

# SECTION 4

## HAZARD IDENTIFICATION

This section describes how the planning team identified the hazards to be included this plan. It consists of the following five subsections:

- ◆ 4.1 Overview
- ◆ 4.2 Description of Full Range of Hazards
- ◆ 4.3 Disaster Declarations
- ◆ 4.4 Hazard Evaluation
- ◆ 4.5 Hazard Identification Results

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### 44 CFR Requirement

**44 CFR Part 201.6(c)(2)(i):** The risk assessment shall include a description of the type, location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

## 4.1 OVERVIEW

Wake County is vulnerable to a wide range of natural and human-caused hazards that threaten life and property. Current FEMA regulations and guidance under the Disaster Mitigation Act of 2000 (DMA 2000) require, at a minimum, an evaluation of a full range of natural hazards. An evaluation of human-caused hazards (i.e., technological hazards, terrorism, etc.) is encouraged, though not required, for plan approval. Wake County has included a comprehensive assessment of both types of hazards.

Upon a review of the full range of natural hazards suggested under FEMA planning guidance, the participating jurisdictions in Wake County (Apex, Cary, Fuquay-Varina, Garner, Holly Springs, Knightdale, Morrisville, Raleigh, Rolesville, Wake Forest, Wendell, Zebulon) have identified a number of hazards that are to be addressed in their Multi-Jurisdictional Hazard Mitigation Plan. These hazards were identified through an extensive process that utilized input from the Wake County