spillways ensure that the reservoir does not overtop the dam. Outlet works may be provided so that water can be drawn continuously, or as needed, from the reservoir. Outlets also provide a way to draw down the reservoir for repair or safety concerns. Water withdrawn may be discharged into the river below the dam, run through generators to provide hydroelectric power, or used for irrigation. Dam outlets usually consist of pipes, box culverts or tunnels with intake inverts near minimum reservoir level. Such outlets are provided with gates or valves to regulate the flow rate.

Dam Classifications

Dams are classified in one of three categories:

Dam Hazard Classification		
Hazard Classification	**Description of Potential Damage**	**Quantitative Guidelines**
Low	Interruption of road service, low volume roads;	Less than 25 vehicles/day
	Economic Damage	< $30,000
Intermediate	Damage to highways, interruption of service	25 to less than 250 vehicles/day
	Economic damage	$30,000 to < $200,000
High	Loss of human life (due to breached roadway or bridge on or below the dam)	Probable loss of 1 or more human lives
	Economic damage	>$200,000
	Damage to highways, breached roadway or bridge	250 vehicles/day at 1000 feet visibility 100 vehicles/day at 500 feet visibility 25 vehicles/day at 200 feet visibility

Source: Dam Safety Program, NC Division of Land Resources.
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.

National Dam Safety Program

The National Dam Safety Program Act, enacted in 1996, was established to improve dam safety by:
1. providing assistance grants to state dam safety agencies to improve regulatory programs;
2. funding research to enhance technical expertise as dams are built and rehabilitated;
3. establishing training programs for dam safety inspectors; and
4. creating a National Inventory of Dams.

The Act also requires FEMA to provide education to the public, to dam owners and to others about the need for strong dam safety programs, nationally and locally, and to coordinate partnerships among all players within the dam safety community to enhance dam safety.

North Carolina Dam Safety Program

The NC Dam Safety Program conducts the following:
1. Inspect high hazard dams at least every two years; intermediate and low hazards at least every five years.
2. Notify dam owners of deficiencies found in the dams and needed maintenance or engineering and repairs.
3. Enforcement action if needed.
4. Review plans for construction of new dams, and repairs, modifications and decommissioning of existing dams.
5. Inspect during construction activities as resources permit.
6. Inspect prior to impoundment once construction is completed.
7. Inspect during and after extreme events such as floods.
8. Maintain databases and records of dams under state jurisdiction.

The U.S. Army Corps of Engineers is responsible for dams under federal jurisdiction, (e.g., Falls Lake Reservoir and Jordan Lake Reservoir) and for hydroelectric dams or cooling water dams for power plants.

Potential of Dam Failure

Early in the 20th century, it was recognized that some form of regulation was needed after a number of dams failed due to lack of proper engineering and maintenance. Federal agencies, such as the Army Corps of Engineers and the Department of Interior, Bureau of Reclamation built many dams during the early part of the twentieth century and established safety standards during this time. It was not until a string of significant dam failures in the 1970s that awareness was raised to a new level among the states and the federal government.

Driving every other issue and all activities within the dam safety community is the risk of dam failure. Although the majority of dams in the U.S. have responsible owners and are properly maintained, many dams still fail every year. In the past several years, there have been hundreds of documented failures across the nation (this includes 250 after the Georgia Flood of 1994). Dam and downstream repair costs resulting from failures in 23 states reporting in one recent year totaled $54.3 million.

Dam failures are most likely to happen for one of the following reasons:
- Structural failure of materials used in dam construction
- Cracking caused by movements like the natural settling of a dam
- Piping—when seepage through a dam is not properly filtered and soil particles continue to progress and form sink holes in the dam.

Property owners downstream often know nothing about the potential that an upstream dam has to cause devastation should it fail. Even if citizens understand and are aware of dams, they still can be overly confident in the infallibility of these manmade structures. Living in dam-break flood-prone areas is a risk. Many dam owners do not realize their responsibility and liability toward the downstream public and environment. Adequate understanding of proper dam maintenance and upgrade techniques is a typical problem among many owners across the United States.

History of Dam and Levee Failures in North Carolina

The North Carolina Dam Safety Program has made use of National Dam Safety Program funds to create and implement the North Carolina Emergency Action Plan. The Plan was activated in 1999 during and after Hurricane Floyd and was instrumental in reducing response time in closing roads and evacuating persons from high-risk areas. Following Hurricane Floyd, no injuries were reported despite the failure of 36 dams (14 high hazard, 5 intermediate, and 12 low or unclassified dams). In the days and months following Hurricane Floyd, North Carolina dam safety personnel worked to ensure the safety of over fifty dams damaged by the hurricane. Dam owners, safety inspectors and local emergency management personnel monitored these dams asking owners to lower water levels and/or complete emergency repairs.

Dams in Orange County

There are 38 regulated dams in Orange County. Three (3) of these are within the town limits of Chapel Hill, which is not included in this plan. Seven (7) of the dams are rated "high hazard" (3 of these are within Chapel Hill),meaning that if a failure were to occur there is a probable loss of one or more human lives and property damage exceeding $200,000. A list of the dams is found in the table below.

Orange County Dams
(including Town of Carrboro and Town of Hillsborough)

Orange County Dams		
Dam Name	**Hazard Potential**	**River or Stream**
Caldmont Lake Dam	Low	Buffalo Creek
Hogan Farms Dam	High	Bolin Creek
Lake Michael Dam	Intermediate	Back Creek-Tr
Arrowhead Lake Dam	Low	East Fork Eno River-Tr
Lake Orange Dam	Intermediate	East Fork Eno River
Johnson Lake Dam	Low	Eno River-Tr
Orange-Alamance Lake Dam	Low	Eno River
Blackburn Lake Dam	Intermediate	Eno River-Tr
Smith Lake Dam	Low	Crabtree Creek-Tr
Fellowship Lake Dam	Low	Seven Mile Creek-Tr
Cane Creek Reservoir Dam	High	Cane Creek
Blackwood Lake Dam	Low	Morgan Creek
Eastwood Lake Dam	High	Booker Creek
University Lake Dam	High	Morgan Creek
Ashley Lake Dam	Low	North Fork Little River-Tr
Piedmont Minerals Lake Dam	Low	Eno River
New Hope Dam	Low	Off New Hope Creek
Clearwater Lake Dam	Low	Big Branch
Hogan Dam	Low	Rocky Run-Tr
Lake Ellen Dam	High	Booker Creek
Rush Dam	Low	Prichard Mill Creek
Wilsondel Pond Dam	Low	Haw Creek-Tr
Spring Valley Lake Dam	Low	Eno River-Tr
Fox Lake Dam	Low	Little Creek-Tr
Pleasant Green Road Dam	Low	Eno River
Carrboro Park Dam	Intermediate	Morgan Creek-Tr
Rogers Dam	Low	Back Creek-Tr
C. S. Burton Dam	Low	Rocky Run-Tr
Lloyd Heron Pond Dam	Low	Buffalo Creek-Tr
Spring Valley Dam	High	Bolin Creek-Tr
Gordon Dam	Low	Eno River-Tr
Hines Pond Dam	Low	Eno River-Tr
Rogers Pond	Low	Frank Creek-Tr
P.W. Scott Lagoon	Low	Toms Creek-Os
Meadowlands	Intermediate	Eno River-Tr
Strayhorn Farm Dam	Intermediate	Stony Creek-Tr
Strayhorn Dam #2	Intermediate	Stony Creek-Tr
Colony Lake	High	Little Creek-Tr

Source: Dam Safety Program, NC Division of Land Resources

Note: Shaded lines indicate dams within the town limits of Chapel Hill (not included in this Plan)

History of Dam Failures in Orange County

There is no recorded history of significant dam failures occurring in Orange County, including the Town of Carrboro and Town of Hillsborough. However, several years ago, a dam breach in Chatham County, which is located directly south of Orange County, caused some flooding problems within the southern limits of the Town of Carrboro.

Earthquake

Earthquakes are geological events that involve movement or shaking of the crust of the earth. Earthquakes are measured in terms of their magnitude and intensity as shown in the table below. Earthquakes can cause devastating destruction to the manmade environment.

Earthquakes are relatively infrequent but not uncommon in North Carolina. From 1568 to 1992, 157 earthquakes have occurred in North Carolina. There is no existing data to indicate that any earthquakes have occurred in Orange County.

North Carolina's vulnerability to earthquakes decreases from west to east in relation to the Eastern Tennessee Seismic Zone. Epicenters are generally concentrated in this active seismic zone, which is second in activity in the eastern United States only to the New York Madrid Fault.

Modified Mercalli Scale of Earthquake Intensity

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	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	<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

Source: Local Hazard Mitigation Planning Manual, North Carolina Division of Emergency Management, 1998, p. 75.

Since there is no recorded history of earthquakes impacting Orange County and its' municipalities, and it is highly unlikely that a earthquake would impact Orange County, this natural hazard was not analyzed for potential impact on Orange County, including the Town of Carrboro and Town of Hillsborough.

Tsunamis

Tsunami (pronounced tsoo-nah-mee) is a wave train, or series of waves, generated in a body of water by a disturbance that vertically displaces the water column. Earthquakes, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis. Tsunamis can savagely attack coastlines, causing devastating property damage and loss of life.

Tsunamis are unlike hurricane or wind generated waves in that they are characterized as shallow-water waves, with long periods and wave lengths. A wind-generated swell that rhythmically rolls in, one wave after another, might have a period of about 10 seconds and a wave length of 150 meters. A tsunami, on the other hand, can have a wavelength in excess of 100 kilometers and last on the order of one hour.

The character of a tsunami transforms as it leaves the deep water of the open ocean and travels into the shallower water near the coast. A tsunami travels at a speed that is related to the water depth - hence, as the water depth decreases, the tsunami slows. But the energy flux of a tsunami, which is dependent on both wave speed and wave height, remains nearly constant. Consequently, as the speed of the tsunami diminishes as it travels into shallower water, the height of the tsunami grows. A tsunami may be imperceptible at sea but grow to be several meters or more in height near the coast. When the tsunami finally reaches the coast it may appear as a rapidly rising or falling tide or a series of breaking waves.

Just like other water waves, tsunamis begin to lose energy as they rush onshore - part of the wave energy is reflected offshore, while the shoreward-propagating wave energy is dissipated through bottom friction and turbulence. Despite these losses, tsunamis still reach the coast with tremendous amounts of energy that strips beaches of sand and undermines trees and other coastal vegetation. Capable of inundating or flooding hundreds of meters inland past the typical high-water level, a tsunami can crush homes and other coastal structures. Tsunamis may reach a maximum vertical "runup" height onshore above sea level of 10, 20, and even 30 meters.

History of Tsunamis in Orange County

Since there is no recorded history of tsunamis impacting North Carolina, and it is highly unlikely that a tsunami would impact Orange County, this natural hazard was not analyzed for potential impact on Orange County.

Volcanoes

Volcanic eruptions are one of the most dramatic and violent agents of environmental change. Not only can powerful explosive eruptions drastically alter land and water for tens of kilometers around a volcano, but tiny liquid droplets of sulfuric acid erupted into the stratosphere can temporarily change the climate of the planet. Eruptions often force people living near volcanoes to abandon land and homes, sometimes forever. Those living farther away are likely to avoid complete destruction, but cities and towns, crops, industrial plants, transportation systems, and electrical grids can still be damaged by tephra, lahars, and flooding caused by volcanic eruptions.

Worldwide volcanic activity since 1700 A.D. has killed more than 260,000 people, destroyed entire cities and forests, and severely disrupted local economies for months or years. Even with the improved ability to identify hazardous areas and warn of impending eruptions, increasing numbers of people face certain danger. Scientists have estimated that the total population at risk from volcanoes in 2000 is at least 500 million, which is comparable to the entire population of the world at the beginning of the seventeenth century.

Volcano Hazard Areas Around the Globe

Active volcanoes are not randomly distributed over the earth surface. Instead, they tend to be located in linear volcanic mountain chains thousands of kilometers long on the edges of continents, in the middle of oceans, or as island chains. The locations of these volcanic chains are closely related to the way in which the earth crust is divided into more than a dozen enormous sections or "plates" and how the plates move relative to one another.

According to the theory of plate tectonics, rigid plates averaging 80 kilometers in thickness, move in slow motion on top of the hot, pliable interior of the earth. Most active volcanoes are located along the boundaries where these massive plates spread apart or collide. But some of the most active volcanoes, like Kilauea Volcano on the Island of Hawaii, are found in the middle of these massive plates above hot spots in the interior of the earth. More than fifty volcanoes in the United States have erupted one or more times in the past few hundred years.

The United States Geological Survey (USGS) is charged with the responsibility to issue warnings of hazardous volcanic activity in the United States. The USGS has identified volcano-hazard zones around active and potentially active volcanoes. Volcano-hazard assessments are based on the assumption that the same general area around a volcano is likely to be affected by future volcanic activity of the same type and at about the same average frequency as in the past. Through detailed geologic mapping of the type and size of past eruptions, the USGS has estimated the area most likely to be affected by similar events in the future.

Volcanoes generate a wide range of activity that can affect the surrounding land, river valleys, and communities in different ways. Depending on the type, size, and duration of the eruptive activity, hazardous areas might exist within a few kilometers of a volcano or extend to areas hundreds of kilometers from an active vent. By studying the natural history

of a volcano, it is possible to identify those hazard areas most likely to be affected in the future by volcano hazards.

Historic Volcanic Eruptions in the United States

Records of volcanic eruptions within the United States are centered in the states of Alaska, Washington, Oregon, California, and Hawaii. Since there are no recorded instances of volcanic eruptions in North Carolina, this natural hazard was not analyzed for potential impact.

Landslides

According to the United States Geological Survey (USGS), landslides are a major geologic hazard that occur in all 50 states, cause $3.5billion in damages per year and cause between 25 and 50 fatalities each year (USGS, 2005). Landslides often occur with other natural hazards such as earthquakes and floods.

Clay-rich soil landslides are common throughout the mountainous Appalachian region of the United States. The USGS classifies landslide incidence/susceptibility for the eastern United States as low, medium, or high based on geographic features and geologic formations.

USGS further defines susceptibility to landslides as the probable degree of response of geologic formations to natural or artificial cutting, loading of slopes, or unusually high precipitation. Generally, unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced landslides in the past.

Historic records suggest that destructive landslides and debris flows in the Appalachian Mountains occur when unusually heavy rain from hurricanes and intense rain storms soak the ground, reducing the ability of steep slopes to resist the downward pull of gravity. Scientists have documented fifty-one debris-flow events in North Carolina between 1844 and 1985. All of these occurred in the Appalachian Mountains and most were in the Blue Ridge area. (Gori and Burton, 1996)

USGS Landslide Susceptibility/Incidence		
Category	**Incidence**	**Susceptibility**
1	Low	Low
2	Low	Moderate
3	Low	High
4	Moderate	Moderate
5	Moderate	High
6	High	High

Source: Local Hazard Mitigation Planning Manual, North Carolina Division of Emergency Management, 1998.

An area with a "low" incidence ranking means that less than 1.5% of the area has experienced a landslide in the past. An area with a "moderate" incidence ranking means that between 1.5% and 15% of the area has experienced a landslide in the past. An area with a "high" incidence ranking means that greater than 15% of the area has experienced a landslide in the past. The susceptibility rankings of "low", "moderate" and "high" follow the same percentage classifications for landslide susceptibility for a specific area. The overall likelihood of occurrence of a landslide in Orange County, including the Town of Carrboro and Town of Hillsborough, can be classified as "moderate," especially the southeastern quadrant of the county, which includes the Town of Carrboro, due to the soil types and slopes found in the county.

History of Landslides in Orange County

There are no records of landslides occurring in Orange County although the hazard is classified as "moderate" due to soil types and topography, especially in the southeastern portion of the county.

Plane Crash

Orange County is located approximately 20 miles west of RDU (Raleigh-Durham) Airport. In addition, Horace Williams Airport, a non-commercial airport, is located in Chapel Hill. Some approach and take-off zones for Horace Williams Airport are over the town limits of Carrboro. The vulnerability of the county and its municipalities to a plane crash is minimal but does exist.

RDU Airport, which is centrally located between the city limits of Raleigh and Durham, is a major commercial airport that is also open to the public for general aviation use. The airport has an air traffic control tower and three (3) runways. The main runway, which is concrete/wired/combed construction, is 10,000 feet long and 150 feet wide. A second runway, with an asphalt/grooved surface, is 7,500 feet long and 150 feet wide. The third runway, which is asphalt surfaced, is 3,570 feet long and 100 feet wide. There are an average of 662 airport operations per day with the following categorization by type: 38% air taxi, 33% commercial, 26% transient general aviation, 2% military, and <1% local general aviation.

Horace Williams Airport, located in Chapel Hill, is operated by the University of North Carolina at Chapel Hill (UNC-CH) and is open to the public for general aviation use. The small airport does not have an air traffic control tower. It is equipped with one (1) asphalt-surfaced runway which is 4,005 feet long by 75 feet wide. Aircraft are limited in weight to no more than 12,500 pounds. There are an average of 30 airport operations per day with the following categorization by type: 76% local general aviation, 19% transient general aviation, 5% air taxi, and 1% military operations.

The following table is a history of aviation incidents in Orange County, including the Town of Carrboro and Town of Hillsborough, from January 1, 1964 through December 31, 2008:

History of Aviation Incidents in Orange County 1964 - 2008						
Date	**Nature of Incident**	**Location**	**Injuries**			**Commercial Flight?**
			Fatal	Major	Minor/ None	
4/22/2008	Collision with ground in heavy winds	Chapel Hill			4	No
4/19/2001	Collision with trees	Chapel Hill			2	No
5/25/2000	Collision with ground	Chapel Hill			2	No
6/5/1999	Collision with trees	Chapel Hill		1		No
8/29/1998	Forced landing in wooded area	Chapel Hill			1	No
2/25/1998	Collision with ground	Chapel Hill		3		No
7/5/1996	Forced landing in open pasture	Hillsborough			2	No
4/20/1996	Forced landing	Mebane		1		No
7/10/1994	Collision with drainage ditch	Chapel Hill			2	No
5/25/1994	Departed Runway surface	Chapel Hill			4	No
12/11/1993	Collision with wooded area	Chapel Hill	3			No
1/17/1993	Emergency landing in open area	Mebane		4		No
10/1/1989	Collision with trees	Hurdle Mills	2			No
8/11/1989	Collision with ground	Chapel Hill	1			No
7/21/1986	Collision with ground	Chapel Hill			5	EMS (Emergency Medical Service)
10/1/1985	Collision with tree, power transmission line, and ground	Chapel Hill	2			No
10/30/1981	Collision with ground	Chapel Hill		1		No
6/5/1981	Collision with ground	Chapel Hill	1	3		No
2/7/1981	Collision with trees	Chapel Hill	7			No
9/13/1980	Collision with ground	Chapel Hill			3	No
8/14/1980	Collision with ground	Mebane			1	No
6/13/1977	Gear Collapsed	Chapel Hill			4	No
11/3/1975	Collided with wires/poles	Carrboro			2	No
9/3/1975	Gear Collapsed	Chapel Hill			2	No
11/14/1974	Collision with ground	Chapel Hill			3	No
1/9/1972	Emergency landing off airport	Hillsborough			2	Yes

History of Aviation Incidents in Orange County 1964 - 2008						
Date	**Nature of Incident**	**Location**	**Injuries**			**Commercial Flight?**
			Fatal	Major	Minor/ None	
3/27/1969	Collision with ditch	Hillsborough			1	No
1/19/1969	Collision with trees	Carrboro			2	No
4/24/1968	Collision with ground	Hillsborough	1			No
7/20/1967	Collision with trees	Chapel Hill			2	No
5/10/1967	Collision with ground	Chapel Hill		2		No
12/8/1966	Gear Collapsed	Chapel Hill			1	No
11/21/1964	Collision with trees	Chapel Hill			3	No
3/30/1964	Collision with trees	Chapel Hill			4	No

Source of data: NTSB – Accident Database & Synopses, 2009

2. Hazard Likelihood of Occurrence

The OCHM Team estimated the likelihood of each type of hazard occurring in Orange County. This estimate is based on the local history of the events.

- Highly Likely: Near 100% probability in the next year.
- Likely: Between 10% - 100% probability in the next year, or at least one chance in the next ten years.
- Possible: Between 1% - 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.

3. Hazard Prone Areas

Certain areas, such as floodplains and steep slopes, are more prone to hazards than others. Many of these are readily identifiable on maps. The OCHM Team identified those areas that are most vulnerable to each natural hazard and determined whether they cover a small, medium, or large proportion of Orange County and Towns.

All but two of the types of natural hazards most likely to affect Orange County (Severe Winter Storms, Thunderstorms and Tornadoes, Drought and Heat Waves, Flooding, and Landslides) have equal potential to occur anywhere within the county and its municipalities (i.e.: one area of the county is not more likely to be affected than another). Landslides are more likely to occur in the southeastern portion of the county, which includes the Town of Carrboro, due to the types of soils and topography prevalent in that geographic area. Flooding, while it can conceivably occur anywhere in the county, is more likely in floodplain areas, which are located throughout unincorporated Orange County, the Town of Carrboro, and the Town of Hillsborough.

4. Hazard Impact

Some natural hazards have greater impacts than others, but occur infrequently (severe earthquakes) and others hazards occur annually or several time a year but cause less damage (thunderstorms). The impact is a combination of the magnitude of the event, how large an area within the community is affected and the amount of human activity in that area. The following table explains how the impact is measured.

Measurement of Types of Hazard Impacts		
Type	**Magnitude (percent of property in county damaged)**	**Severity**
Catastrophic	More than 50%	Multiple deaths, complete shutdown of facilities for 30 days or more. 50% of property damaged.
Critical	25% to 50%	Multiple severe injuries, complete shutdown of critical facilities for 2 weeks, more than 25% of property damaged.
Limited	10% to 25%	Some injuries, complete shutdown of critical facilities for more than a week. More than 10% of property damaged.
Negligible	Less than 10%	Minor injuries, minimal quality of life impact, shutdown of critical facilities for 24-hours or less. Less than 10% of property is severely damaged.

Orange County Hazard Identification and Analysis				
Hazard	**Likelihood of Occurrence**	**Area Small/Medium/ Large**	**Impacts Catastrophic/ Critical/Limited/ Negligible**	**Hazard Index**
Hurricanes	Possible	Large	Critical	Low
Floods	Possible	Large	Negligible	High
Tornadoes	Possible	Medium	Limited	Moderate
Drought and Heat Wave	Possible	Large	Limited	Moderate
Nor'easter	Unlikely	Medium	Limited/ Negligible	Low
Thunderstorms	Highly Likely	Large	Negligible	Low
Severe Winter Storm	Likely	Large	Negligible	Moderate
Wildfire	Possible/Unlikely	Medium	Negligible	Low
Chemical Spills	Likely	Small	Limited	Moderate
River Basins Dam Failure	Possible	Large	Limited	Low
Earthquake	Unlikely	Large	Critical	Low
Tsunamis	Unlikely	Medium	Limited	Low
Volcano	Unlikely	Medium	Critical	Low
Landslide	Possible	Small	Negligible	Moderate
Plane Crash	Possible	Small	Limited	Low

Data Sources: North Carolina Emergency Management, Orange County Emergency Management, "Keeping Natural Hazards From Becoming Disasters"

5. Hazard Historical Summary

Hurricanes have affected Orange County, including the Town of Carrboro and Town of Hillsborough, with the most recent being Floyd (1999) with property damage exceeding $1,000,000, though Fran in 1996 was the most severe. In addition, Floyd inflicted over $10,000 in direct recovery costs on Orange County. Furthermore, it caused major damage to property, businesses and infrastructure that impacted the economy.

Flooding, which historically has caused the largest damage in terms of dollar amounts in Orange County, is caused when drainage basins are not capable of withstanding large amounts of rain in a short period of time (thunderstorms).

Tornados have struck with little or no warning to alert citizens to protect themselves. A tornado occurred in May 2000, which damaged 55 mobile homes, 80 site-built homes and caused several tons of debris.

Severe winter storms can quickly impact and immobilize the county and its' municipalities. With roads blocked, power outages and possible loss of critical services, it can pose an immediate threat to loss of life. The last severe winter storm to impact the county was January 2000, when 20 inches of snow and ice fell. Direct recovery costs for Orange County due to the storm event totaled approximately $45,500.

With increased home development in vulnerable wooded areas, a wildfire can cause heavy losses to homes and forestry. Structures in close proximity of wooded areas are at a greater risk to wildfires than homes in urban areas.

Technological hazards can impact the county in many ways including road closures, power outages, evacuations, and water use restrictions.

The following table depicts natural hazards, for which there is a record, that have affected Orange County, including the Town of Carrboro and Town of Hillsborough, from 1956 through 2008.

Orange County Hazard History 1956-2008

Date	Type of Event	Magnitude*	Deaths**	Injuries**	Property & Crop Damage ($)**
7/22/1998	Excessive Heat	N/A			
1/15/1994	Extreme Cold	N/A	3		500,000
1/19/1994	Extreme Cold	N/A	6		
2/3/1996	Extreme Cold	N/A			
3/23/1993	Flash Flood	N/A			
8/27/1995	Flash Flood	N/A			300,000
8/27/1995	Flash Flood	N/A			750,000

Orange County Hazard History 1956-2008					
Date	**Type of Event**	**Magnitude***	**Deaths****	**Injuries****	**Property & Crop Damage ($)****
9/6/1996	Flash Flood	N/A			5,000
3/19/1998	Flash Flood	N/A			
9/05/1999	Flash Flood	N/A			
9/28/1999	Flash Flood	N/A			
7/23/2000	Flash Flood	N/A			6,400,000
3/20/2003	Flash Flood	N/A			150,000
7/13/2003	Flash Flood	N/A			
8/09/2003	Flash Flood	N/A			
8/17/2004	Flash Flood	N/A			
6/14/2006	Flash Flood	N/A			
6/24/2006	Flash Flood	N/A			
7/25/2006	Flash Flood	N/A			
9/06/2008	Flash Flood	N/A			150,000
3/18/1956	Hail	0.75			
6/26/1961	Hail	1.5			
5/14/1967	Hail	2.75			
6/20/1974	Hail	0.75			
4/2/1983	Hail	1			
5/26/1983	Hail	1			
5/6/1984	Hail	1			
3/24/1985	Hail	0.75			
5/22/1985	Hail	1			
5/22/1985	Hail	1.75			
5/23/1985	Hail	0.88			
6/4/1985	Hail	1.75			
8/27/1985	Hail	1			
4/26/1986	Hail	1.75			
6/2/1988	Hail	1			
9/24/1988	Hail	1.75			
3/15/1989	Hail	0.75			
5/5/1989	Hail	1			
4/2/1990	Hail	0.75			
8/4/1991	Hail	0.75			
6/19/1992	Hail	.75			
6/24/1992	Hail	.75			
3/27/1993	Hail	0.75			
8/3/1993	Hail	1.75			
7/25/1994	Hail	0.75			
6/8/1995	Hail	0.88			
10/27/1995	Hail	1			
10/27/1995	Hail	0.75			

Orange County Hazard History 1956-2008					
Date	**Type of Event**	**Magnitude***	**Deaths****	**Injuries****	**Property & Crop Damage ($)****
7/18/1996	Hail	0.75			
3/5/1997	Hail	0.75			
4/21/1997	Hail	0.75			
3/20/1998	Hail	0.75			
3/20/1998	Hail	0.75			
3/20/1998	Hail	1.75			
4/9/1998	Hail	0.75			
6/2/1998	Hail	0.75			
6/3/1998	Hail	1.75			500,000
6/3/1998	Hail	1.75			
5/17/2000	Hail	1.50			
4/01/2001	Hail	.75			
4/30/2003	Hail	.75			
3/08/2005	Hail	1.75			
5/19/2005	Hail	.75			
4/08/2006	Hail	1.75			
5/14/2006	Hail	1.0			
5/14/2006	Hail	.88			
5/25/2006	Hail	1.0			
6/06/2006	Hail	.75			
7/03/2006	Hail	.88			
6/04/2007	Hail	1.75			
5/09/2008	Hail	.75			
5/09/2008	Hail	1.0			
5/09/2008	Hail	.75			
5/09/2008	Hail	1.75			
5/20/2008	Hail	.88			
5/20/2008	Hail	.75			
6/01/2008	Hail	.75			
6/22/2008	Hail	1.0			
6/22/2008	Hail	.88			
6/22/2008	Hail	.88			
7/23/2008	Hail	.75			
2/3/1998	Heavy Rain	N/A			
2/16/1998	Heavy Rain	N/A			
1/3/1994	Heavy Snow	N/A			
1/6/1996	Heavy Snow	N/A			
2/16/1996	Heavy Snow	N/A			
11/19/2000	Heavy Snow	N/A			
2/3/1998	High Wind	35			
2/16/1998	High Wind	52			

Orange County Hazard History 1956-2008					
Date	**Type of Event**	**Magnitude***	**Deaths****	**Injuries****	**Property & Crop Damage ($)****
3/07/2004	High Wind	65			136,000
11/22/2006	High Wind	35			1,000
4/16/2007	High Wind	46			5,000
2/10/2008	High Wind	43			
9/06/2008	High Wind	50			100,000
9/06/2008	High Wind	39			50,000
7/12/1996	Hurricane	N/A			
9/5/1996	Hurricane	N/A	7	2	
9/04/1999	Hurricane	N/A			3,000,000***
9/15/1999	Hurricane	N/A			3,500,000,000***
2/10/1994	Ice Storm	N/A			
1/11/1996	Ice Storm	N/A			
2/2/1996	Ice Storm	N/A			
12/23/1998	Ice Storm	N/A			
6/14/1997	Lightning	N/A			10,000
8/14/1999	Lightning	N/A		1	
8/22/2003	Lightning	N/A	1		
6/11/2006	Lightning	N/A	1		
12/11/2008	Lightning	N/A			1,500,000
8/3/1993	Thunderstorm	N/A			
8/17/1993	Thunderstorm	N/A			20,000
7/25/1994	Thunderstorm	N/A			30,000
5/19/1995	Thunderstorm	N/A			300,000
5/26/1995	Thunderstorm	N/A			750,000
6/8/1995	Thunderstorm	N/A			10,000
6/10/1995	Thunderstorm	N/A			
6/10/1995	Thunderstorm	N/A			20,000
6/11/1995	Thunderstorm	N/A			30,000
7/13/1975	Thunderstorm Wind	0			
2/23/1980	Thunderstorm Wind	0			30,000
1/4/1982	Thunderstorm Wind	0			15,000
5/8/1984	Thunderstorm Wind	52			
5/22/1985	Thunderstorm Wind	0			
10/15/1985	Thunderstorm Wind	0			
4/26/1986	Thunderstorm Wind	69			
8/11/1996	Thunderstorm Wind	0			
8/11/1996	Thunderstorm Wind	0			
8/11/1986	Thunderstorm Wind	0			
8/27/1986	Thunderstorm Wind	0			
8/4/1987	Thunderstorm Wind	0			
5/16/1988	Thunderstorm Wind	0			

Orange County Hazard History 1956-2008					
Date	**Type of Event**	**Magnitude***	**Deaths****	**Injuries****	**Property & Crop Damage ($)****
5/23/1988	Thunderstorm Wind	0			
6/16/1989	Thunderstorm Wind	0			
5/1/1990	Thunderstorm Wind	0			
6/22/1990	Thunderstorm Wind	0			
7/11/1990	Thunderstorm Wind	0			
7/26/1991	Thunderstorm Wind	0			
4/24/1992	Thunderstorm Wind	0			
6/24/1992	Thunderstorm Wind	0			
6/26/1992	Thunderstorm Wind	0			
8/11/1992	Thunderstorm Wind	0			
8/11/1992	Thunderstorm Wind	0			
5/26/1995	Thunderstorm Wind	0			
1/19/1996	Thunderstorm Wind	0			
4/20/1996	Thunderstorm Wind	0			
5/11/1996	Thunderstorm Wind	0			30,000
5/27/1996	Thunderstorm Wind	0			15,000
6/12/1996	Thunderstorm Wind	0			
7/31/1996	Thunderstorm Wind	0			
3/5/1997	Thunderstorm Wind	50			
6/23/1998	Thunderstorm Wind	50			
6/30/1998	Thunderstorm Wind	50			
7/07/1999	Thunderstorm Wind	50			
7/24/1999	Thunderstorm Wind	50			
7/24/1999	Thunderstorm Wind	50			
5/20/2000	Thunderstorm Wind	50			
5/20/2000	Thunderstorm Wind	50			
5/25/2000	Thunderstorm Wind	60			
5/25/2000	Thunderstorm Wind	60		2	
6/15/2000	Thunderstorm Wind	50			
8/10/2000	Thunderstorm Wind	50			
8/18/2000	Thunderstorm Wind	50			
12/17/2000	Thunderstorm Wind	50			
6/01/2002	Thunderstorm Wind	50		1	
7/04/2002	Thunderstorm Wind	50			
2/22/2003	Thunderstorm Wind	50			
7/22/2003	Thunderstorm Wind	50			
10/14/2003	Thunderstorm Wind	50			
11/19/2003	Thunderstorm Wind	50			
6/11/2004	Thunderstorm Wind	50			
6/23/2004	Thunderstorm Wind	50			
8/17/2004	Thunderstorm Wind	50			

Orange County Hazard History 1956-2008					
Date	**Type of Event**	**Magnitude***	**Deaths****	**Injuries****	**Property & Crop Damage ($)****
9/17/2004	Thunderstorm Wind	50			
6/27/2005	Thunderstorm Wind	50			
7/28/2005	Thunderstorm Wind	50			
7/28/2005	Thunderstorm Wind	50			
8/05/2005	Thunderstorm Wind	50			
4/03/2006	Thunderstorm Wind	50			
5/26/2006	Thunderstorm Wind	50			
7/03/2006	Thunderstorm Wind	50			
7/14/2006	Thunderstorm Wind	50			
9/28/2006	Thunderstorm Wind	50			
8/21/2007	Thunderstorm Wind	50			
3/04/2008	Thunderstorm Wind	55			
5/09/2008	Thunderstorm Wind	52			
6/01/2008	Thunderstorm Wind	50			
6/22/2008	Thunderstorm Wind	50			
6/22/2008	Thunderstorm Wind	52			
6/23/2008	Thunderstorm Wind	50			
7/04/2008	Thunderstorm Wind	50			
7/27/2008	Thunderstorm Wind	50			
8/02/2008	Thunderstorm Wind	50			
7/13/1975	Tornado	F1		1	5,000
3/29/1991	Tornado	F2			
11/23/1992	Tornado	F3	2	10	500,000
1/28/1994	Tornado	F0			
6/19/2000	Tornado	F0			
1/14/2005	Tornado	F0			
3/12/1993	Winter Storm	N/A	2	10	50,000,000
1/18/2000	Winter Storm	N/A			
1/20/2000	Winter Storm	N/A			
1/22/2000	Winter Storm	N/A			
1/24/2000	Winter Storm	N/A			
1/28/2000	Winter Storm	N/A			
1/03/2002	Winter Storm	N/A			
1/06/2002	Winter Storm	N/A			
2/04/2002	Winter Storm	N/A			
2/16/2003	Winter Storm	N/A			
2/27/2003	Winter Storm	N/A			
1/26/2004	Winter Storm	N/A			
2/15/2004	Winter Storm	N/A			
2/26/2004	Winter Storm	N/A			
1/29/2005	Winter Storm	N/A			

Orange County Hazard History 1956-2008					
Date	**Type of Event**	**Magnitude***	**Deaths****	**Injuries****	**Property & Crop Damage ($)****
1/19/2008	Winter Storm	N/A			
2/13/2008	Winter Storm	N/A			
12/15/2005	Winter Weather/Mix	N/A	1	3	
1/18/2007	Winter Weather	N/A			
1/21/2007	Winter Weather	N/A			
12/07/2007	Winter Weather	N/A			20,000
1/17/2008	Winter Weather	N/A			
1/19/2008	Winter Weather	N/A			

* - Hail: diameter in inches; Tornado: Fujita category (1 to 5); Wind: speed in knots.
** - Value is "0" if cell is empty
***- includes damages outside Orange County
Source of data: North Carolina Division of Emergency Management.

B. Vulnerability Assessment

Vulnerability to a natural hazard can be defined as "the extent to which people experience harm and property damage from a hazard". These hazards can result in the loss of life and property damages in the millions. The impact felt may take years to overcome. It is important to know where and to what extent the community is susceptible to the impacts of natural and technological hazards.

Vulnerability to hazards can be assessed in both the present and future. The current level of development and infrastructure generates a set of conditions, which results in every area of the community being vulnerable to some hazard. This level will change with future increases or decreases of population, development and whether the community implements or ignores hazard mitigation. Future vulnerability should not increase because Orange County, the Town of Carrboro and the Town of Hillsborough land use policies, ordinances, and regulations prohibit development in vulnerable (especially flood prone) areas. Each governmental jurisdiction covered by this Hazard Mitigation Plan shares the same level of vulnerability to each type of hazard; the only difference being the exact location of the hazard (i.e.: each jurisdiction could be impacted by a dam breach but since there are many dams within the county, one jurisdiction may be impacted while another is not). No jurisdiction is more "at risk" to a particular hazard than any other jurisdiction included in this Plan.

Orange County is centrally located in the piedmont of North Carolina and contains 400 square miles. The 2000 Census recorded a population of 115,531 with 66,330 of these residents in the Towns of Carrboro, Chapel Hill and Hillsborough. A unique feature of Orange County is the University of North Carolina at Chapel Hill. The student population of the university adds approximately 25,000 people to the County's population during the school year. Orange County has several major highways to include I-40/85, US 70, 15/501, and NC 54, 57, 86, and 157. There are portions of three major river basins – Cape Fear, Neuse, and Roanoke - that are located in the county.

The value of all structures in unincorporated Orange County and the Towns of Carrboro and Hillsborough on lots situated partially or entirely within the special flood hazard area is $439,594,791. In the event of flooding, this number does not represent the total loss potential for the properties. It accounts for the value of the structures located therein. Occupied residential properties also have the potential for damages to personal property such as household contents and motor vehicles. Agricultural properties possess the same personal property loss potential as residential properties and also include potential losses in terms of damage to livestock, crops and equipment. Commercial and industrial parcels may experience great losses in damages to equipment and inventory though there are no known vulnerable commercial or industrial structures. All of these potential losses will have a great impact on the local county economy.

The Total Building-Only Values for structures located within the unincorporated areas of Orange County is $3,576,616,323. The Total Building-Only Values for structures located within Carrboro is $1,179,137,738 and the value for Hillsborough is $455,549,819. If a catastrophic event, such as a devastating tornado, were to hit Orange County, property losses could potentially be in the hundreds of millions of dollars, if not into the billions.

If structures were to be damaged or destroyed, the typical building construction cost in North Carolina, per square foot, for various types of uses is as follows:

Commercial:	$140.00
Single Family Residential:	$108.00
Multi Family Residential:	$98.00
Industrial:	$82.00
Utility:	$40.00

Source: International Code Council (ICC), 2009

Appendix A includes a series of maps that help illustrate Orange County's, including the Town of Carrboro and Town of Hillsborough, vulnerability to natural disasters. The following table is a brief summary of each jurisdiction's hazard vulnerability.

1. Hazard Vulnerability Summary

Hazard Vulnerability			
Hazard	**Unincorporated Orange County**	**Carrboro**	**Hillsborough**
Hurricanes	Hurricanes have impacted the jurisdiction in the past and are expected to have an impact in the future. The nature of hurricanes causes them to have an impact over a large geographic area.	Hurricanes have impacted the jurisdiction in the past and are expected to have an impact in the future. The nature of hurricanes causes them to have an impact over a large geographic area.	Hurricanes have impacted the jurisdiction in the past and are expected to have an impact in the future. The nature of hurricanes causes them to have an impact over a large geographic area.
Floods	Flooding has occurred in the past and will likely occur in the future. Governmental regulations prohibit new structures from being located	Flooding has occurred in the past and will likely occur in the future. Governmental regulations prohibit new structures	Flooding has occurred in the past and will likely occur in the future. Governmental regulations allow the construction of

Hazard Vulnerability			
Hazard	**Unincorporated Orange County**	**Carrboro**	**Hillsborough**
	in floodplains, therefore, additional future losses are not expected. Relatively few structures are located within floodplains in the unincorporated areas. As Map 8 in Appendix A shows, the vast majority of structures located within floodplains are within the corporate limits of Chapel Hill and Carrboro. Floodplains in Orange County tend to be relatively narrow due to the fact the county is located in the upper reaches of river basins.	from being located in floodplains, therefore, additional future losses are not expected. Approximately 67 single family units are located within floodplain areas. Approximately 20 multi-family units (in 1 complex 2 buildings.) and 24 mobile homes are located in floodplain areas. An estimated 275 people reside in these 111 units. In addition, 2 commercial structures, 6 accessory and 15 public/quasi-public structure are located in floodplain areas. The building value of all structures located within a floodplain area is approximately $20,906,250.	new structures in floodplain areas provided the finished elevation is a minimum of 2-feet above the documented flood level. According to National Flood Insurance Program (NFIP) information, 18 structures are located in floodplain areasThe value of these structures is approximately $5,130,167.
Tornados	Tornados have struck Orange County in the past and it is reasonable to expect they will affect the county in the future. Tornados in the past decade have struck in the central and northern sections of the county. Other than operating an emergency warning system, mitigating for tornados is impractical.	Tornados have struck Orange County in the past and it is reasonable to expect they will affect the county in the future. Tornados have not impacted Carrboro in the last decade but the threat of a tornado does exist. Other than operating an emergency warning system, mitigating for tornados is impractical.	Tornados have struck Orange County in the past and it is reasonable to expect they will affect the county in the future. Some tornados in the past decade have touched down extremely close to Hillsborough. Other than operating an emergency warning system, mitigating for tornados is impractical.
Droughts and Heat W	Periods of drought and heat waves have impacted Orange County in the past and ensuring adequate water supply is an issue for the county and its municipalities because the county is located at the headwaters of three major river basins. Therefore, no sizeable rivers flow within the county. Water supplies are stored in reservoirs and most of the population in the unincorporated area has	Periods of drought and heat waves have impacted Carrboro in the past and ensuring adequate water supply is an issue. The vast majority of Carrboro's water is supplied via water storage reservoirs.	Periods of drought and heat waves have impacted Hillsborough in the past and ensuring adequate water supply is an issue. The vast majority of Hillsborough's water is supplied via water storage reservoirs.

Hazard Vulnerability			
Hazard	**Unincorporated Orange County**	**Carrboro**	**Hillsborough**
	individual wells which utilize groundwater.		
Nor'easter	Nor'easters rarely reach as far inland as Orange County. Vulnerability to this hazard is relatively low.	Nor'easters rarely reach as far inland as Orange County. Vulnerability to this hazard is relatively low.	Nor'easters rarely reach as far inland as Orange County. Vulnerability to this hazard is relatively low.
Thunderstorms	Thunderstorms are a common occurrence in Orange County. Hazards associated with thunderstorms include flooding due to heavy rains, lightning strikes, tornados, and high winds.	Thunderstorms are a common occurrence in Orange County. Hazards associated with thunderstorms include flooding due to heavy rains, lightning strikes, tornados, and high winds.	Thunderstorms are a common occurrence in Orange County. Hazards associated with thunderstorms include flooding due to heavy rains, lightning strikes, tornados, and high winds.
Severe Winter Storm	Severe winter weather, including "ice storms", is fairly common in Orange County, although it does not necessarily occur each winter.	Severe winter weather, including "ice storms", is fairly common in Orange County, although it does not necessarily occur each winter.	Severe winter weather, including "ice storms", is fairly common in Orange County, although it does not necessarily occur each winter.
Wildfire	Wildfires have not historically been a significant threat in Orange County. However, more development of rural areas can increase vulnerability to this hazard.	Wildfires have not historically been a significant threat in Carrboro. The majority of the jurisdiction is developed in an urban/suburban pattern, thereby minimizing the vulnerability to this hazard.	Wildfires have not historically been a significant threat in Hillsborough. The majority of the jurisdiction is developed in an urban/suburban pattern, thereby minimizing the vulnerability to this hazard.
Chemical Spills	Approximately 30 chemical storage reportable sites with reportable quantities (under the Emergency Planning and Community Right to Know Act) are located within Orange County, Carrboro, and Hillsborough. In addition, the county is vulnerable to transportation spills since Interstates 40 and 85 traverse the county as do railways and state highways.	Approximately 30 chemical storage reportable sites with reportable quantities (under the Emergency Planning and Community Right to Know Act) are located within Orange County, Carrboro, and Hillsborough. In addition, Carrboro is vulnerable to transportation spills since State Highway 54 passes through the municipal limits as does a railway spur.	Approximately 30 chemical storage reportable sites with reportable quantities (under the Emergency Planning and Community Right to Know Act) are located within Orange County, Carrboro, and Hillsborough. In addition, Hillsborough is vulnerable to transportation spills since Interstate 85 and other state highways pass through the municipal limits as does a railway.
River Basins Dam Failure	There are 4 water supply reservoirs located within Orange County, one of which (University Lake) is located primarily within Carrboro's jurisdiction. In addition, there are numerous	Carrboro is vulnerable primarily to dam failure associated with the University Lake water supply reservoir. Several of the small farm ponds/stormwater	Hillsborough is vulnerable to dam failure of two of the water supply watersheds (Eno Reservoir and Lake Orange). In addition, several of the small farm ponds/ stormwater

Hazard Vulnerability			
Hazard	**Unincorporated Orange County**	**Carrboro**	**Hillsborough**
	(approximately 30) farm ponds and stormwater management ponds which utilize earthen dams. Dam failure on any of the water supply reservoirs would be expected to cause downstream flooding. Dam failure on farm ponds and stormwater management ponds could cause flooding downstream as well.	management ponds are also located upstream or within the municipal limits of Carrboro.	management ponds are also located upstream or within the municipal limits of Hillsborough
Earthquake	The closest active seismic zone to Orange County is the Eastern Tennessee Seismic Zone. There have not been any intense earthquakes in this area since 1928 (when records began to be kept). The location of Orange County to the Eastern Tennessee Seismic Zone puts the county and its municipalities at low risk of experiencing any significant seismic activity.	The closest active seismic zone to Orange County is the Eastern Tennessee Seismic Zone. There have not been any intense earthquakes in this area since 1928 (when records began to be kept). The location of Orange County to the Eastern Tennessee Seismic Zone puts the county and its municipalities at low risk of experiencing any significant seismic activity.	The closest active seismic zone to Orange County is the Eastern Tennessee Seismic Zone. There have not been any intense earthquakes in this area since 1928 (when records began to be kept). The location of Orange County to the Eastern Tennessee Seismic Zone puts the county and its municipalities at low risk of experiencing any significant seismic activity.
Tsunamis	Orange County is located a significant distance from the Atlantic coastal area. Therefore, vulnerability from tsunamis is minimal.	Orange County is located a significant distance from the Atlantic coastal area. Therefore, vulnerability from tsunamis is minimal.	Orange County is located a significant distance from the Atlantic coastal area. Therefore, vulnerability from tsunamis is minimal.
Volcano	There are no known volcanoes in the vicinity of Orange County. Therefore, vulnerability from volcanoes does not exist at this time.	There are no known volcanoes in the vicinity of Orange County. Therefore, vulnerability from volcanoes does not exist at this time.	There are no known volcanoes in the vicinity of Orange County. Therefore, vulnerability from volcanoes does not exist at this time.
Landslide	Parts of Orange County have soil types and slopes that are vulnerable to landslides. The greatest threat is in the southeastern quadrant of the county.	Carrboro is located in the southeastern quadrant of the county where soil types and slope characteristics present a moderate level of landslide vulnerability.	Soil types and slopes in the vicinity of Hillsborough are such that vulnerability to landslides is less than that in other areas of the county.
Plane Crash	Orange County is located approximately 20 miles west of RDU airport. The vulnerability of the county and its municipalities to a plane crash is minimal but does exist. In addition, Horace Williams airport, a	Orange County is located approximately 20 miles west of RDU airport. The vulnerability of the county and its municipalities to a plane crash is minimal but does exist. In addition, Horace Williams airport, a	Orange County is located approximately 20 miles west of RDU airport. The vulnerability of the county and its municipalities to a plane crash is minimal but does exist. In addition, Horace Williams airport, a

Hazard Vulnerability			
Hazard	**Unincorporated Orange County**	**Carrboro**	**Hillsborough**
	non-commercial airport, is located in Chapel Hill.	non-commercial airport, is located in Chapel Hill. Some approach and take-off zones are over the city limits of Carrboro.	non-commercial airport, is located in Chapel Hill.

2. Critical Facilities

A critical facility is any facility that if destroyed or damaged to the extent it cannot be utilized, a severe life, health, or safety impact on the public would be created. To a certain extent most or all roadways and bridges within the county could be considered critical facilities if they were damaged and alternate access was not available. However, for the purposes of this Hazard Mitigation Plan, the focus shall be on buildings.

The hospital within Orange County, which is affiliated with UNC-Chapel Hill, is located within the municipal limits of Chapel Hill. The Town of Chapel Hill has prepared a separate Hazard Mitigation Plan. There are several critical facilities within Orange County, Carrboro, and Hillsborough including fire stations, emergency management operations, and law enforcement offices. Both Hillsborough and Carrboro operate their own police departments. Each department operates from its own building within its respective municipal limits. Carrboro also operates its own fire department which is housed separately from the police department. Hillsborough and the unincorporated areas of Orange County rely on nine separate volunteer fire departments for fire suppression services. There are 11 volunteer fire stations located within the county.

Orange County's Emergency Services Department, which operates out of its own facility, provides disaster response, EMS (Emergency Medical Services), and 9-1-1 services for the unincorporated area and the municipalities.

3. Analysis

Population tends to be concentrated in the municipal areas (Chapel Hill, Carrboro, and Hillsborough) of the county. Therefore, these areas of more dense population would likely suffer a greater impact from a hazard event, in terms of human and structural measures, than the unincorporated portions of the county. The unincorporated portions of the county contain a relatively large population, in terms of the actual number of people, but the population is not densely concentrated.

Orange County and Carrboro have regulations in place to prevent new construction in flood hazard areas. Both of these jurisdictions contain structures within flood hazard areas that were constructed prior to adoption of the new regulations. Additionally, these jurisdictions limit development in areas of steep slopes. The Town of Hillsborough historically has restricted development less than other jurisdictions and therefore administers a less

restrictive code of ordinances that allows development to occur in areas that would not be allowed in other jurisdictions.

Orange County, as a whole, is an area experiencing moderate population growth. Regulations and policies are in place that attempt to "steer" growth into the municipal areas, including the Towns of Carrboro and Hillsborough, where population can be better and more efficiently served with public services and the rural character of the county can be preserved. Orange County recently updated its Comprehensive Plan and included policies to further limit housing density in rural areas. The Comprehensive Plan update was adopted November of 2008. Regulation revisions implementing the Comprehensive Plan are expected to be adopted over the next few years.

IV. Mitigation Strategy

A. Community Goals

Orange County, Carrboro, and Hillsborough planning goals are statements that set priorities for reducing susceptibility to natural and technological hazards. These goals serve as the basis for development of the more specific plan objectives and strategies. These goals are:

1. To reduce loss of human life.
2. To protect property and minimize damage.
3. To increase public awareness of risk and mitigation activities.
4. To minimize damage to public facilities, utilities, infrastructure.
5. To adopt local ordinances and plans that assist hazard mitigation planning.
6. To ensure that NFIP maps are available to property buyers so they may determine if property is located in or near a floodplain.
7. Decrease the community's vulnerability to future disasters.

These goals are broad based and can be revised to meet the future needs of the county. There are no goals that could potentially hinder hazard mitigation efforts. Furthermore, goals are reviewed by the Board of County Commissioners at their goal-setting retreat in December of each year. Existing goals are modified and new ones created as appropriate.

B. Mitigation Strategies

The strategies to meet the goals will be categorized into five different groups:

1. Prevention
2. Property Protection
3. Natural Resource Protection
4. Structural Projects
5. Public Information

This section of the update (Mitigation Strategies), as well as Appendices B, C, and D, list the existing and potential policies, practices, programs, regulations, and activities that Orange County, the Town of Carrboro, and the Town of Hillsborough (respectively by appendix order) currently enforce, have in place, or are considering. All of the activities listed should lessen the vulnerability of county residents, property owners, structures and future development to natural hazards.

A process for prioritization of identified hazard mitigation strategies was performed the same way for each of the participating jurisdictions. The Hazard Mitigation Team used the following criteria for prioritization of hazard mitigation strategies:

1. cost-benefit review
2. results of Hazard Identification Analysis
3. results of Vulnerability Assessment
4. results of Community Capability Assessment
5. effectiveness in meeting hazard mitigation goals and comprehensive plan goals

Cost-benefit review was given emphasis due to its possible use in environmental reviews for HMGP, FMA and other federal hazard mitigation projects.

With limited financial and staff resources to dedicate to hazard mitigation, it is essential that those hazards with the highest likelihood of occurrence and the greatest potential impact receive the highest investment of County resources. Through hazard identification and analysis and vulnerability assessment, it has been determined that Orange County, including the Town of Carrboro and Town of Hillsborough, is susceptible to the impact of certain natural hazards more so than others (as shown in the "Orange County Hazard Identification and Analysis" table located in a previous section).

Moderate and High Hazard Threats

Floods

Flooding is often associated with hurricanes and coastal storms (most often general flooding) as well as with severe summer storms (typically flash flooding). Floods are the easiest hazard to quantify and isolate as flooding occurs only in known locations. The severity of a flood is generally dependent upon the amount of rainfall and prior soil conditions (including ground cover).

Orange County, Carrboro, and Hillsborough all participate in FEMA's National Flood Insurance Program (NFIP). At this time, none of the communities participate in the voluntary National Community Rating System (CRS) program. However, Orange County has begun assessing the feasibility of participating in the CRS and Carrboro intends to apply for the program in the near future. Orange County effectively disallows new construction in special flood hazard areas through provisions in the Zoning Ordinance relating to stream buffers. The Town of Carrboro allows very limited development within special flood hazard areas and all development must be constructed with a finished elevation above flood levels. In accordance with State regulations, The Town of Hillsborough allows construction within special flood hazard areas provided the finished elevation is above flood levels. None of the local governments are considering changes to these practices at this time. In addition, there are no repetitive loss structures within the partner jurisdictions.

In addition to the continued assessment and modifications of development regulations, Orange County and the Towns of Carrboro and Hillsborough, undertake activities to ensure continued compliance with the National Flood Insurance Program (NFIP). The County has identified every property within Orange County that is located wholly or partially located within a special flood hazard area, and has developed a program to flag those properties for added review when any development and/or construction activity is proposed on site. In addition, the County participates in an on-going map maintenance program through the North Carolina Division of Emergency Management. Every five years, staff works with emergency management specialists at the State level to ensure the special flood hazard area maps are as accurate and up to date as possible. Additionally, each jurisdiction makes NFIP maps available to persons interested in determining if properties are located in special flood hazard areas. Finally, County and municipal flood plain managers obtain a minimum of 16 hours of continuing education credits every two years to maintain Certified Floodplain Manager certifications.

High Winds (Severe Storms/Tornadoes/Nor'easter/Hurricanes)

Severe storms and tornadoes as well as hurricanes and coastal storms present high wind hazards. This hazard is mainly combated through building codes and construction. Enforcement of the current State building code and enhancement of the code in regards to wind resistance will prove the most beneficial in addressing high winds.

All of the local governments included in this hazard mitigation plan require new construction to be in accordance with the State building code which takes into account wind loading and resistance to other natural hazards. At this time, none of the local governments are considering changes to this practice.

Droughts and Heat Waves

In general, communities can have little influence or impact on mitigating the impact of droughts/heat waves on the local government level except through ensuring adequate water supplies for normal circumstances and through implementation of water conservation measures when drought conditions are imminent. Similarly, heat waves have wide ranging effects that are almost impossible to combat on a level government level. Communities, therefore, depend upon State and Federal agencies for assistance.

Representatives from the participating jurisdictions met in October 2005 to discuss the county's vulnerability to drought and heat waves. At that time, the group determined that additional actions were not necessary or feasible to reduce the area's vulnerability. Later, in 2007 in response to severe drought conditions in the county and beyond, elected officials approved resolutions and measures to encourage water conservation throughout the county. In addition, the County maintains a website (www.H2Orange.org) that discusses current conditions, water conservation, and drought relief programs for those in need.

Winter Storms and Freezes

Local governments also look to the State and to private utility companies for leadership in dealing with winter storms/freezes. The typical effects of snow and ice accumulation – loss of electrical power, phone, and cable service and treacherous road conditions - can be only minimally addressed at the local level. (The exceptions would be larger cities which have more snow/ice removal equipment and manpower and governments that own the local electrical distribution system.)

Orange County and the municipalities included in this plan address winter storms and freezes to the greatest extent they are able to with limited resources. Nothing can be done to prevent winter storms. However, the County and participating jurisdictions inform the public of potential impacts of severe weather systems and emergency services available to them. A significant storm or freeze will likely require State and other (i.e.: electric company) assistance. State DOT (Department of Transportation) staff and equipment clear snow and ice from the roadways using a priority system based on road usage.

Landslides

Landslides are most likely to occur when unusually heavy rain from hurricanes and intense rain storms soak the ground, reducing the ability of steep slopes to resist the downward pull of gravity. Certain types of soils are more susceptible to landslides than other soil types.

Landslide vulnerability can be decreased through adoption and enforcement of local land use regulations that limit development in areas susceptible to landslides due to soil types and slope. Such regulations are in place in Orange County and the Towns of Carrboro and Hillsborough.

Representatives from the participating jurisdictions met in October 2005 to discuss the county's vulnerability to landslides. At that time, the group determined that additional actions were not feasible to reduce the area's vulnerability.

Chemical Spills

Local governments generally look to State agencies for leadership in dealing with large chemical spills, especially because such spills are most likely to occur on State road right-of-way or along railroad right-of-way. Local governments do not generally have an extensive Hazardous Materials Team and rely on the State's Regional Response Team for assistance with hazardous materials.

Orange County's Emergency Services Department (which also serves the municipalities within the county), addresses vulnerability to chemical spills to the greatest extent they are able with limited resources. However, little can be done to prevent occurrences within the County. A large chemical spill occurring in the county would require State assistance to contain and remove the spill.

C. Ordinances and Actions

Per the Action Items list included in the adopted Orange County Hazard Mitigation Plan, representatives from the participating jurisdictions met in October 2005 to discuss the county's vulnerability to drought, heat waves, and landslides. At that time, the group determined that additional actions were not feasible or necessary to reduce the area's vulnerability. Later, in 2007 in response to severe drought conditions in the county and beyond, elected officials approved resolutions and measures to encourage water conservation throughout the county. In addition, the County maintains a website (www.H2Orange.org) that discusses current conditions, water conservation, and drought relief programs for those in need.

1. Orange County

The following provides a summary of ordinances that Orange County is currently involved in or has completed relevant to hazard mitigation. Review processes related to the ordinances are thorough and overlapping.

Legal Capability

The North Carolina General Statutes grant Orange County and the Towns of Carrboro and Hillsborough the general police powers reserved for local governments. This confers the legal authority to enact and enforce local ordinances which define, prohibit, regulate or abate acts, omissions or conditions detrimental to the health, safety and welfare of the people and to define and abate nuisances (including public health nuisances).

Floodplain Management Ordinance

Orange County participates in the National Flood Insurance Program (NFIP) and complies with all related regulatory requirements. The ordinance is enforced through requirements set forth by the County's zoning ordinance. It provides a means for prohibiting or restricting development within special flood hazard areas. This ordinance seeks to prevent property loss, insure human safety, and enable the safe and natural flow of streams. The Current Planning Division of the Planning and Inspections Department reviews development proposals for consistency with the ordinance.

Stormwater Ordinance

Riparian Area Protection within the Neuse River Basin: The purpose of the County in adopting the Neuse River Basin regulations is to protect the County's streams, wetlands, and floodplains; to protect the water quality of the County's watercourses, reservoirs, lakes, and ponds; to protect the County's riparian and aquatic ecosystems; reduce Nitrogen laden runoff to the Neuse by 30%; and to provide environmentally sound use of the County's land resources. The Sedimentation and Erosion control Division of the Planning and Inspections Department is responsible for this ordinance.

404 Wetlands

404 wetlands are areas covered by water or that have waterlogged soils for long periods during the growing season. Plants growing in wetlands are capable of living in soils lacking oxygen for at least part of the growing season. Some wetlands, such as swamps, are obvious. Others are sometimes difficult to identify because they may be dry during part of the year. Wetlands include, but are not limited to, bottomlands, forest, swamps, pocosins, pine savannas, bogs, marshes, and wet meadows.

Section 404 of the Clean Water Act requires that anyone interested in depositing dredged or fill material into "waters of the United States," including wetlands, must apply for and receive a permit for such activities.

Erosion and Sedimentation Controls

Soil erosion is and has been a serious problem in the Piedmont of North Carolina, resulting in land degradation and water quality deterioration. The Orange County Soil Erosion and Sedimentation Control Ordinance, adopted in 1975 and since amended, provides the legal means by which the adverse impacts of land disturbing development activities can be minimized. The Ordinance regulates the clearing, grading, excavation, filling and manipulation of the earth and the moving and storing of waters in order to: control and prevent accelerated soil erosion and sedimentation, prevent the pollution of water, prevent damage to public and private property, maintain the balance of nature, prevent the obstruction of natural and artificial drainageways, inhibit flooding and reduce the undermining of roads and other transportation facilities. Before a construction permit is granted, a developer must submit an erosion and sedimentation control plan to the County's Erosion Control Officer. These plans include the

type of soils present at the site, the topography and location of nearby streams, erosion control measures to be taken during construction, and the operation and maintenance of any structural controls during the life of the project. The Sedimentation and Erosion Control Division of the Planning and Inspections Department is responsible for countywide enforcement of this ordinance, including the incorporated towns.

North Carolina State Building Code

Orange County has adopted the North Carolina Building Code (International Building Code with North Carolina Amendments) and the North Carolina Residential Code (International Residential Code with North Carolina Amendments). The NCBC and the NCRC (Chapters 16 and Chapter 3) include provisions for requiring specific information regarding structural loads and design loads to include seismic, wind, flood, snow and combination loading. These designs tabulate the total horizontal and vertical forces that are assumed to act on a building in relation to different wind areas, exposures and wind speeds as exposed to building frameworks and cladding. The Inspections Division of the Planning and Inspections Department is responsible for enforcement of the referenced building codes.

Zoning

The Zoning Ordinance is the major legal tool for implementing the Land Use Element of the Orange County Comprehensive Plan. The Zoning Ordinance serves as the means to achieve the desired relationship between land uses; to prevent incompatible land use associations; and to encourage and provide incentives for the more compact and efficient land use patterns delineated in the plan.

Simply stated, zoning is the division of a jurisdiction into different districts and the regulation of population density, buildings and land use intensity, lot coverage, and building heights and setbacks within those districts. Most zoning ordinances divide land uses into three general categories of residential, commercial, and industrial use and specify the areas (or districts) where each of these uses is permitted. Zoning ordinances consist of maps and written text.

The stated purpose of the Orange County Zoning Ordinance is to accomplish compatible development of the land within Orange County in a manner which will best promote the health, safety, and general welfare, as well as to provide for efficiency and economy in the process of development; to make adequate provisions for traffic; to secure safety from fire, panic, and other hazards; to provide for light and air; to prevent the overcrowding of land; to avoid undue concentration of populations; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements; to provide for the protection of the surface and underground water resources of the County, and to provide for efficient use of renewable and non-renewable sources of energy; to promote desirable living conditions and the sustained stability of neighborhoods; to protect property against blight and depreciation and for other purposes in accordance with the comprehensive plan for the County. The Current Planning Division of the Planning and Inspections Department has primary responsibility for implementation and enforcement of the zoning ordinance.

Through zoning provisions related to stream buffering, Orange County's Zoning Ordinance effectively prohibits new construction in special flood hazard areas.

Subdivision Regulations

Subdivision Regulations govern the conversion of raw land for intensive residential use. This implementation tool is particularly necessary to coordinate existing development and potential future development with proposed development. As the interest of the developer is generally short term, the application of subdivision regulations protects not only the individual homeowner, but also the general public by providing for a review process which suggests and facilitates coordination of the proposal with the long range specifications of the plan. By providing an opportunity for negotiation it likewise allows for the potential coordination of public and private activities.

The purpose of the Orange County Subdivision Regulations is to guide and regulate the subdivision of land for sale or building development in order to insure the public health, safety, and welfare, and to provide for the sound use of land. The regulations are designed to insure adequate planning of street systems; to avoid overcrowding of land, prevent fire, panic, and other dangers; insure that water and sewage systems be safe and adequate; to prevent flood damage; to facilitate an orderly use of land; to insure the proper legal description and monumenting of subdivided land; and to encourage the proper management of Orange County's natural resources.

It is the expressed purpose of the regulations to provide for, in addition to the above, the protection of water resources in Orange County, through the use, alone or in combination, of buffer zones, varying lot sizes, slope restrictions, vegetation, or other equally effective techniques. Innovative techniques on the part of the developer are encouraged where these techniques can be shown to be as effective as the specific requirements of the Ordinance. The Current Planning Division of the Planning and Inspections Department has primary responsibility for implementation of the subdivision regulations and reviews development proposals for consistency with the regulations.

Water Restriction

In the event of severe drought which has caused reservoir levels to decrease to dangerous levels and damages agricultural production, mandatory water restrictions on residential and commercial uses can be put into effect. These and other conservation methods are employed in a gradual time frame so that business and residents are not suddenly struck with severe restrictions that undermine commercial and agricultural efforts. Concurrently, the three public water suppliers to Orange County citizens (Orange Water and Sewer Authority, Hillsborough Municipal, and Orange Alamance Water Service) have been working diligently to increase reservoir capacity to better avoid and mitigate against drought conditions.

Existing Mitigation Efforts

Orange County has participated in the Federal Emergency Management Agency (FEMA) Buyout Program. This program allows local governments to purchase homes that have a

history of being flooded several times. One of the most recent buyouts was in the Heritage Hills Subdivision in the southern portion of Orange County.

Financial Resources

Orange County, including the Town of Carrboro and Town of Hillsborough, will seek funds, when available, for Hazard Mitigation studies and implementation of programs. Potential funding sources include (but are not limited to) programs administered by or through NC Emergency Management, the Division of Community Assistance, and the Hurricane Redevelopment Center.

ACTION ITEMS: Orange County efforts currently underway that affect natural hazard mitigation

***Note: relocated from another section of adopted plan**

1. Update of Land Use Element of Comprehensive Plan

   The Land Use Element of the Comprehensive Plan was first adopted September 2, 1981, and has been amended numerous times since adoption. Preparation of a new Land Use Element is currently under way by the Orange County Planning Department Staff.

   The Comprehensive Plan is expected to re-solidify policies that restrict development in hazard areas such as floodplains and steep slopes. In addition, the update will likely recommend policies that lower density in rural areas.

   If policies such as these are adopted and implemented, vulnerability to hazards such as flooding, landslides, and wildfires should be further reduced.

   Responsibility: Orange County Planning and Inspections

   Target Date for Completion**:** by the end of 2004

   Status: The Orange County 2030 Comprehensive Plan update was adopted by the Orange County BOCC November 18, 2008. The updated comprehensive plan maintains the County's position on restricting development in hazard areas.

2. Unified Development Ordinance (UDO)

   The County's land use ordinances (Zoning, Economic Development District Design Manual, Hillsborough Economic Development District Design Manual, Subdivision, Flood Damage Prevention, Soil Erosion and Sedimentation Control, Strom Water Management, and Environmental Impact) are to be combined into one UDO. Rewrite to occur after update of the Land Use Element of the Comprehensive Plan.

The UDO will implement the policies outlined in the Comprehensive Plan. Implementation of the types of policies likely to be included in the Comprehensive Plan update should reduce vulnerability to such hazards such as flooding, landslides, and wildfires.

Responsibility: Orange County Planning and Inspections

Target Date for Completion: FY 04-05

Status: To date, the Unified Development Ordinance (UDO) has not been completed. It is anticipated to be completed mid to late 2010.

3. Floodplain Mapping Projects

Orange County continues to work with State and Federal agencies to complete new floodplain mapping within its jurisdiction.

Orange County development regulations do not permit new structures to be constructed in floodplain areas.

Responsibility: Orange County Planning and Inspections

Target Date for completion: Unknown

Status: The new FEMA FIRMs became effective February 2, 2007. The County continues to work with State and Federal agencies on map maintenance within the jurisdiction.

4. Decrease Density in Protected Water Supply Watersheds

Current reviews of existing housing densities in protected water supply watersheds are being performed. This work will most likely be connected with the preparation of the new Land Use Element of the Comprehensive Plan.

Reducing density in rural areas should reduce vulnerability to several hazards, including wildfires.

Responsibility: Orange County Planning and Inspections

Target Date for Completion: FY 2004-05

Status: With the adoption of the 2030 Comprehensive Plan, densities in the critical watershed areas will not be increased.

Analysis

Complete removal of risk from several identified hazards is realistically not possible to achieve. For example, tornados can occur anywhere in the region, so restricting development in an area where a tornado had “touched down” in the past is not likely an effective mitigation measure for this hazard. A more effective mitigation measure would is to enforce wind velocity provisions in building codes, which Orange County does. Even so, a very strong tornado would be expected to damage or destroy some

structures; it is the risk people take when living in a region of the country where tornado activity is likely.

Mitigation measures for hazards such as earthquakes are available, but because the risk of an earthquake in this region of the country is relatively low, the costs involved to mitigate against a low-risk hazard would increase the cost burden to higher than acceptable levels. For example, building codes similar to those enforced in California, a state with a much greater earthquake risk, could be adopted and enforced but the substantially higher engineering and construction costs make it difficult to justify mitigating against the hazard in Orange County, North Carolina.

Orange County has been proactive in mitigating against the hazards to which it is most susceptible, namely flooding and landslides, by prohibiting construction of new structures in floodplain areas and limiting construction in areas of steep slopes.

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2. Town of Carrboro

ACTION ITEMS:
TOWN OF CARRBORO, N.C.
LOCAL MITIGATION STRATEGIES

New or Revised Initiatives	Local Responsibility	Target Dates for Completion	Comment
The programs, policies, ordinances and goals listed in the previous section serve the town's hazard mitigation needs quite well and provide a comprehensive approach toward hazard mitigation. This section includes a list of new programs, goals, ordinances, or approaches that the Town may wish to undertake in the future to further reinforce its ability to mitigate natural hazards. In addition to the forgoing, the Town of Carrboro supports the goals listed in *Orange County's Hazard Mitigation Plan*. The Town of Carrboro, as a member of the Orange County Hazard Mitigation Team, will coordinate with Orange County to reevaluate and update its hazard mitigation planning component at least once every five years or sooner as deemed appropriate by the Orange County Planning Director.			Revised update period: 2010-2015
• **Community Rating System** The National Flood Insurance Program's (NFIP) Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. The National Flood Insurance Reform Act of 1994 codified the Community	Town of Carrboro Planning Department	12-2002	**REVISED** The CRS application was not submitted during the initial planning period as envisioned. The

New or Revised Initiatives	Local Responsibility	Target Dates for Completion	Comment
Rating System in the NFIP. 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; and (3) promote the awareness of flood insurance. The Community Rating System administered by the Insurance Services Office, Inc. (ISO), provides communities that complete their application requirements with an insurance rating. The town of Carrboro intends to submit an application to the ISO for an insurance rating that will benefit owners of flood prone property.			planning department intends to complete the CRS application during the upcoming 2010 planning period.
• **Floodplain Mapping Projects** The Town of Carrboro will continue to monitor ongoing efforts by the State and the Army Corps of Engineers to complete new floodplain mapping for the planning area. Local staff resources will be needed to implement and encourage the completion of these activities.	Town of Carrboro Planning Department and Town Engineer and the Town of Chapel Hill, Engineering Department	Ongoing	**COMPLETE** Digital flood insurance rate maps (DFIRM) dated February 2, 2007 were adopted by reference on January 16, 2007 under section 15-251.2 of the Carrboro Land Use Ordinance.
• **Greenways** The Town needs assistance and support for the development of greenways and parklands dedicated to public use along streams and easements. The Town will seek to secure funding from federal, state and local sources to implement the Town's greenway system, which will in turn mitigate flood hazards.	Town of Carrboro Planning Department and Recreation Department	Ongoing	**UNDERWAY** -2003 greenways bond approved -MPO funding approved for planning Bolin and Morgan Creek greenways -2007 Greenways Commission established -2008 Greenways Inc retained to prepare the Bolin Creek Greenway plan and Coulter, Jewell and Thames retained to prepare a plan for the Morgan Creek Greenway 2009 Greenway Concept Plans

New or Revised Initiatives	Local Responsibility	Target Dates for Completion	Comment
			completed with implementation slated for the upcoming mitigation planning period.
• **Underground Utilities** The Town of Carrboro requires new developments to install electric, cable and telephone wires underground. The older neighborhoods are served by overhead utilities and services fail when fallen trees and or tree limbs break lines. It would be beneficial to locate these utilities underground since the Town has experienced lengthy power outages during ice storms or major storm events such as Hurricane Fran. Retrofitting above ground utilities by placing them underground is beyond the financial means of the town and could only be accomplished with resources from the utilities and/or with state and federal assistance.	Town of Carrboro Planning Department and Public Works Department Public Utilities	Ongoing	**ONGOING** No assistance obtained during the reporting period; the staff will continue to seek assistance to accomplish this task.

3. Town of Hillsborough

ACTION ITEMS:
Town Of Hillsborough
Local Mitigation Strategies

New or Revised Initiatives	Local Responsibility	Target Dates for Completion	Comment
The programs, policies, ordinances and goals listed in this section serve as the Town's Hazard Mitigation needs and provide a comprehensive approach toward hazard mitigation. This section includes a list of new programs; goals, ordinances, or approaches that the Town may wish to under in the future to further reinforce its ability to mitigate natural hazards.			
• Loss Prevention The Town of Hillsborough has experienced previous damage or losses at older facilities located where natural hazards are reasonable to expect. The Town plans to take the following steps to limit future losses:		Ongoing	
Relocate the Motor Pool operation to a non-flood prone site. This is a sizable project generally beyond the Town's financial	Public Works Department	Facility Design-FY04	Offer made on an existing building

New or Revised Initiatives	Local Responsibility	Target Dates for Completion	Comment
capabilities in the next 10 years. Funding assistance is needed.		Construction-FY05	new building. Move in Dec 09
Relocation of sewer pump stations in critical areas.	Engineering Dept.	Ongoing	Ongoing 75% complete
Relocation of raw water intake pumps at Ben Johnston Lake (raise above flood levels).	Engineering Dept.	FY04	Completed FY05
Work with Tree Board, Public Works, and Utilities to ensure that dangerous situations are addressed timely.	Public Works Dept.	Ongoing	Ongoing
Work with State efforts to study hydrology and map/designate any new flood prone areas.	Planning Dept.	FY05	Ongoing
Amend Flood Plain Ordinance to prohibit building and land disturbance in floodplain	Planning Dept.	Post FY05	Completed FY06
• Preparedness and Education		Ongoing	Ongoing
Adopt local operations plan that details which Town functions will be maintained, and how we will keep the public informed.	Town Manager	End of FY05	Completed June 2007
Look at alternative electrical sources (generators, etc.), for each Town administrative facility and determine what level needs to be maintained and where.	Town Management Team	End of FY05	Completed FY05
Prepare sewer pump stations for easy generator connection	Engineering Dept.	End of FY03	Completed FY04
Install generators at most serious pump station locations	Engineering Dept.	End of FY05	Completed FY05
Outfitting the Water Plant with a generator.	Engineering Dept.	FY04	Completed FY04
Outfitting the Sewer Plant with a generator.	Engineering Dept.	Approx. FY10	Approx. FY10 Redundant connection to power grid in Place.

4. Draft Statement of Commitment to Mitigating Impacts of Natural Hazards

Through the act of developing and adopting a Hazard Mitigation Plan, Orange County and the participating municipalities (Carrboro and Hillsborough) are committing to continuing to develop and engage in programs, activities and practices that can be implemented at the local government level in a fiscally feasible manner to help to mitigate the impacts of future natural hazards.

The local governments intend to create a process by which the requirements of this hazard mitigation plan will be incorporated into other local plans. During the planning process for new and updated planning documents, such as a comprehensive plan, land use plan, capital improvements plan, or emergency management plan, to name a few examples, the local planner will provide a copy of the hazard mitigation plan to each respective advisory committee member. The local planner will recommend the advisory committee members to ensure that all goals and strategies of new and updated local planning documents are consistent with the hazard mitigation plan and will not contribute to increased hazards in the jurisdiction.

V. Plan Maintenance

The OCHM Team will monitor the plan to measure effectiveness and recommend future changes that may need to be incorporated. Following plan adoption, it is important to continually track the progress of the action items and evaluate how the mitigation strategies contained in the plan work. The OCHM Team will meet on an annual basis in October of each year to evaluate the plan and ensure any necessary changes are made. Orange County's Planning Director shall take the lead in ensuring that an on-going process of monitoring the Hazard Mitigation Plan occurs. The Planning Director will be responsible for tracking progress as implementation occurs and submitting an annual report to the Hazard Mitigation Team prior to the annual meeting.

The Director of Orange County's Planning Department will also serve as Mitigation Coordinator of the plan. It shall be the responsibility of Orange County's Planning Director to convene the OCHM Team for the purposes of plan review on at least an annual basis, as described above. The OCHM Team will also meet when the Orange County Planning Director deems necessary to review, update and prepare a report of the status of the mitigation progress. This report should include: a review of the goals, accomplishments, revisions, discussions on why any goals are not met, why projects may be behind schedule, recommendations for new projects and review new disasters that may have occurred. Prior to finalization of the report, the public will be invited to comment. Public comments will be solicited via the local government websites, on which the Hazard Mitigation Plan will be posted, and via a public notice published in the relevant newspaper(s). The OCHM Team will ensure the following questions are adequately addressed at the annual meetings and included in the resultant update report:

1. Do the goals and objectives address current and expected conditions?
2. Has the nature or magnitude of risks changed?
3. Are the current resources appropriate for implementing the plan?
4. Are there implementation problems, such as technical, political, legal, or coordination issues with other agencies?
5. Have the outcomes occurred as expected?
6. Did the agencies and other partners participate in the plan and planning process as proposed?

Additionally, a formal update of the plan shall be completed every 5 years. Orange County's Planning Director will be responsible for convening the OCHM Team to undertake the formal update. At a minimum, the formal update will include an analysis of changes in development within the county and the participating municipalities and an analysis of any changes in vulnerability to natural hazards and appropriate mitigation strategies that can be enacted to address vulnerabilities.

Appendix A: Orange County Hazard Mitigation Maps, 2009

- North Carolina Counties – Graphical representation of Orange County and its surrounding counties.

- Orange County Base Map – This map contains municipal boundaries and roads.

- Orange County Comprehensive Plan - Land Use Element - This map represents County policy as to desired type and intensity of growth and development. Appropriate zoning is applied to be consistent with the Land Use Element.

- Orange County Zoning - Zoning is a legal tool used to regulate the size, scope, and function of new development (i.e. use, height, impervious surface, etc.) This map represents on a parcel-by-parcel basis the applicable zoning districts for Orange County's planning jurisdiction. The attached list further defines the zoning classifications.

- Orange County Watersheds – This map includes all watershed and major river basins and streams in the county.

- Orange County Special Flood Hazard Areas with Tornado Paths (1950-2006) – Source: Flood Hazard Data effective 2007 from the NC Floodplain Mapping Program

- Hurricane Paths – North Atlantic hurricane paths 1851-2008

- Houses in Special Flood Hazard Areas, Orange County – Source: Flood Hazard Data effective 2007 from the NC Floodplain Mapping Program

- Morgan Creek – FEMA Flood Hazard Areas & Local Buffers – FEMA Flood Hazard Areas, local buffers, and structures along Morgan Creek within the Town of Carrboro

- Bolin Creek – FEMA Flood Hazard Areas & Local Buffers – FEMA Flood Hazard Areas, local buffers, and structures along Bolin Creek with the Town of Carrboro

- Structures in Floodplain – Hillsborough, NC

- Orange County Wetlands – Environmental Resource Conservation Division designated wetlands from the National Wetlands Inventory

- Orange County Topography – This map is in 10-foot elevation intervals.

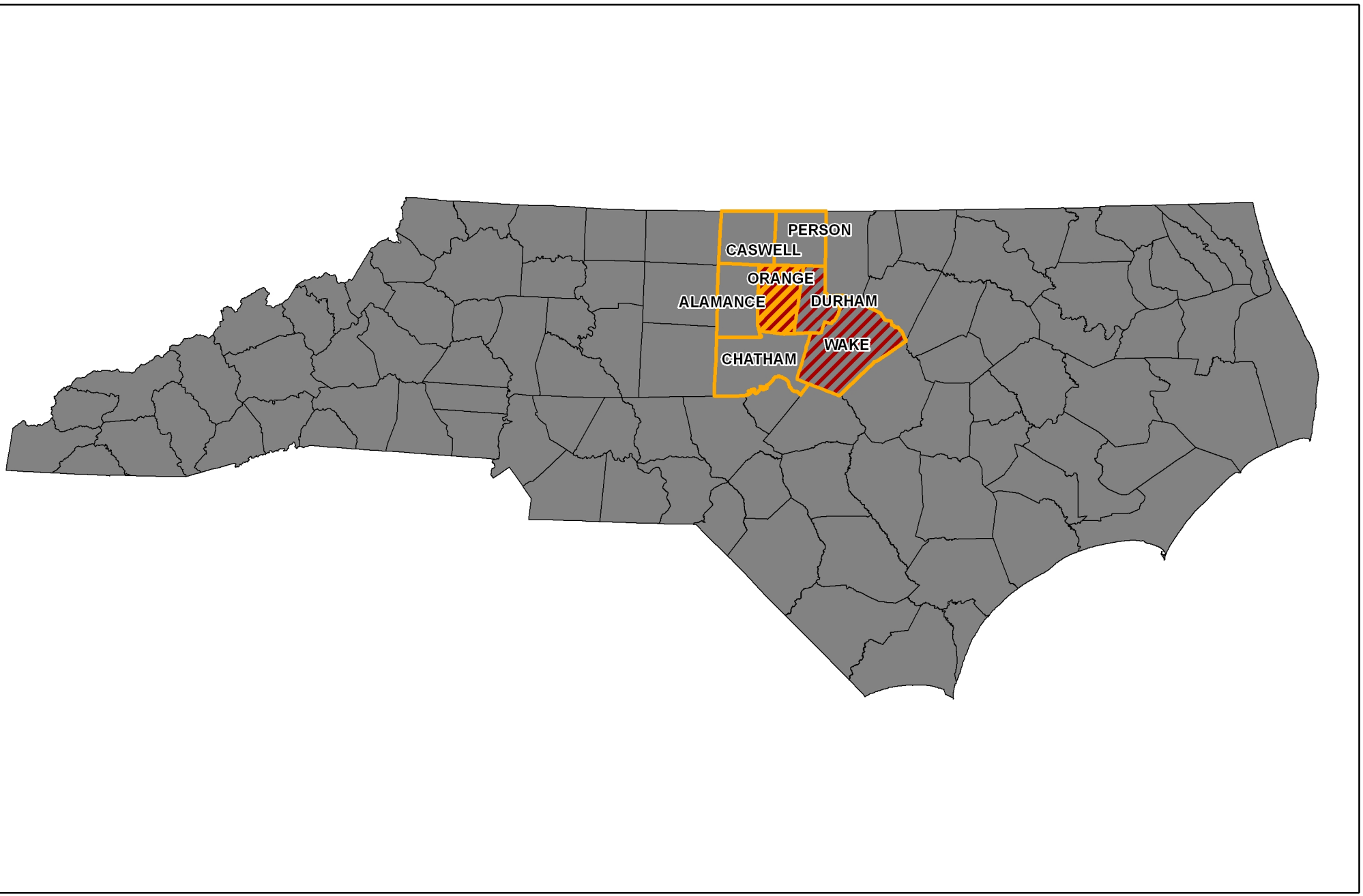
- Steep Slopes – Map which shows where steep slopes (15% or greater) are located

- Orange County Population Concentration – This map has the 2000 Census population by blocks, with persons per acre

- Orange County Approved Subdivisions, 1992-2006 - Includes all major subdivisions from 1992-2006.

- Orange County Critical Facilities, Including Town of Carrboro and Town of Hillsborough – This map contains sheriff districts, schools, hospitals, government buildings, and water and wastewater treatment facilities. Floodplains, major roads and railroads are also displayed.

North Carolina Counties



Surrounding Counties | Triangle | Orange County | NC Counties

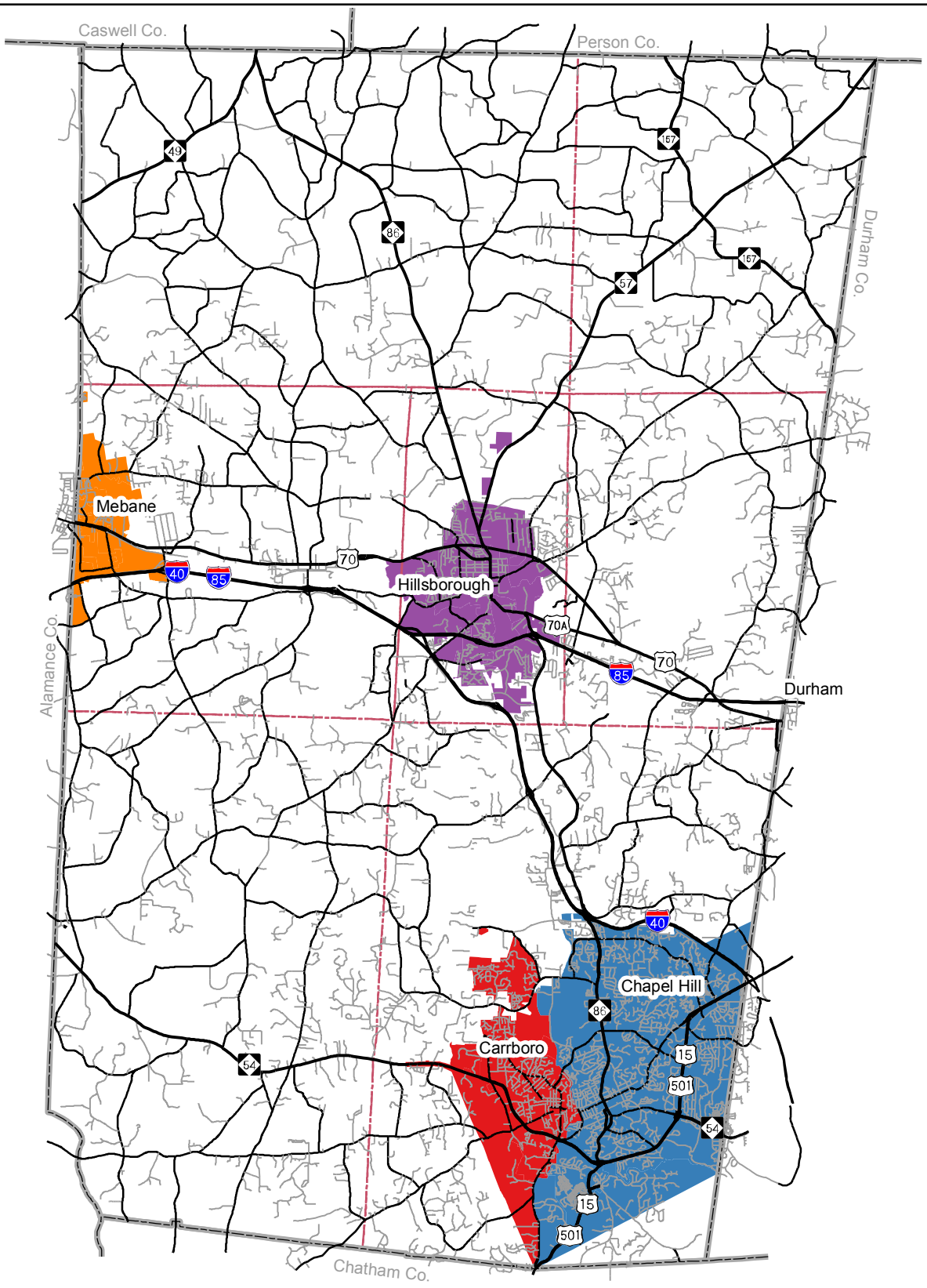
N

1 inch = 50 miles

0 30 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 15, 2009

Orange County
Base Map



Township Boundary
Carrboro Jurisdiction
Chapel Hill Jurisdiction
Durham Jurisdiction
Hillsborough Jurisdiction
Mebane Jurisdiction

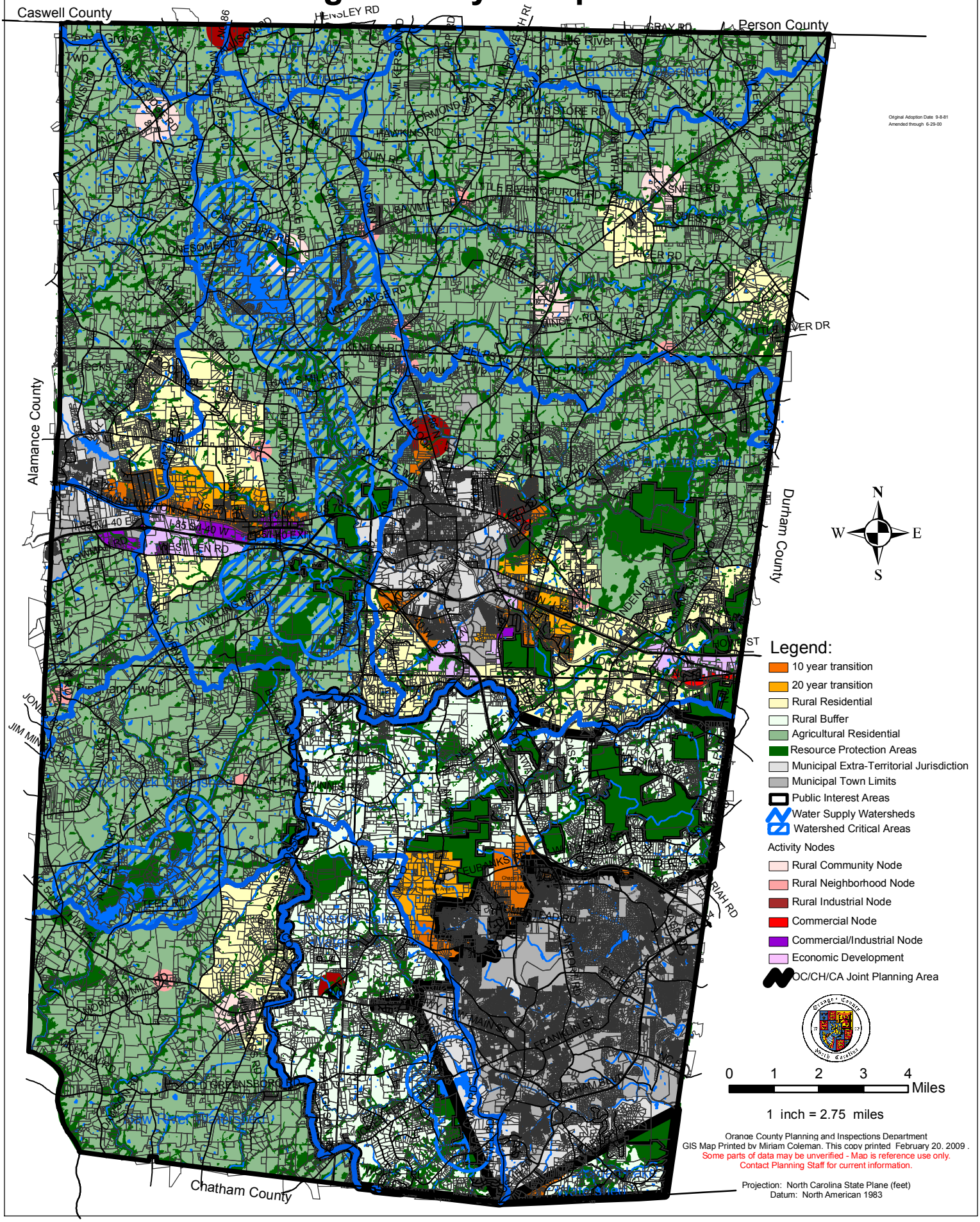
N

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 17, 2009

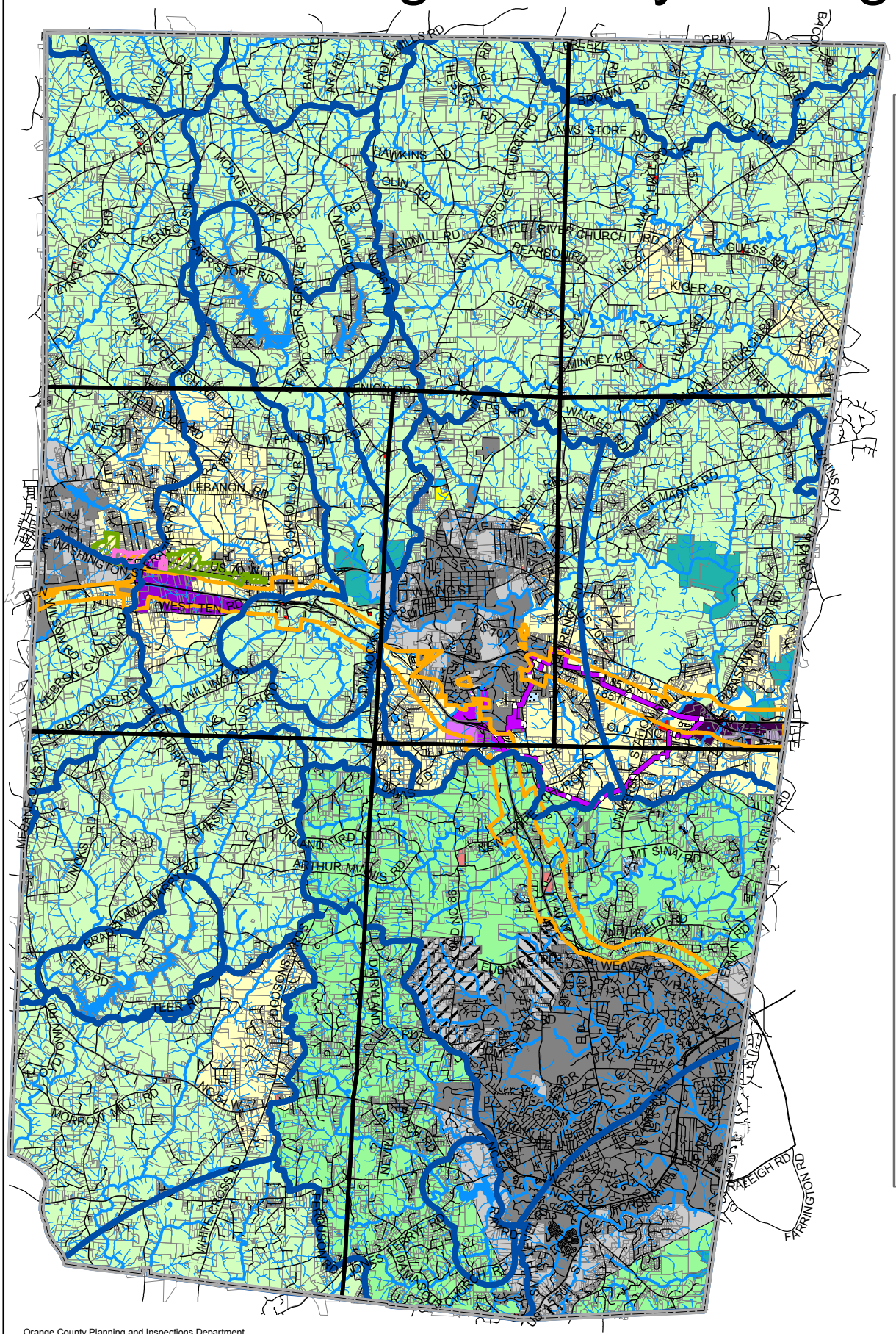
Land Use Element
of the Orange County Comprehensive Plan



Orange County Zoning Districts

AR	Agricultural Residential
AS	Agricultural Service
CC3	Community Commercial
EC5	Existing Commercial
EDD	Economic Development
EDD-P	Economic Development-Primary
EDD-S	Economic Development-Secondary
ED-LNR	Economic Development - Linear Office
ED-LO-1	Economic Development - Limited Office
ED-LO-2	Economic Development - Limited Office
EI	Existing Industrial
GC4	General Commercial
I1	Light Industrial
I2	Medium Industrial
I3	Heavy Industrial
LC1	Local Commercial
NC2	Neighborhood Commercial
PDCGC4	Planned Development Commercial - General Commercial
PDHR1	Planned Development Housing - Rural Residential
PDHR2	Planned Development Housing - Low and Medium Intensity Residential
PDHR4	Planned Development Housing - Low and Medium Intensity Residential
PDHR5	Planned Development Housing - High Intensity Residential
PDHR8	Planned Development Housing - High Intensity Residential
PDHRB	Planned Development - Rural Buffer
PD-I1	Planned Development - Light Industrial
PD-OI	Planned Development - Office/Institutional
PID	Public Interest
PUD-R1	Planned Development
R1	Rural Residential
R2	Low and Medium Intensity Residential
R3	Low and Medium Intensity Residential
R4	Low and Medium Intensity Residential
R5	High Intensity Residential
R8	High Intensity Residential
RB	Rural Buffer

Orange County Zoning



Residential

- AR
- RB
- R1
- R2
- R3
- R4
- R5
- R8
- PUD-R1
- PDHR1
- PDHR2
- PDHR4
- PDHR5
- PDHR8
- PDHRB

Business/Commercial

- LC1
- NC2
- CC3
- GC4
- EC5
- EDD
- EDD-P
- EDD-S
- ED-LO-1
- ED-LO-2
- ED-LNR
- PDCGC4
- PD-OI
- AS

Industrial

- I1
- I2
- I3
- EI
- PD-I1

Public

- PID

Overlays

- Watersheds
- Efland-Cheeks Highway 70 Overlay District
- Pre-designated Commercial Area
- Major Transportation Corridor
- Stoney Creek Basin

- City Limits
- ETJ
- CA Transition
- CH Transition
- Streams
- Water Bodies

0 1 2 3 Miles

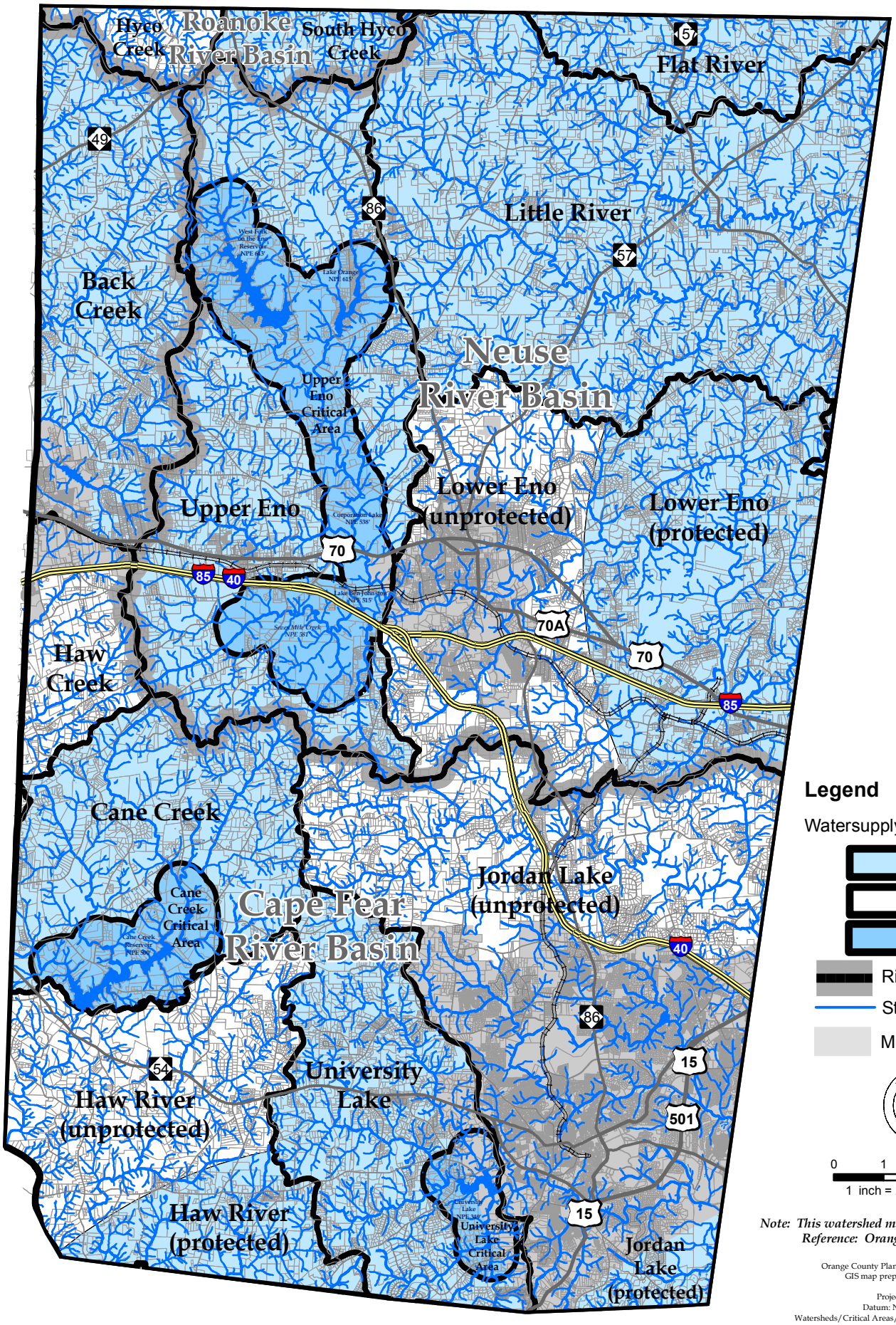
1 in = 2.89 miles

N

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson. This copy printed June 26, 2009.
Some parts of data may be unverified - Map is reference use only.
Contact Planning Staff for current information.

Projection: North Carolina State Plane (feet)
Datum: North American 1983

Orange County Watersheds

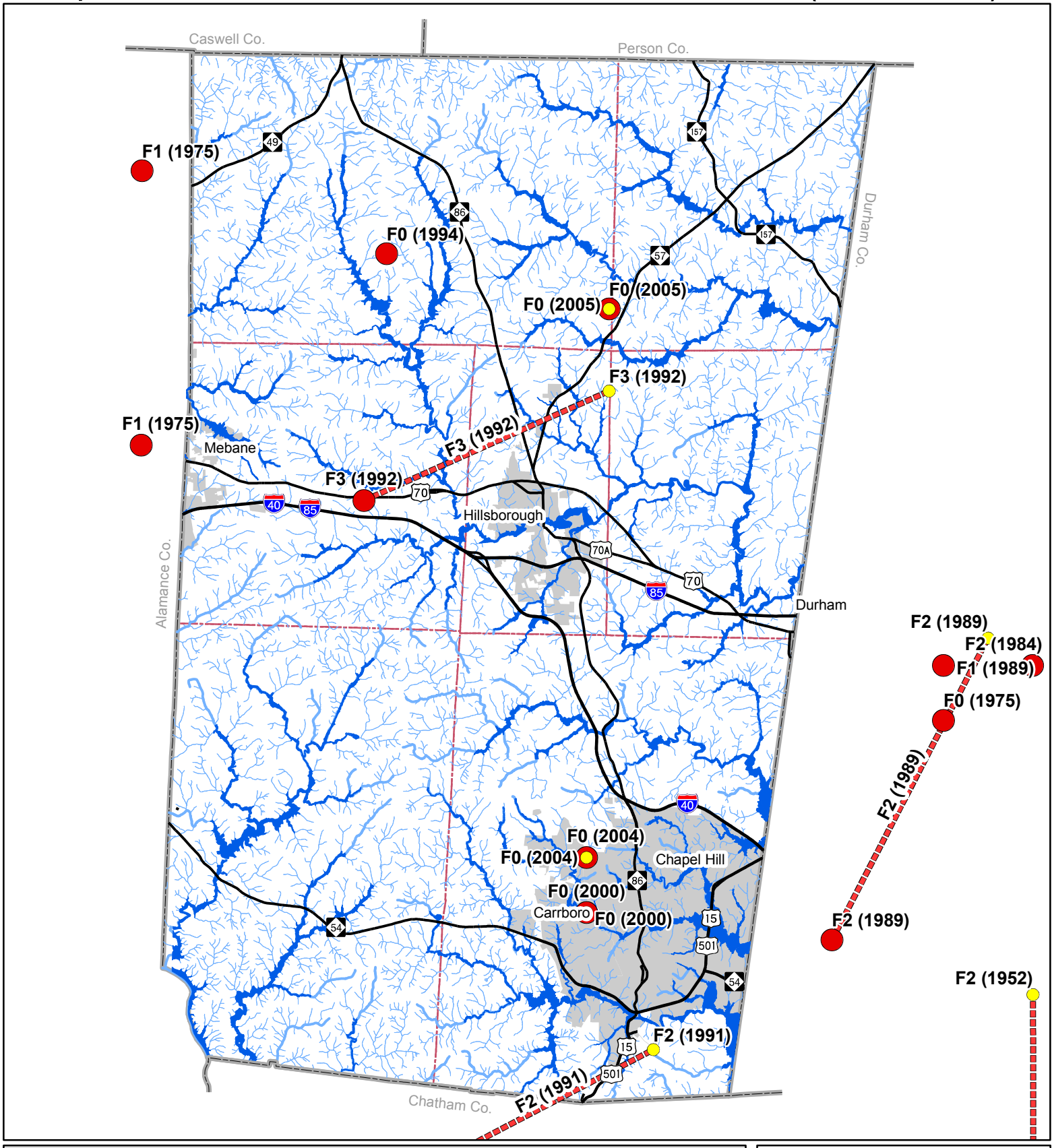


Note: This watershed map replaces previous versions.
Reference: Orange County Zoning Ordinance

Orange County Planning & Inspections Department
GIS map prepared by Miriam Coleman

Projection: State Plane
Datum: North American 1983
Watersheds/Critical Areas/Basins Data: November, 2005 Revision

Orange County
Special Flood Hazard Areas with Tornado Data (1950-2006)



Tornado Liftoffs
Tornado Touchdowns
Tornado Tracks
Special Flood Hazard Areas
Streams
Township Boundary

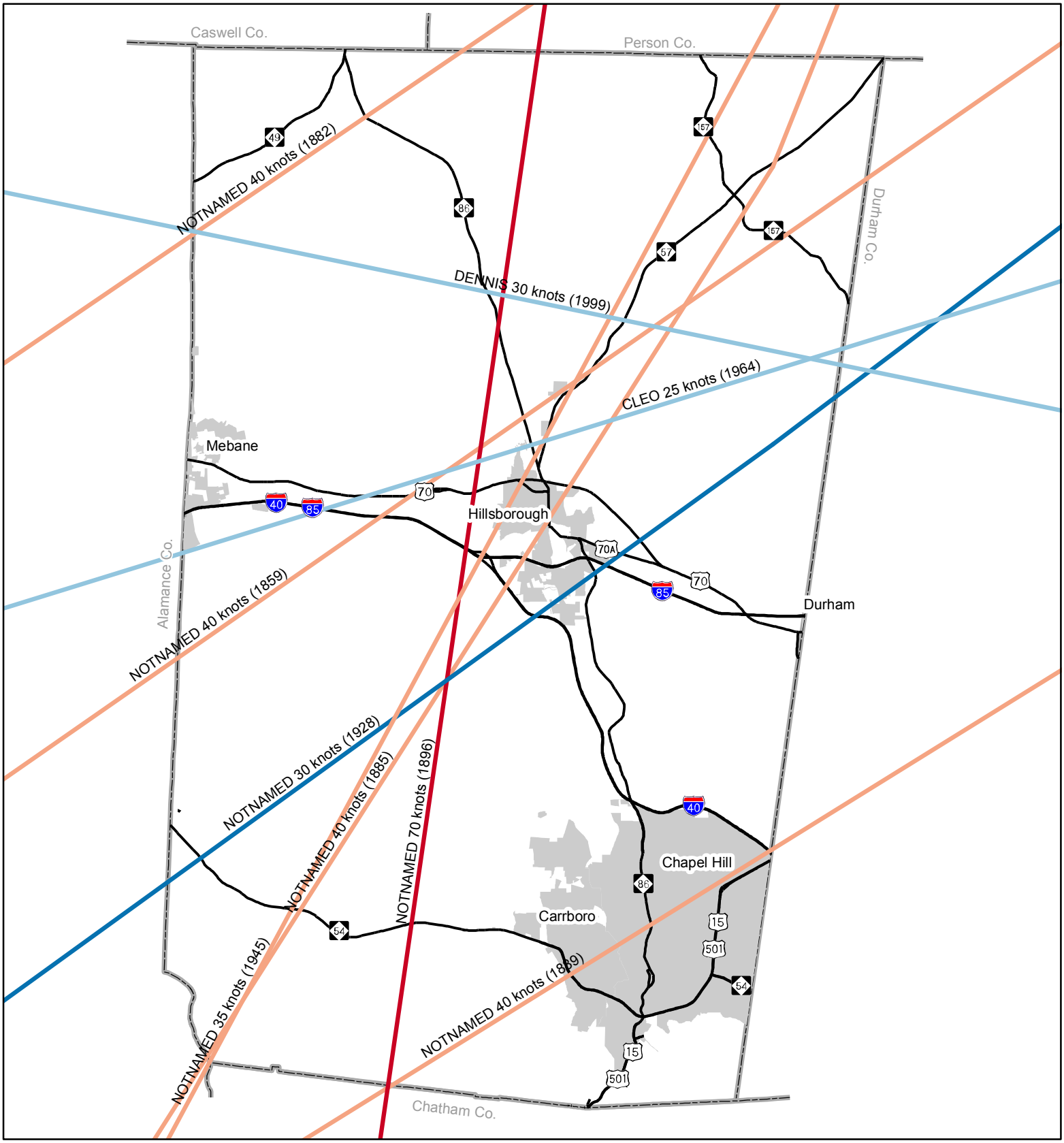
N

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson July 10, 2009

Orange County
Historical North Atlantic Tropical Cyclone Tracks, 1851-2008



Category 1 Hurricane
Tropical Storm
Tropical Depression
Extratropical

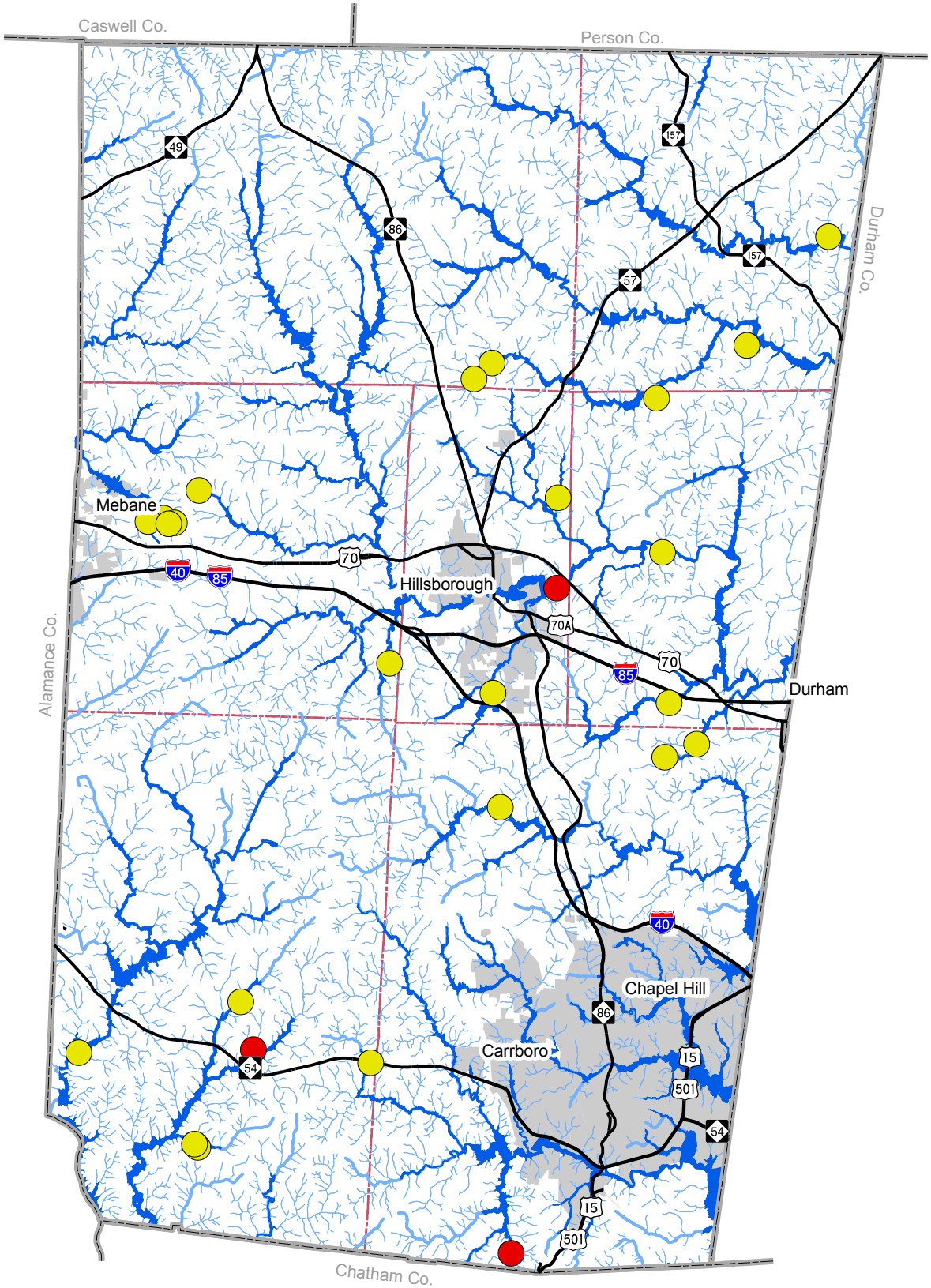
N

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 17, 2009

Orange County
Houses in Special Flood Hazard Area



Houses Completely in Special Flood Hazard Area

Houses Partially in Special Flood Hazard Area

Township Boundary

Special Flood Hazard Areas

Streams

N

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson July 10, 2009

TOWN OF CARRBORO
301 W. Main St.
Carrboro, NC 27510

Printed Aug 31, 2005

Feet
0 600 1,200 2,400

NC State Plane Coordinate System (NAD83)

THIS MAP IS NOT A CERTIFIED SURVEY
NO RELIANCE MAY BE PLACED IN ITS ACCURACY

The Town of Carrboro assumes no liability for damages caused by inaccuracies in this map or supporting data and makes no warranty, expressed or implied, as to the accuracy of the information presented. The fact of distribution does not constitute such a warranty.

CARRBORO, NC

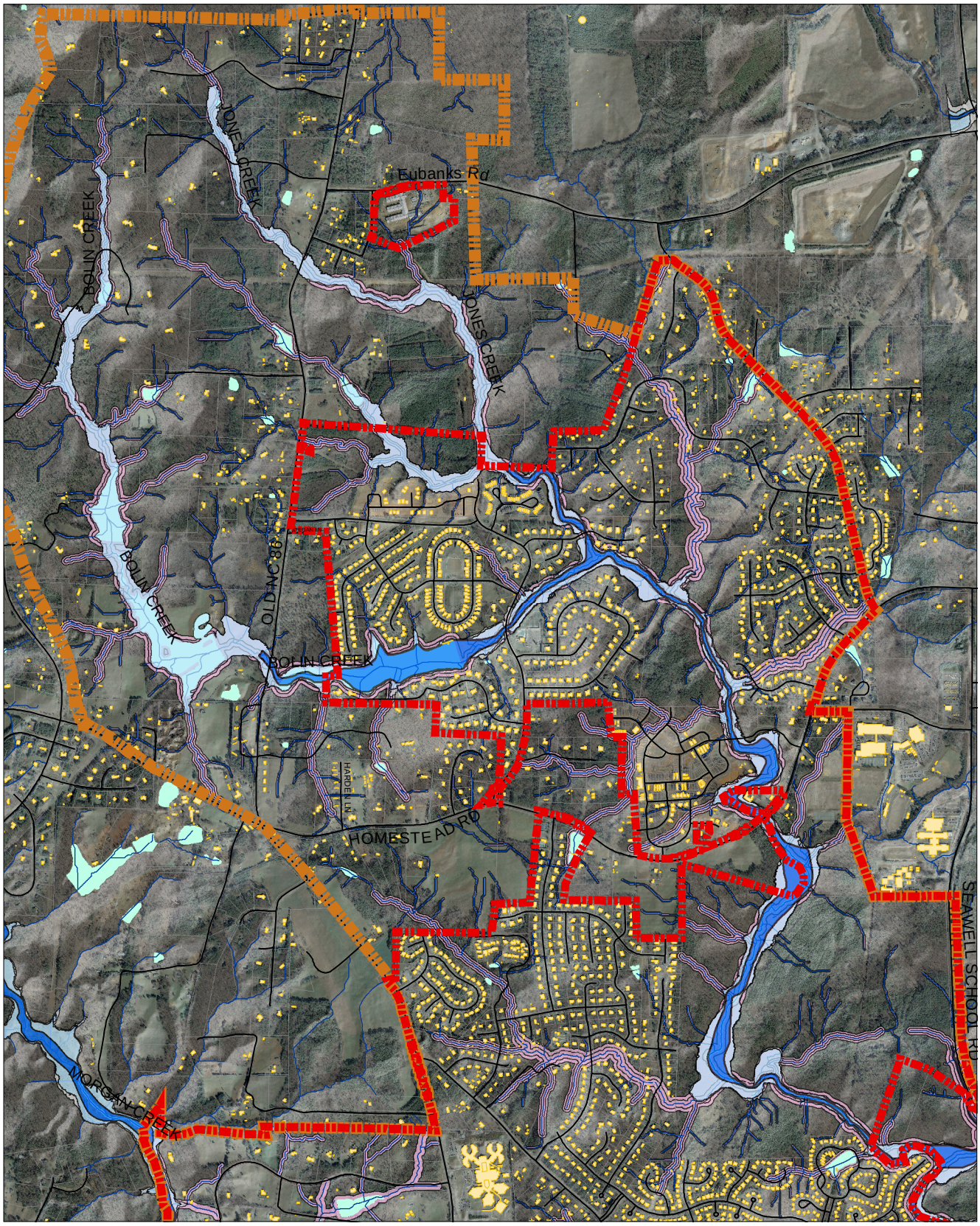
FEMA Flood Hazard Areas & Local Buffers
MORGAN CREEK

Legend

- City Limits
- Planning Jurisdiction
- Buildings

NC Floodmapping Floodplain
FLD_ZONE, FLOODWAY

- 500 yr Floodplain
- 100 yr Floodplain
- 100 yr Floodway
- Streams
- CarrboroGDB.DBO.StreamBuffer



TOWN OF CARRBORO
301 W. Main St.
Carrboro, NC 27510

Printed Aug 31, 2005

Feet
0 600 1,200 2,400

NC State Plane Coordinate System (NAD83)

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CARRBORO, NC

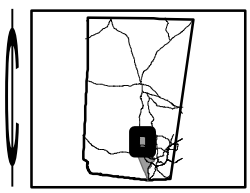
FEMA Flood Hazard Areas & Local Buffers
BOLIN CREEK

Legend

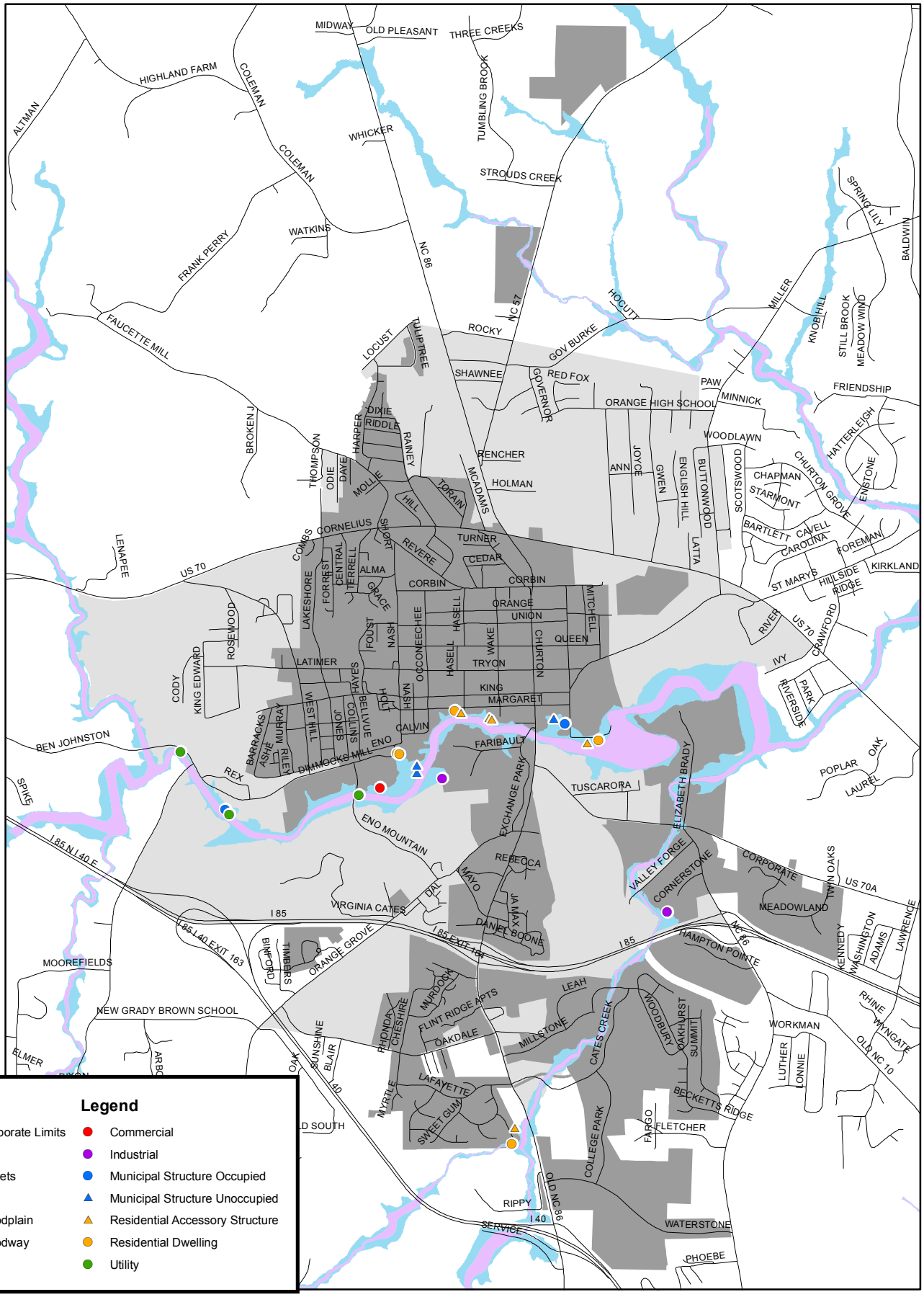
- City Limits
- Planning Jurisdiction
- Buildings

NC Floodmapping Floodplain
FLD_ZONE, FLOODWAY

- 500 yr Floodplain
- 100 yr Floodplain
- 100 yr Floodway
- Streams
- CarrboroGDB.DBO.StreamBuffer



Structures In Floodplain-Hillsborough, NC

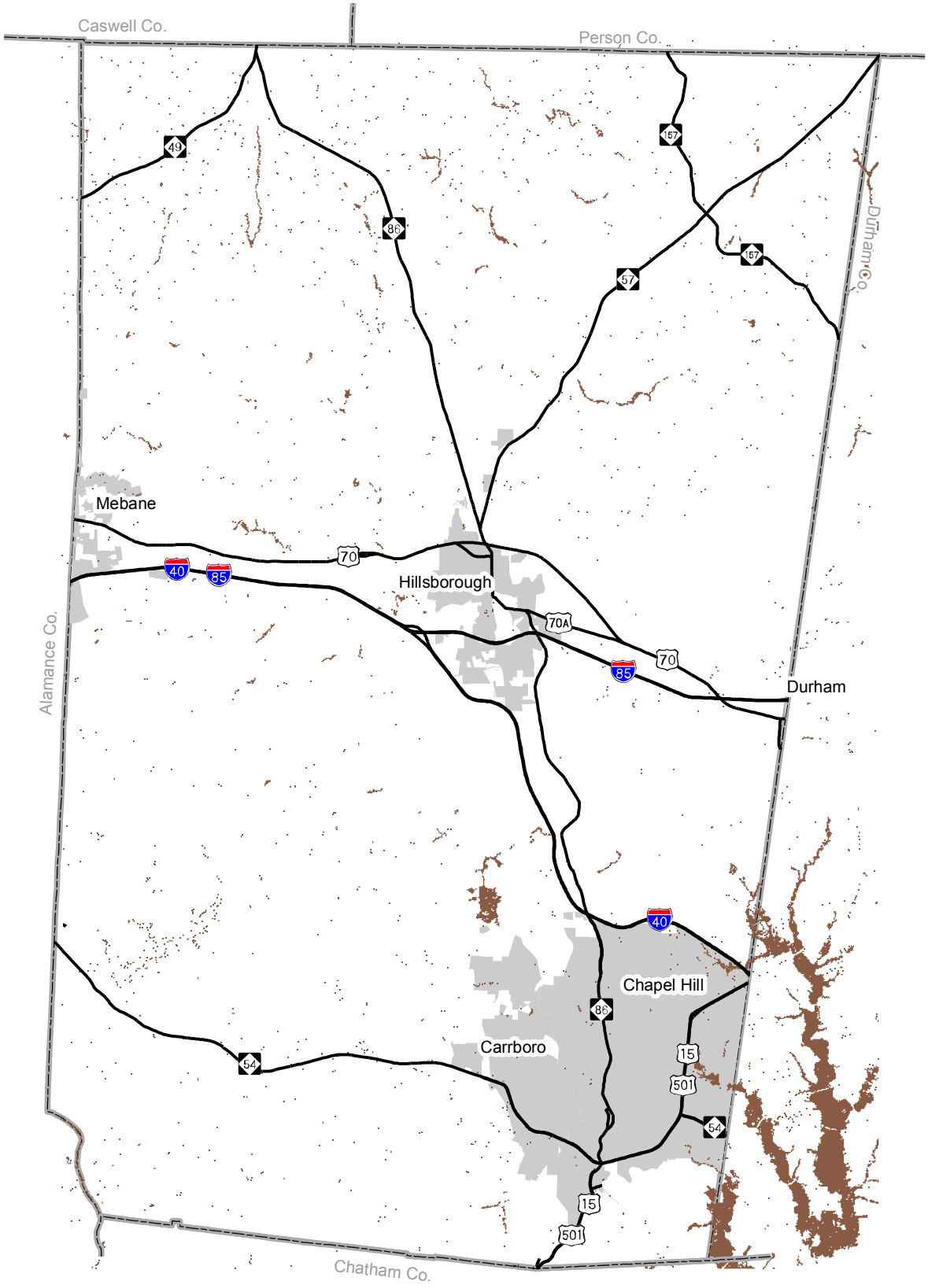


Map Prepared by Tom King, AICP, CZO-Senior Planner
Base Data Dates: Orange County GIS 2008/2009
Structure Point Data: Town of Hillsborough
Date: July 8, 2009

0 0.4 0.8 1.6 Miles

N

Orange County Wetlands



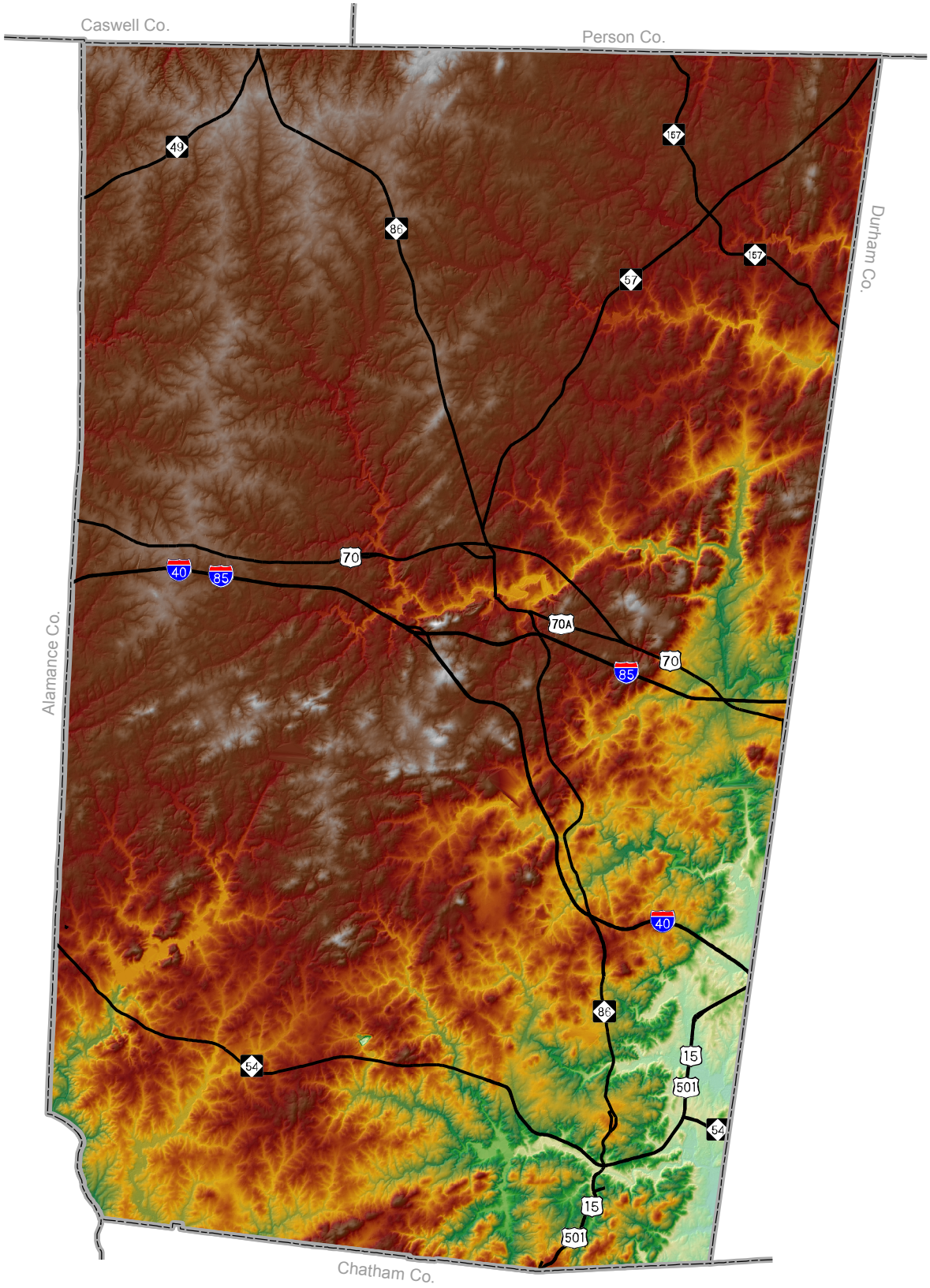
Wetlands

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 17, 2009

Orange County Topography



High : 847 ft

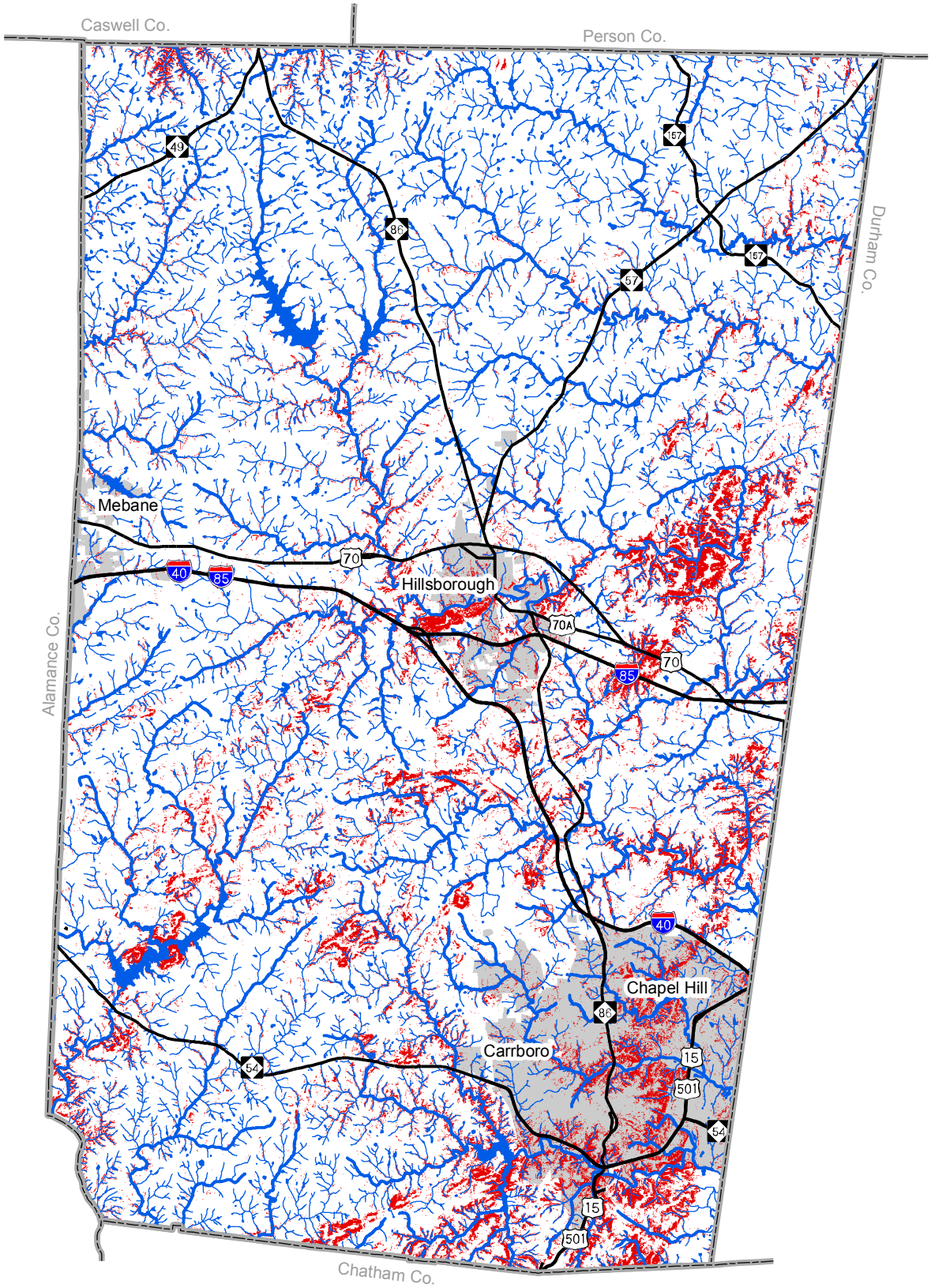
Low : 221 ft

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 17, 2009

Orange County
Steep Slopes



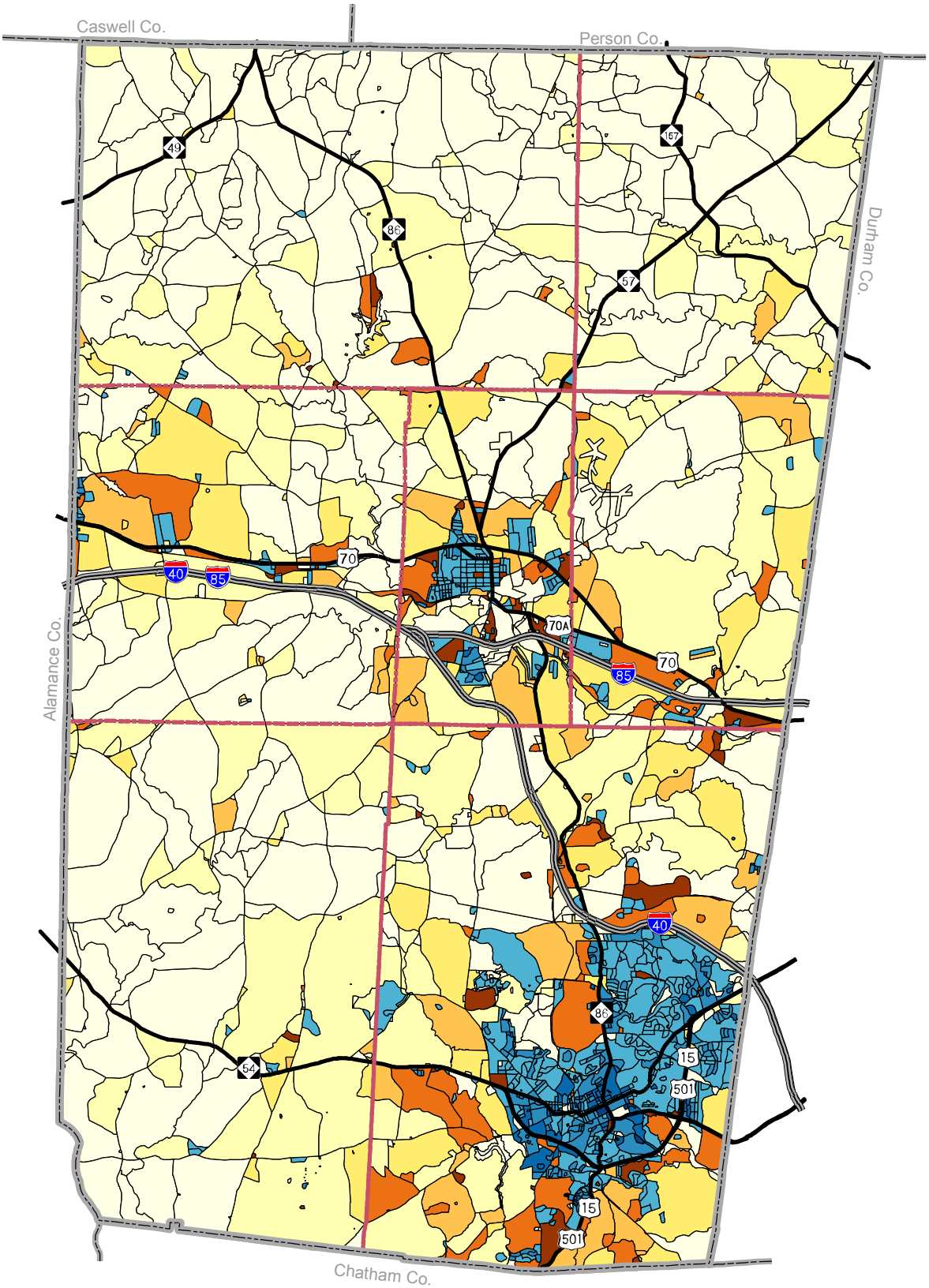
Slopes 15% or Greater

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 17, 2009

Orange County
Population Concentration (Census 2000)



Density (People per Acre)

- 0.000000000 - 0.1250
- 0.1251 - 0.2500
- 0.2501 - 0.3750
- 0.3751 - 0.5000
- 0.5001 - 0.7500
- 0.7501 - 1.000
- 1.001 - 5.000
- 5.001 - 10.00
- 10.01 - 50.00
- 50.01 - 260.0

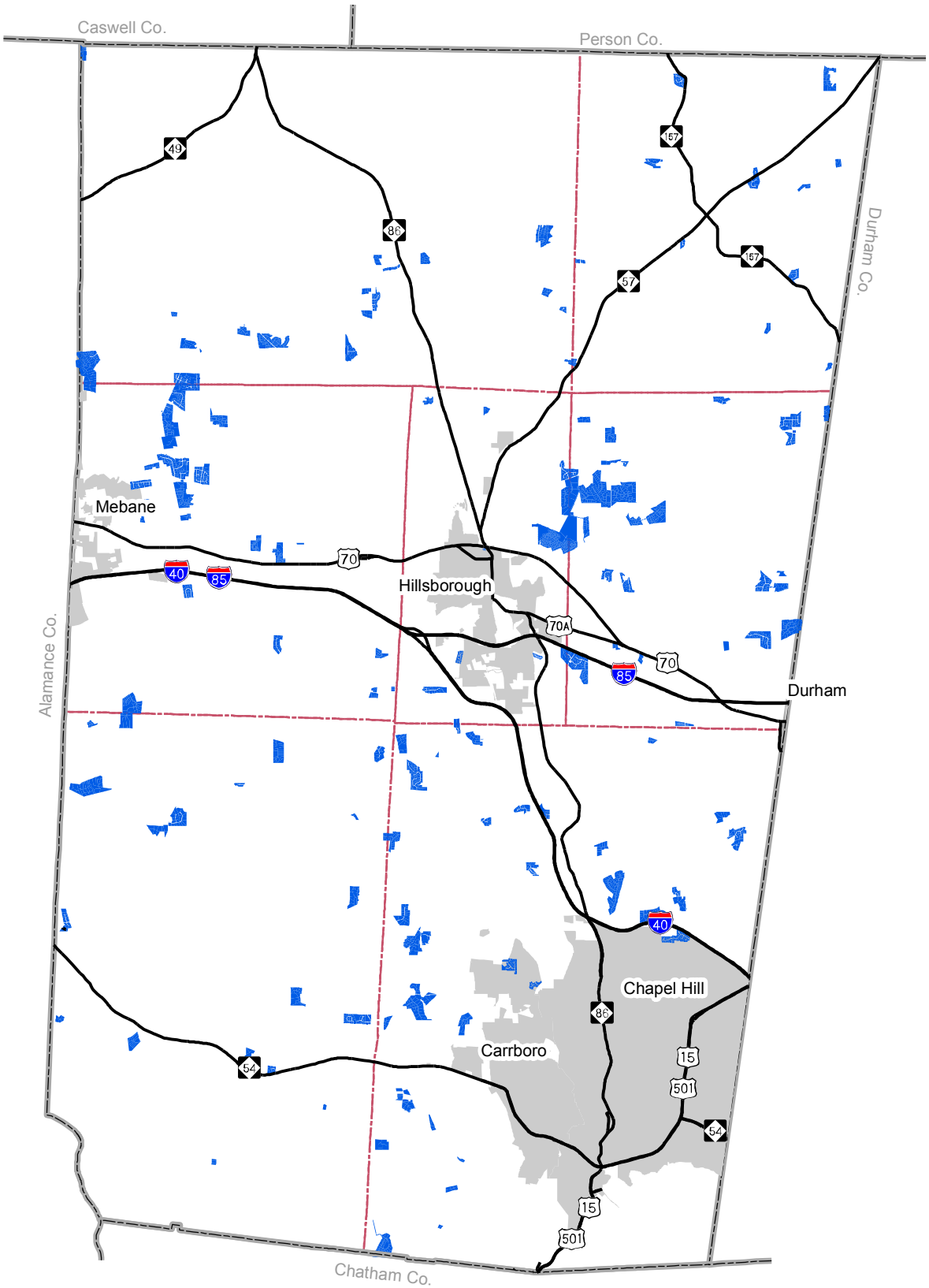
N

1 inch = 3.25 miles

0 1 2 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 16, 2009

Orange County
Major Subdivisions Approved 1992-2006



Major Subdivision Lots

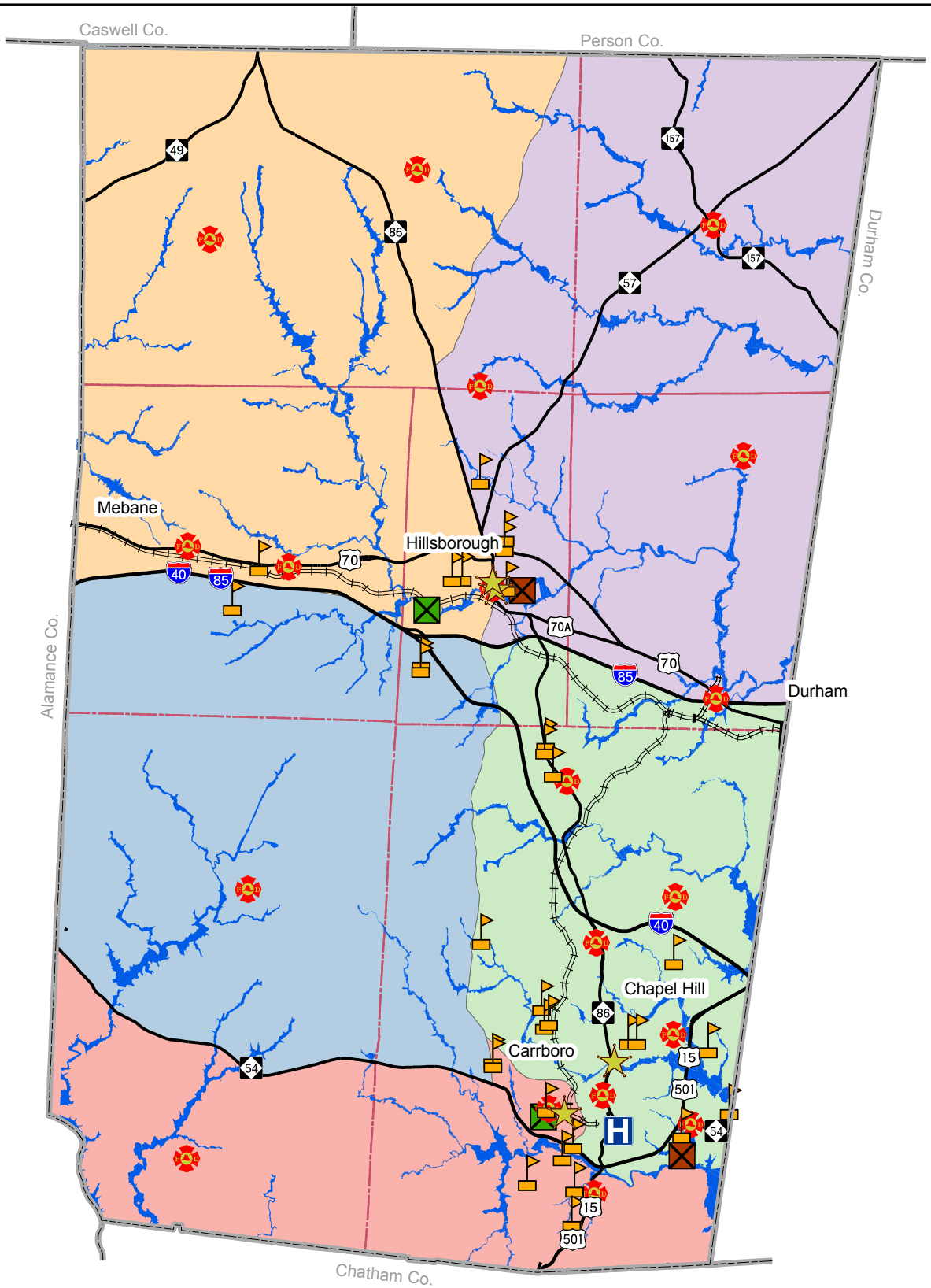
Township Boundary

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson June 17, 2009

Orange County
Critical Facilities



Schools
Sewage Treatment
Water Treatment
Special Flood Hazard Areas
Rails

Fire Stations
Police/Sheriff Offices
Hospital
Township Boundary

Sheriff Districts
9
10
11
12
13

N

1 inch = 3.25 miles

0 3 Miles

Orange County Planning and Inspections Department
GIS Map Prepared by Brian Carson July 10, 2009

Appendix B: Orange County Capability Assessment

Policies, Practices, Programs, Regulations and Activities (Existing and Potential)	Document Reference (Page number or other source)	Effectiveness for Mitigation (High/Med/Low/Not Effective) & Notes	Rationale for Effectiveness
Orange County Subdivision Regulations			
❑ Section IV-B-2.Land Suitability	Page 25	High	Protection of floodplains, wetlands, & steep slopes
❑ Section IV-B-3 Streets	Page27	Medium	Street interconnectivity & adequacy of design
❑ Section IV-B-5 Lot Layout	Page 33	Medium	Control lot layout related to streets & hazard/sensitive areas
❑ Section IV-B-8. Landscape & Buffer Requirements	Page 46	Medium	Protection from pollution & airborne hazards
❑ Section IV-B-9. Cluster Developments	Page 60-b	High	Encourages preservation & protection of hazard sensitive areas
❑ Section IV-B-11. Wetlands	Page 65-t	High	Permitting for land disturbance in/near water bodies & wetlands
❑ Appendix A. Private Road Standards	Page A-1	Low	Construction standards for private roads. Interconnectivity not required for private roads
Orange County Zoning Ordinance			
Article 4. Establishment of Permitted Use Table and Schedule			
❑ Section 4.2.27. Watershed Protection Overlay Districts	Page 4-10	High	Development standards to reduce pollution that enters drinking water supplies
❑ Sections 4.2.34 through 4.2.40. Special Flood Hazard Area Overlay District	Section 4.2.34 through 4.2.40	High Notes: Adopted April 2009; Establishes special flood hazard Overlay District on Official Zoning Atlas; incorporates previously adopted FDPO within Zoning Ordinance	Limits activities within SFHAs, thereby reducing loss and hazards
Article 6. Application of Dimensional Requirements	Page 6-1		
❑ Section 6.14.1 Electrical Disturbance or Interference	Page 6-15	High	Prohibits electrical disturbances that may interfere with emergency comm. equipment
❑ Section 6.14.9. Air Pollution	Page 6-18-a	Low	Air pollution standards for land uses.

Policies, Practices, Programs, Regulations and Activities (Existing and Potential)	Document Reference (Page number or other source)	Effectiveness for Mitigation (High/Med/Low/Not Effective) & Notes	Rationale for Effectiveness
❑ Section 6.14.10 Disposal of Liquid Wastes	Page 6-18-a	High	Establishes Standards for disposal of liquids wastes
❑ Section 6.19 Federal Wetlands Permits	Page 6-25-b	High	Permit required if land disturbance in or near water.
❑ Section 6.23 Extra requirements for watershed protection overlay districts.	Page 6-26	High	Exceeds State requirements for water supply watershed
❑ Section 6.23.1 Land Use Restrictions	Page 6-26	High	Prevention of water supply contamination.
❑ Section 6.23.2 Residential Density	Page 6-27	High	Controls density in protected watersheds
❑ Section 6.23.3 Storm water Infiltration and Detention	Page 6-28	High	Prevention of water supply contamination.
❑ Section 6.23.4 Operation and Maintenance of Structure BMPs (Detention Ponds)	Page 6-28	High	Prevention of water supply contamination.
❑ Section 6.23.5 Placements of streets, Driveways and buildings	Page 6-39	Medium	Protection of stream buffers
❑ Section 6.23.7 Stream Buffers	Page 6-40	High	Protection of floodplains along USGS classified water bodies.
❑ Section 6.23.9 Clustering	Page 6-44	High	Protection of sensitive/flood plain areas.
❑ Section 6.32.1 through 6.32.9. Special Flood Hazard Areas	Sections 6.32.1 through 6.32.9	High Note: Adopted April 2009	Establishes specific development limits and criteria within special flood hazard areas
Article 8. Planned Development Districts	Page 7-1	High	Allows for flexibility in design to aid in protection of sensitive areas.
Article 10. Off-Street Parking and Loading	Page 10-1		
❑ Section 10.2. Prohibited within Special Flood Hazard Areas	Section 10-1	High	Prohibits off-street parking and loading facilities within special flood hazard areas
Article 11. Non-Conformities			
❑ Section 11.9 Non-Conforming Uses of Major Structures, or Structures and Premises in Combination	Page 11-5	High	Prohibits enlargement, replacement of remodeling of portion of structures below regulatory flood protection elevation in the floodway, non-encroachment area, or stream setback
Article 23. Enforcement			
❑ Section 23.5. Corrective Procedures – Special Flood Hazard Area Overlay District	Section 23.5	High	Establishes enforcement and corrective procedures for violations of Special Flood Hazard Area

Policies, Practices, Programs, Regulations and Activities (Existing and Potential)	Document Reference (Page number or other source)	Effectiveness for Mitigation (High/Med/Low/Not Effective) & Notes	Rationale for Effectiveness
Standards			Overlay District
Economic Development District Design Manual			
❑ Section 2.2 Permitted Uses	Page 2.1.1	Low	Protection of adjoining properties from incompatible uses.
❑ Section 2.3. Impervious Surface Ratio (ISR)	Page 2.3.3	High	Water supply protection. Storm water runoff control.
❑ Section 2.3. Building Volume Ratio (BVR)	Page 2.3.5	Low	Regulation of height/bulk of buildings.
❑ Section 2.3 Landscape Volume Ratio (LVR)	Page 2.3.7	Low	Pollution reduction protection; erosion control
❑ Section 2.3. Site Volume Ratio (SVR)	Page 2.3.10	Low	Limits bulk of structures on zoning lots.
❑ Section 2.4. Noise	Page 2.4.2	Low	Reduction in noise pollution.
❑ Section 2.4. Vibration	Page 2.4.5	Low	Standards based on dated tech.
❑ Section 2.4. Air Pollution	Page 2.4.6	High	Reduction in air pollution.
❑ Section 2.4. Electromagnetic Interference	Page 2.4.9	High	Prohibits electromagnetic interference, which can impact emergency communications equipment.
❑ Section 2.4. Hazardous Materials	Page 2.4.9	High	Allows for comprehensive management of risk from hazardous materials
❑ Section 2.4. Solid Waste	Page 2.4.12	Low	Solid waste management
❑ Section 2.4. Grading & Erosion Control	Page 2.4.17	High	Supports floodplain/water supply protection and erosion control
❑ Section 2.4. Storm water Management	Page 2.4.18	High	Supports floodplain/water supply protection and erosion control.
❑ Section 3.3. Parking Lot Design	Page 3.3.1	High	Provides adequate drive lanes and emergency vehicle access.
❑ Section 3.3. Thoroughfare Planning	Page 3.3.8	Medium	Supports coordinated street parking systems.
❑ Section 3.3. Transit Access	Page 3.3.14	Medium	Planning in process for transit
❑ Section 3.5 Signs	Page 3.5.2	Low	Limits size, height & placement of signs
Soil Erosion and Sedimentation Control Ordinance			
❑ Section 2.2 Objective of Regulations Applicable to University Lake, Cane Creek, and Upper Eno Watersheds	Page 2	Medium	Articulates the intent of the regulations with regard to University Lake, Cane Creek, and the Upper Eno watersheds
❑ Section 4 Jurisdiction and Effect	Page 9	Medium	Clearly states the applicability of the regulations contained within the ordinance
❑ Section 5 Scope and Exclusions (County Wide)	Page 9	Medium	Clearly articulates the activities which are not subject to the ordinance
❑ Section 6 General Requirements for Areas Other Than University Lake, Cane Creek, and Upper Eno	Page 10	High	Provides the requirements for approval of land-disturbing activities in all portions of the County except

Policies, Practices, Programs, Regulations and Activities (Existing and Potential)	Document Reference (Page number or other source)	Effectiveness for Mitigation (High/Med/Low/Not Effective) & Notes	Rationale for Effectiveness
Watersheds			the University Lake, Cane Creek, and Upper Eno Watersheds
❑ Section 7 Basic Control Objectives	Page 12	Medium	Clearly articulates the objectives that must be addressed in and erosion and sedimentation control plan
❑ Section 8 Mandatory Design and Performance Standards for Land-Disturbing Activity	Page 13	High	Provides mandatory standards for approval of land-disturbing activities
❑ Section 9 Stormwater Outlet Protection	Page 19	High	Reduces runoff and limits damage to properties and water quality
❑ Section 15 Existing Uncovered Areas	Page 23	Medium	Intended to reduce erosion and sedimentation by providing mechanism for restoration of uncovered areas and enforcement
❑ Section 17 Permits	Page 24	High	Provides standards for submittal application for land-disturbing activities
❑ Section 18 Erosion and Sedimentation Control Plans	Page 26	High	Provides standards for approval of land-disturbing activities
❑ Section 21 Inspection and Investigations	Page 32	High	Provides mechanism for enforcement of ordinance
❑ Section 22 Penalties	Page 34	High	Provides mechanism for enforcement of ordinance
❑ Section 23 Injunctive Relief	Page 36	High	Provides mechanism for enforcement of ordinance
❑ Section 24 Restoration of Areas Affected by Failure to Comply	Page 25	High	Provides mechanism for enforcement of ordinance
Stormwater Ordinance for Lands Within Neuse River Basin			
❑ Section 3 Riparian Area Protection Within the Neuse River Basin	Page 6	High	Limits erosion, sedimentation and flood damage within Neuse River Basin
❑ Section 4 Table of Uses	Page 8	Low	Limits erosion, sedimentation and flood damage within Neuse River Basin
❑ Section 5 New Development Review	Page 22	Low	Provides standards for new development
❑ Section 6 Nutrient Load Calculations	Page 22	Medium	Provides standards for new development
❑ Section 7 Stormwater Management Plan	Page 25	Low	Provides standards for stormwater management plan submittal and processing
❑ Section 8 Permanent Nitrogen Export Reduction Best Management Practices	Page 26	Medium	Provides BMP options for reducing nitrogen from new developments tithing Neuse Basin
❑ Section 9 BMP Construction	Page 27	Medium	Clearly articulates nitrogen removal rates associated with specific BMPs
❑ Section 10 Annual Maintenance	Page 28	Medium	Ensures required maintenance of BMPs

Policies, Practices, Programs, Regulations and Activities (Existing and Potential)	Document Reference (Page number or other source)	Effectiveness for Mitigation (High/Med/Low/Not Effective) & Notes	Rationale for Effectiveness
❑ Section 11 Land Use Planning Provisions	Page 28	Medium	Provides design options for reducing impervious surface in new developments
❑ Section 12 Jurisdiction-wide and Inter-local Approaches	Page 29	Medium	Allows Orange County option of implementing jurisdiction-wide and/or inter-local approaches to achieve nitrogen reductions
❑ Section 13 Jurisdiction-wide Collection of Illegal Discharge Information	Page 29	Medium	Orange County shall collect information related to illegal discharges within the Neuse River Basin
❑ Section 14 Illegal Discharges	Page 29	Medium	Establishes methods for controlling the introduction of pollutants into stormwater collection system
❑ Section 15 Inspections and Investigations	Page 32	Medium	Provides mechanism for enforcement of ordinance
❑ Section 16 Penalties	Page 34	Medium	Provides mechanism for enforcement of ordinance
❑ Section 17 Injunctive Relief	Page 35	Medium	Provides mechanism for enforcement of ordinance
❑ Section 18 Compliance with Requirements	Page 35	Medium	Provides mechanism for enforcement of ordinance

Appendix C: Town Of Carrboro Community Capability Assessment

TOWN OF CARRBORO, N.C.
COMMUNITY CAPABILITY ASSESSMENT

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
Carrboro Vision 2020, Policies Through the Year 2020- adopted by the Carrboro Board of Aldermen on December 5, 2000. This documents provides the following policies that support a decrease in the town's exposure to natural hazards:			
Open Space **1.11** The town should encourage and support the development of greenways and parklands dedicated to public use along streams and easements. There should be a network of connected greenways throughout the town. These greenways should serve as nature trails**,** biking and walking trails, wildlife corridors. All should protect our natural environment.	Page 9	High *Financial assistance will benefit the full implementation of the greenway system.*	Limits or disallows construction within flood hazard areas
2.0 DEVELOPMENT Carrboro's development should take place in a manner consistent with a set of adopted values… Respect for and protection of the natural environment should be integrated into the town's policies as a high priority in enriching the quality of life…	Page 12	Medium *Need assistance in maintaining the inventory, database and digital topos /ortho-photos*	Supports floodplain protection

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
<u>Preservation of the Natural Environment</u> **2.21** The Town should continue to require the preservation and maintenance of open space when land is developed, to enforce restraints on clear-cutting, and to require adequate buffers. **2.22** Where development is deemed acceptable, there should be well-defined dense development with areas of well-preserved open space. **2.23** The town encourages the planting of native plant species, as well as non-native species that are not invasive. Removal of invasive species is encouraged. The town supports education on this topic and encourages the public to become aware of the list of invasive plant species found in Appendix E-17 of the Town of Carrboro Land Use Ordinance.	Page 12-13	Medium *Enabling legislation is needed to limit clear cutting within buffers on bonafide farms* *Need assistance in maintaining the inventory, database and digital topos /ortho-photos*	Supports floodplain protection
Limits on Development **2.41** Development throughout Carrboro should be consistent with its distinctive town character. The town should adhere to policies that limit the widening of roads, encourage plantings alongside roads, preserve historic areas, buildings and older neighborhoods, and retain unspoiled green spaces and other natural areas. **2.42** Carrboro should plan and encourage the growth of tree canopies over roads to mitigate the heat and smog effect caused by superheated pavement. Carrboro should strongly encourage the electric utilities to put their lines underground to allow for full canopy coverage.	Page 13	Medium Financial assistance for maintaining and/or enhancing open space. *Assistance from utilities and others to install existing overhead utilities underground.*	Supports floodplain protection
Town of Carrboro, North Carolina; Land Use Ordinance- adopted by the Board of Aldermen on November 25, 1980. This documents is a unified development ordinance that regulates all matters relating to the use of land throughout the town's planning jurisdiction including both zoning and subdivision regulations. Following is a summary of			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
regulations that should decrease the town's exposure to natural hazards:			
Section 15-251.9 Specific Standards for Flood Hazard Reductions (a) New structures generally prohibited within SFHAs. Within a Special Flood Hazard Area, no new structure (as defined in this part) may be constructed or located, and no substantial improvement of an existing structure may take place, unless and to the extent that the permit issuing authority for the proposed use determines that, in the absence of an authorization to do so, the owner would be deprived of all reasonable use of the subject property. Notwithstanding the foregoing, manufactured homes that are nonconforming because they are located within a SFHA may be replaced with another manufactured home. If such construction (or replacement of manufactured homes) is authorized, all such construction (or replacement) shall be in conformity with the remaining provisions of this section in addition to those set forth in Section 15-251.8. (b) Residential construction. New construction and substantial improvement of any residential structure (including manufactured homes) located within a Special Flood Hazard Area or on any lot where a SFHA is located shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation. ***Definition#45 Regulatory Flood Protection Elevation. The "Base Flood Elevation" plus the "Freeboard." In "Special Flood Hazard Areas" where Base Flood Elevations (BFEs) have been determined, this elevation shall be the BFE plus two (2) feet of freeboard.*** (c) Non-residential construction. New construction and substantial improvement of any	Section 15-251.9	High Assistance may be needed to acquire properties substantially within a floodway or floodplain.	Limits or disallows construction within flood hazard areas

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
commercial, industrial, or other non-residential structure located within a SFHA shall have the reference level, including basement, elevated no lower than the regulatory flood protection elevation. Structures located in the AE Zone may be floodproofed to the regulatory flood protection elevation in lieu of elevation provided that all areas of the structure, together with attendant utility and sanitary facilities, below the regulatory flood protection elevation are watertight with walls substantially impermeable to the passage of water, using structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A registered professional engineer or architect shall certify that the standards of this subsection are satisfied. Such certification shall be provided to the administrator along with the operational and maintenance plans. (d) Manufactured homes. Manufactured homes that are located within a SFHA or on a lot where a SFHA is located shall be securely anchored to an adequately anchored foundation to resist flotation, collapse, and lateral movement, either by engineer certification, or in accordance with the most current edition of the State of North Carolina Regulations for Manufactured Homes adopted by the Commissioner of Insurance pursuant to NCGS 143-143.15. Additionally, when the elevation would be met by an elevation of the chassis thirty-six (36) inches or less above the grade at the site, the chassis shall be supported by reinforced piers or engineered foundation. When the elevation of the chassis is above thirty-six (36) inches in height, an engineering certification is required. Finally, all enclosures or skirting below the lowest floor shall meet the requirements of subsection (e). (e) Elevated buildings. Fully enclosed areas of new construction and substantially improved			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
structures that are below the lowest floor of buildings located with a SFHA: (1) Shall not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door) or limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator). The interior portion of such enclosed area shall not be finished or partitioned into separate rooms, except to enclose storage areas; (2) Shall be constructed entirely of flood resistant materials below the regulatory flood protection elevation; (3) Shall include flood openings to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings must either be certified by a professional engineer or architect or meet or exceed the following minimum design criteria; a. A minimum of two flood openings on different sides of each enclosed area subject to flooding; b. The total net area of all flood openings must be at least one (1) square inch for each square foot of enclosed area subject to flooding; c. If a building has more than one enclosed area, each enclosed area must have flood openings to allow floodwaters to			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
automatically enter and exit; d. The bottom of all required flood openings shall be no higher than one (1) foot above the adjacent grade; e. Flood openings may be equipped with screens, louvers, or other coverings or devices, provided they permit the automatic flow of floodwaters in both directions; and f. Enclosures made of flexible skirting are not considered enclosures for regulatory purposes, and, therefore, do not require flood openings. Masonry or wood underpinning, regardless of structural status, is considered an enclosure and requires flood openings as outlined above. (f) Additions/Improvements. With respect to additions and improvements to structures that are nonconforming because they are located within a Special Flood Hazard Area: (1) When the addition or improvement constitutes a substantial improvement as defined in Section 15-251.1, both the existing structure and the addition or improvement must comply with the standards for new construction. (2) When the addition or improvement does not constitute a substantial improvement, the addition or improvement must be designed to minimize flood damages and must not be any more non-conforming than the existing structure.			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
(g) Accessory Structures. When accessory structures (sheds, detached garages, etc.) are allowed to be placed within a Special Flood Hazard Area pursuant to the provisions of subsection (a) of this section, the following criteria shall be met: (1) Accessory structures shall not be used for human habitation (including working, sleeping, living, cooking or restroom areas); (2) Accessory structures shall not be temperature-controlled; (3) Accessory structures shall be designed to have low flood damage potential; (4) Accessory structures shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters; (5) Accessory structures shall be firmly anchored in accordance with Section 15-251.8; (6) All service facilities such as electrical shall be installed in accordance with Section 15-251.8; and (7) Flood openings to facilitate automatic equalization of hydrostatic flood forces shall be provided below regulatory flood protection elevation in conformance with Subsection (e) of this section. (8) An accessory structure with a footprint less than 150 square feet that satisfies the criteria outlined above does not require an elevation or floodproofing certificate. Elevation or floodproofing certifications are required for all			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
other accessory structures. (h) Subsequent to the effective date of this subsection, no portion of any Special Flood Hazard Area outside of the floodway may be filled in with fill dirt or similar material for the purpose of elevating buildings. Whenever fill is placed within a SFHA for any other permitted purpose, slopes shall be adequately stabilized to withstand the erosive force of the base flood. **Section 15-251.10 Floodways and Non-Encroachment Areas** (a) Areas designated as floodways or non-encroachment areas are located within the Special Flood Hazard Areas established in Subsection 15-251.2(b) (1). The floodways and non-encroachment areas are extremely hazardous areas due to the velocity of floodwaters that have erosion potential and carry debris and potential projectiles. The requirements set forth in the remaining provisions of this section, in addition to the standards set forth in Sections 15-251.8 and 15-251.9 shall apply to all development within such areas. (b) No encroachments, including fill, new construction, substantial improvements and other developments shall be permitted unless it has been demonstrated that: (1) The proposed encroachment would not result in any impact to the flood levels during the occurrence of the base flood, based on hydrologic and hydraulic analyses performed in accordance with standard engineering practice and presented to the administrator prior to			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
issuance of any development permit, or (2) A Conditional Letter of Map Revision (CLOMR) has been approved by FEMA. A Letter of Map Revision (LOMR) must also be obtained upon completion of the proposed encroachment. (c) Any development within a floodway or non-encroachment area that is authorized by this section shall comply with all applicable flood hazard reduction provisions of this part. (d) No manufactured homes shall be permitted, except replacement manufactured homes in an existing manufactured home park or subdivision, provided the following provisions are met: (1) The anchoring and the elevation standards of Subsection 15-251.9(d); and (2) The no encroachment standard of Subsection 15-251.10(b) (1). **Section 15-251.11 Special Provisions for Subdivisions** (a) An applicant for a conditional use permit or special use permit authorizing a major subdivision and an applicant for minor subdivision final plat approval shall be informed by the planning department of the use and construction restrictions contained in this Article if any portion of the land to be subdivided lies within a Special Flood Hazard Area. (b) A conditional use permit or special use permit for a major subdivision may not be issued, and final plat approval for any subdivision may not be granted, if any portion of one or more lots lies within a Special Flood Hazard Area unless it reasonably appears			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
that: (1) With respect to each lot that lies wholly or partly within a Special Flood Hazard area, either (i) a building of the type that is consistent with the zoning of the property can practicably be located in accordance with applicable regulations on the portion of such lot that is located outside the SFHA, or (ii) such lot has already been developed, or (iii) such lot is formed as the result of an adjustment of lot lines between lots in existence on the effective date of this section, and such readjustment does not result in a previously developable lot being rendered undevelopable, or (iv) it plainly appears that such lot is intended to be devoted to a permissible use that does not involve the construction of any building (e.g. that such lot is reserved or dedicated for open space purposes). (2) Creation of each lot that does not satisfy the criteria set forth in subdivision (1) of this subsection is necessary to avoid depriving the owner of the property of all reasonable use of the tract taken as a whole. (c) Final plat approval for any subdivision containing land that lies within a Special Flood Hazard Area may not be given unless the plat shows the boundary of the SFHA according to the best information available at the time the final plat is approved and contains in clearly discernible print the			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
following statement: *"Use of land within a special flood hazard area is substantially restricted by Article XVI of Chapter 15 of the Carrboro Town Code."* If, at the time final plat approval is granted, a Conditional Letter of Map Revision (CLOMR) affecting such subdivision has been approved, or the town is otherwise aware that some action is pending that would likely alter the location of the boundary of the SFHA as it affects such subdivision, then the statement on such plat referenced immediately above shall include a note similar to the following: "*The location of the boundary of the special flood hazard area may be altered by a request for a special flood hazard map revision now pending before the Federal Emergency Management Agency."*			
Storm Water Management **Natural Drainage System Utilized to Extent Feasible.** (a) To the extent practicable, all development shall conform to the natural contours of the land and natural drainage ways shall remain undisturbed. (b) To the extent practicable, lot boundaries shall be made to coincide with natural drainage ways within subdivisions to avoid the creation of lots that can be built upon only by altering such natural drainage ways.	Section 15-261	High *Need assistance in maintaining the drainage inventory, database and digital topos /ortho-photos*	Limits or disallows construction within flood hazard areas and minor drainage ways
Development Must Drain Properly (a) All development shall be provided with a stormwater management system containing drainage facilities that are adequately designed and constructed to prevent the undue retention of surface water on the development site. Surface water shall not be regarded as unduly retained if: (1) The retention results from a technique, practice or device deliberately installed as part of an approved sedimentation or stormwater management plan, or	Section 15-262		

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
(2) The retention is not substantially different in location or degree than that experienced by the development site in its pre-development stage, unless such retention presents a danger to health or safety. (b) No surface water may be channeled or directed into the OWASA sanitary sewer system. (c) Whenever practicable, the drainage system of a development shall coordinate with the drainage system or drainage ways on surrounding properties or streets. (d) Use of drainage swales rather than curb and gutter and storm sewers in subdivisions is provided for in Section 15-216. Private roads and access ways within unsubdivided developments shall utilize curb and gutter and storm drains to provide adequate drainage if the grade of such roads or access ways is too steep to provide drainage in another manner or if other sufficient reasons exist to require such construction. (e) The minimum design storm frequency for all drainage systems shall be the 10 year storm, except that those facilities crossing streets shall be designed for the 25 year storm. (f) Drainage culverts and associated facilities shall be suitably sized to accommodate designated storm frequencies and shall be suitably constructed and installed to insure that the facilities will function adequately and will not deteriorate within an unreasonably short period of time. **(AMENDED**			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
04/03/90)			
Management of Stormwater ***Abbreviated:*** (c) Developments must install and maintain stormwater management systems that will control and treat runoff from the first one inch of rain as follows: (1) Draw down the treatment volume no faster than 48 hours, but no slower than 120 hours. (2) Achieve an eighty-five percent (85%) average annual removal rate for Total Suspended Solids. To the extent reasonably practicable, the stormwater management systems designed and constructed to satisfy the requirements of this section shall utilize best management practices that reduce nutrient loadings. **(AMENDED 6/24/08)** (d) Developments shall be constructed and maintained so that their stormwater management systems meet the following minimum standards: (1) The post-development discharge rates shall be less than or equal to the pre-development discharge rates for the 1-, 2-, 5-, 10-, and 25-year 24-hour design storms. (2) For upstream properties, the 1% chance flood elevation may not be increased.	Section 15-263	High Additional financial support to offset engineering expenses would benefit both the town and the developer. *Opportunities exist for storm water mitigation computer models to assist in selecting water quality and quantity BMP's.* *Additional assistance is needed to fund water quality monitoring on an ongoing basis.*	Limits or disallows construction within flood hazard areas, reduces runoff and limits damage to properties and water quality.
Sedimentation and Erosion Control. (b) The Orange County Erosion Control Officer is authorized by resolution of the Carrboro Board of Aldermen to	Section 15-264	Medium Financial assistance	Supports floodplain protection and

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
by resolution of the Carrboro Board of Aldermen to enforce within the town the Orange County Soil Erosion and Sedimentation Control Ordinance		would be helpful to support monitoring and enforcement capabilities.	soil stabilization
Buffer Requirements rewritten as PART III. WATER QUALITY BUFFERS to incorporate new State "Jordan Rules", including buffer classification, function, definitions and list of activities within buffer areas that are either allowed with or without mitigation or exempt. Revised buffer rules were adopted by the Carrboro Board of Aldermen on March24, 2009 effective upon approval by the State. **Section 15-270.3 Width of Buffers** (a) ZONES OF THE RIPARIAN BUFFER. The protected riparian buffer shall have two zones as follows: (1) A streamside zone ("Zone 1') shall consist of an undisturbed area except as provided for in Section 15-270.5. The function of the streamside zone is to protect the physical and ecological integrity of the stream ecosystem, and filter runoff received from Zone 2. The desired vegetation for Zone 1 is mature forest. The location of Zone 1 shall be as follows: a. Zone 1 shall begin at the most landward limit of the top of the bank. Zone 1 shall extend landward on either side of the stream as indicated in Table 1, measured	Section 15-270.2	High *Need assistance in maintaining the stream buffer inventory, database and digital topos /ortho-photos*	Limits or disallows construction within flood hazard areas and minor drainage ways

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
horizontally on a line perpendicular to a vertical line marking the origin of the buffer as defined above. b. For ponds, lakes and reservoirs, Zone 1 shall begin at the most landward limit of the normal water level and extend landward as indicated in Table 1, measured horizontally on a line perpendicular to a vertical line marking the edge of the surface water. (2) Zone 2 shall consist of an undisturbed area except as provided for in Section 15-270.5. The functions of this zone are to: protect the streamside zone, to filter runoff from upland development, and deliver runoff to Zone 1 in a dispersed fashion. Grading and revegetating Zone 2 is allowed provided that the health of the vegetation in Zone 1 is not compromised. Zone 2 shall begin at the outer edge of Zone 1 and extend landward as indicated in Table 1 as measured horizontally on a line perpendicular to the surface water. The desired vegetation for this zone is mature native vegetation; forest cover is encouraged. (3) The total buffer width shall be the sum of the widths of the two zones, as indicated in Table 1, and shall extend			

<table>
<tr><th>Policies, Practices, Programs, Regulations and Activities (Existing and potential)</th><th>Document Reference (Include page numbers or Other Source)</th><th>Effectiveness for Mitigation (High/Medium / Low/Not Effective) Notes: gaps, shortfalls, conflicts, or opportunities</th><th>Rationale for Effectiveness</th></tr>
<tr><td>
on all sides of the waterbody.
Table 1: Required Minimum Buffer Width (*)
<table>
<tr><td>Waterbody type</td><td colspan="2">Zone 1 width</td><td colspan="2">Zone 2 width</td><td colspan="2">Total width</td></tr>
<tr><td></td><td>Water shed</td><td>Out of Water shed</td><td>Water shed</td><td>Out of Water shed</td><td>Water shed</td><td>Out of Water shed</td></tr>
<tr><td>Perennial Streams, Ponds, Lakes, Reservoirs</td><td>100’</td><td>50’</td><td>--</td><td>50’</td><td>100’</td><td>100’</td></tr>
<tr><td>Intermittent Streams, <u>Ponds</u></td><td>60’</td><td>30’</td><td>--</td><td>30’</td><td>60’</td><td>60’</td></tr>
<tr><td>Ephemeral Streams, <u>Ponds</u></td><td>--</td><td>--</td><td>30’</td><td>15’</td><td>30’</td><td>15’</td></tr>
</table>
* “Watershed” means within the University Lake Watershed, and “Outside of watershed” means the remainder of the Town’s planning jurisdiction. For streams, the width indicated is in one direction from the stream channel; the total width is therefore twice the width indicated.

(4) Notwithstanding the other provisions of this section, in no case shall the width of any buffer be less extensive than the special flood hazard area for the same stream, pond, or lake drainage feature designated in accordance with the provisions of Part I of this article.

<u>Diffuse Flow Requirement</u>

To the maximum extent practicable and in consideration especially of topography and existing uses, diffuse flow of runoff at non-erosive velocities shall be established before the runoff enters the buffer, and maintained in the
</td><td>Section15-270.4</td><td></td><td></td></tr>
</table>

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
buffer by dispersing runoff that has concentrated into rills, gullies, and ditches, and reestablishing vegetation where concentrated flow has displaced vegetation. Corrective action to restore diffuse flow shall be taken if necessary to impede the formation or expansion of erosion rills or gullies. Where site conditions constrain the ability to ensure diffuse flow through both Zones 1 and 2, emphasis will be placed on ensuring diffuse flow through Zone 1, as provided for in 15-270.3. No new engineered stormwater devices or conveyances are allowed in the buffers except as provided for in Section 15-270.5.			
Impervious Surface Limitations (Univ. Lake Watershed) (a) Commercial (B-5 or WM-3 zoning districts) = 6% impervious and 24% impervious with retention of first one inch of rainfall. Residential (C or WR) = may not exceed an impervious surface area equal to 4% of the lot size (minimum lot size is five acres except for existing lots of record)	Section 15-266	Medium No additional *gaps, shortfalls, conflicts, or opportunities*	Supports floodplain protection and reduces runoff
(b)			
2.			
Open Space. (3) The following areas shall be regarded as open space if such areas satisfy at least the criteria set forth in Subdivision (1) a, b, and c of subsection (b) of this section: a. Utility easements located outside of street rights of way; b. Cemeteries located on a tract prior to its development. c. Areas used for the growing of crops, such as hay, corn, or vegetables, if and to the extent that such uses occur within an area that is subject to the control of a homeowners association and such uses are approved by the homeowners association. (4) The term "primary conservation areas" shall mean:	Section 15-198	High Opportunities are created for new greenways and structures are developed outside of fragile environmental areas such as floodways, floodplains, and steep slopes. *Need assistance in maintaining*	Limits or disallows construction within flood hazard areas and minor drainage ways

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
a. Areas containing slopes greater than 25% b. Hardwood areas identified on the Carrboro Natural Constraints Map c. Wetlands as defined pursuant to Section 404 of the Clean Water Act d. Floodplains e. With respect to streams designated on the adopted Stream Classification Map of Carrboro, those areas within an average perpendicular distance of sixty feet from the edge of the floodway of the stream, if the floodway is designated on the "Flood Boundary and Flood Map" prepared by the U.S. Department of Housing and Urban Development, or sixty feet from the centerline of the stream where the floodway is not designated on this map. f. Lakes and ponds; g. Road buffers as required by Section 15-312 of this Chapter, except for those portions of the buffers that must be included in road or utility crossings. (5) The term "secondary conservation areas" shall mean: a. Areas containing slopes greater than 15% but not more than 25%; b. Wooded areas other than hardwood areas identified on the Carrboro Natural Constraints Map; c. Vistas along entranceways to the town; d. Other areas containing unusual natural features (such as major rock formations); f. Other environmentally, historically or archaeologically significant or unique areas. (c) Except as otherwise provided in subsection (j) and Section 15-203, every residential development in zoning districts other than the R-2 district shall be developed so that at least forty percent (40%) of the total area of the development remains permanently as open space. Every residential development in the R-2 district shall be developed so that at least twenty percent (20%) of the total area of the development remains permanently as open space. **(AMENDED**		*the primary and secondary conservation area inventory, database and digital topos /ortho-photos*	

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
09/05/95) (d) Subject to subsection (g), every residential development containing at least 25 lots or dwelling units shall contain, as part of its required open space, one or more areas that are relatively flat, well drained, grassed, and otherwise well suited for use as a play field: (1) Each such area shall contain a minimum of 20,000 square feet configured in such a manner as to be useful as a play field. (2) Every development covered by this subsection shall set aside in one or more play fields meeting the criteria of this subsection a minimum of 400 square feet of area per lot or dwelling unit within the development. (3) Play fields provided under this section shall be located with due regard for the safety and convenience of those using such facilities as well as the welfare of residents living nearby. The play fields required by this subsection shall be located such that 90% of the lots or dwelling units within any development that is required to install such play field are within 1,500 feet of a play field installed to meet the requirements of this subsection, unless the developer demonstrates by clear and convincing evidence that adherence to this requirement would not be feasible. (4) Play fields constructed to meet the requirements of this subsection may be used by the developer to satisfy the active recreational requirements set forth in Section 15-196 as well as the open space requirements of this section. However, the recreation points assigned to such play fields shall be based upon the actual cost of constructing such play fields, exclusive of land costs. (e) Subject to subsection (g), if a tract where a residential development is proposed contains any areas defined above as primary conservation areas, then such areas shall be designated as open space.			

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
(g) A developer shall not be required to set aside as open space under the provisions of subsections (d) and (e) more than the minimum required percentage of open space set forth in subsection (c). If the sum total of open space otherwise required under the provisions of subsections (d) and (e) exceeds forty percent of the development tract (twenty percent in the R-2 district), then the permit issuing authority shall allow the developer to set aside a smaller area of open space under subsections (d) and (e), individually or collectively, so that the developer is not required to preserve as open space more than forty percent of the development tract (twenty percent in the R-2 district). However, if areas that constitute primary conservation areas have not been set aside as open space, then the development plans shall otherwise provide for the preservation of such areas even though they may be located within privately owned lots (e.g. by specifying buildable areas within individual lots). Notwithstanding the foregoing, hardwood areas identified on the Carrboro Natural Constraints Map that are not set aside as common open space shall be preserved except to the extent that removal of such hardwood trees is necessary to accommodate the permitted uses created out of land not set aside as common open space. (h) If the area of open space required to be preserved under subsections (d) and (e) does not exceed forty percent (40%) of the area of the development tract (20% in the R-2 district), then the permit issuing authority may require that the developer set aside from among the areas that constitute secondary conservation areas as defined above an amount of open space equal to the difference between the amount of open space preserved under subsections (d) and (e) and forty percent (40%) of the development tract (20% in the R-2 district).			
Residential Density of Major Developments in Certain Districts. (a) Notwithstanding the provisions of Section 15-182, when any tract of land within the R-10, R-15, R-20, and	Section 15-182.3	High *Opportunity is created to limit*	Limits or disallows construction

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
RR districts is developed under circumstances requiring the issuance of a special or conditional use permit, the maximum number of dwelling units that may placed on that tract shall be determined in accordance with the provisions of this section. (b) If the development is to be served by OWASA owned water and sewer lines, then the maximum number of dwelling units for any type of residential development shall be determined by dividing the adjusted tract acreage [calculated in accordance with the provisions of subsection (c) below] by the "minimum square feet per dwelling unit" associated with the zoning district of the property to be developed as set forth in Section 15-182. **(AMENDED 06/22/99)** (c) The adjusted tract acreage shall be calculated by deducting from the gross acreage of the tract the sum total of each of the following areas that may be located within the tract in question. If an area within the tract qualifies under more than one of the following categories, then that area shall be included only within the one category that involves the most restrictive (i.e. the greatest) deduction. (1) Floodways: multiply the area within a floodway by a factor of 1.0. (2) Wetlands: multiply the area of designated wetlands by a factor of 0.95. (3) Major Rock Formations: multiply the area of major rock formations by a factor of 0.90. (4) Steep Slopes: multiply the area of land with natural ground slopes exceeding 25 percent by a factor of 0.80. (5) Land traversed by high-tension electrical transmission lines (69kv or higher): multiply the area within the power easement by a factor of 0.75. (6) Floodplains: multiply the 100-year floodplain by a factor of 0.5. (7) Moderately steep slopes: multiply the area with natural ground slopes of between 15 and 25 percent by a factor of 0.4.		*the density of development in relation to the land's ability to support development. The need to utilize less suitable areas is reduced and the potential to preserve hazard areas such as flood ways and flood plains is enhanced.*	within flood hazard areas

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
(8) Land traversed by underground utility lines (not within a street right of way): multiply the area within the easement (or if no easement exists, the area within ten feet on either side of the line) by a factor of 0.3.			
• **Floodplain Mapping** The Town of Carrboro participated in the following floodplain mapping projects designed to more accurately define and locate special flood hazard areas throughout Carrboro's planning area:			
NC Floodplain Mapping Program The Town of Carrboro participated in the North Carolina Floodplain Mapping Program administered by the NC Division of Emergency Management. This effort produced new floodplain maps and FEMA approved documents dated February 2, 2007. This updated flood hazard data provides current, accurate information for communities and property owners to make proper site and design decisions; • Updated flood hazard data provides current, accurate information for communities and property owners to make proper siting and design decisions; • The use of updated data should dramatically reduce long-term flood losses to local communities; • New flood information alerts those at risk of flooding of the need to purchase flood insurance; • A digital Information System allows online access to all map users 24 hours a day without requiring sophisticated software; and • Up-to-date base maps along with the digital format allows users to make more efficient and accurate flood risk determinations.	NA	High *A shortfall in funding has delayed the completion of this project. Additional federal or state assistance is needed.* *The completion of this project should create opportunities for implementing computer storm water modeling.*	Accurately defines and locates flood hazard areas and directly supports the regulation of development activity within flood hazard areas.
• **Cooperating Technical Partner** The Town of Carrboro and the Town of Chapel Hill have entered into an agreement with the State of North Carolina	NA	High *This project creates*	Directly supports the enforcement,

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation (High/Medium / Low/Not Effective) *Notes: gaps, shortfalls, conflicts, or opportunities*	Rationale for Effectiveness
and the Federal Emergency Management Agency to cooperate as technical partners for the purpose of reducing flood losses. Carrboro adopted a resolution and signed the agreement in June of 2001.		*opportunities to work cooperatively in formulating and implementing mutually beneficial solutions that reduce the risk associated with flooding.*	administration, and application of flood hazard regulations

TECHNICAL AND FISCAL CAPABILITIES

Technical-Staff Responsibilities Regarding Hazard Mitigation

The following positions, listed by department, share primary responsibility for implementing components of Carrboro's Hazard Mitigation Plan:

Planning Department

- **Planning Director**-coordinates the implementation of FEMA regulations; directs efforts to secure financial assistance from other sources, recommends local budget support for hazard mitigation projects, coordinates hazard mitigation activities with neighboring jurisdictions, prepares hazard mitigation plans and updates, serves as a member of the Orange County Hazard Mitigation Team.
- **Planning Administrator**-administers amendments to the town's land use ordinance and zoning map, coordinates the formulation and adoption of plans, policies, and programs related to transportation, the use of land and environmental resources within the town's planning jurisdiction.
- **Environmental Planner**-works under the general supervision of the planning administrator and is responsible for NPDES permitting, the Community Rating System and coordinating greenway acquisition activities.
- **Transportation Planner-** works under the general supervision of the planning administrator, responsible for Transportation Improvement Program activities including enhancement projects such as the development and funding of greenway trails.
- **Town Engineer-**reviews all site plans and construction drawings to assure that town engineering standards are complied with including storm water management and FEMA requirements.
- **Land Use Administrator-**Reviews all site plans, final plats, and construction drawings to assure compliance with the Town's land use ordinance.
- **Code Enforcement Supervisor-**reviews and inspects all structures to assure compliance with the NC State Building Code, Minimum Housing Code and FEMA construction requirements.

Public Works Department

- **Director of Public Works-**Serves as a member of the Orange County Hazard Mitigation Team, directs the maintenance and improvement of the Town's street and storm water system, administers emergency clean up efforts for the Town of Carrboro.

Fire Department

- **Fire Chief**-Directs the town's Primary Command Center during an emergency, coordinates the town's emergency response with Orange County

Emergency Management, serves as the town's Civil Preparedness Coordinator, monitors emergency activities such as rising flood waters and coordinates evacuation efforts.

Police Department

- **Police Chief**-Directs general police services, traffic control, protection of life and property, records a photographic and video history of the disaster, assists in search, rescue and evacuation operations.

Fiscal Capabilities Regarding Hazard Mitigation

The Town of Carrboro, in addition to its basic operating budget, the Town will continue to seek additional financial resources through available funding sources such as those listed on the NCEM website http://www.ncem.org/Mitigation/additional funding.htm .

Appendix D: Town of Hillsborough Community Capability Assessment

TOWN OF HILLSBOROUGH
COMMUNITY CAPABILITY ASSESSMENT

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation High/ Medium/Low/Not Effective)	Rationale for Effectiveness
The Town of Hillsborough currently ensures the enforcement of all policies, programs and ordinances. Through various departments and assistance from the County, the town implements its strategies of mitigation. Overall, the Town of Hillsborough had established effective hazard mitigation policies that are consistent with the County's overall floodplain policies.			
Hillsborough Zoning Ordinance			
Stream Buffer requirements	Section 7.11	High	Limits or disallows construction within flood hazard areas
Watershed protection Standards	Section 10	High	
Underground Utility requirements	Section 5.21	Low	Limits exposure of new development areas to loss of service
Conditional Use Permits for transmission lines & towers	Section 4.33&37	Low	Impacts locations of potentially hazardous uses
Hillsborough Subdivision Regulations			
Tree preservation, buffering, and stormwater	Section 4.7&8	Medium	
Underground Utility requirements	Section 4.5	Low	Limits exposure of new development areas to loss of service
Cluster development provisions	Section 4.9	Medium	Provides design flexibility to protect sensitive areas
Hillsborough Vision 2010 revised Plan			
Create a preservation plan including an inventory of open spaces, historic resources, and other areas for	Page 6	Medium	Document and prioritize

Policies, Practices, Programs, Regulations and Activities (Existing and potential)	Document Reference (Include page numbers or Other Source)	Effectiveness for Mitigation High/ Medium/Low/Not Effective)	Rationale for Effectiveness
acquisition and protection			important preservation areas
Encourage preservation of sensitive and aesthetically significant open land through public acquisition, conservation easements, and other devices	Page 7	Low	Limit exposure of new development to hazards/ Education
Adopt regulations of the Upper Neuse Basin Management Study to allow for local enforcement and protection of water quality	Page 7	Medium	Strengthens state implementation
Strengthen the floodplain ordinance to go beyond the minimum requirements and prohibit development within floodplains	Page 7	High	Limits or disallows construction within flood hazard areas
Create emergency/disaster response plan to address natural disasters and other situations	Page 8	High	Education
Hillsborough Floodplain Ordinance	Entire	High	Includes state mandated minimum standards for floodplain development
Soil and Erosion Control The Town of Hillsborough has an agreement with Orange County to provide Soil and Erosion Control review, inspection and enforcement within the town.		Medium	Supports floodplain protection and soil stabilization

Appendix E: Nuclear Hazards

The hazard mitigation planning guidance does not require local jurisdictions to specifically address response to a nuclear incident within this plan, however Orange County has taken measures to prepare for such an event.

Orange County Emergency Services, in conjunction with other local, state, and federal agencies, has developed a comprehensive multi-hazard plan to deal with any emergency that may befall our county. The multi-hazard plan is a separate document from this plan and was updated in 2009.

One of the potential hazards facing the county is a nuclear/radiological materials incident that can be brought about by both intentional and unintentional causes. There are three scenarios involving nuclear or radiological material release that could affect the county.

The three scenarios are:

1. Incident at Shearon Harris Nuclear Power Plant
2. Detonation or activation of a nuclear or radiological weapon
3. Spillage or loss of containment of radiological material

Orange County is located within the 50 mile "ingestion pathway" of the Shearon Harris Nuclear Power Plant. This means that the possibility exists for contamination of water, food stuffs, land, and infrastructure in the event of a catastrophic release of nuclear material from the plant. Both intentional and unintentional causes could effect such a catastrophic release. It should be noted that Orange County is not in danger of any blast effects from an explosion at the plant.

Intentional detonation or activation of a nuclear weapon remains a concern. The range of effects to the county vary widely depending on the device utilized. Devices range from simple radiological material dispersal, use of a high explosive to disperse material, detonation of an improvised fissionable weapon, or detonation of a military grade fissionable nuclear weapon. The first two types of devices would primarily cause contamination and would not result in immediate death due to radiation exposure. The latter two would result in widespread casualties and contamination over a wide area.

Intentional or unintentional spillage or loss of containment of radiological material is the most likely possibility of radiological material to be unnaturally released within our county. Possible methods for this include transportation accidents involving rail or road based vehicles, malfunction of the containment system of devices that utilize radiological materials such as x-ray machines, and breach of containment of airborne or spaceborn nuclear powered devices.

Orange County has taken a pro-active stance in approaching the threat by introducing many studies and programs that have improved our response.

In May 2002, Orange County hosted a symposium on the threat of nuclear terrorism within the area, focusing on spent fuel rod storage at Shearon Harris Nuclear Power plant. Outcomes from this symposium lead to a federally financed study on evacuation methods, routes, and timelines for evacuation orders.

The symposium also offered guidance for the revision of the County's multi-hazard plan. The multi-hazard plan was revised in February 2003 to add responsibilities for county departments to respond to the various impacts of terrorism. The plan was updated again in 2009.

Since this symposium, County personnel have participated in two exercises involving radiological material. The University of North Carolina at Chapel Hill held the first tabletop exercise with a dirty bomb scenario at the Dean Smith Center on June 18th, 2002. Triangle J Council of Government hosted a tabletop exercise with a similar scenario later that year.

Orange County Emergency Services and law enforcement departments completed a US. Department of Homeland Security terrorism assessment tool in 2003 that identified:

- critical targets
- necessary equipment for effective response
- potential threat elements

The multi-hazard plan addresses the three nuclear/radiological scenarios listed above and assigns certain county staff with emergency responsibilities to respond and carry out duties related to a terrorist attack including a nuclear incident. The County's EMS website contains links to the Multi-Hazard Plan and other hazard materials. The website address http://www.co.orange.nc.us/ems/staffinfo.asp .

Appendix F: Resolutions of Adoption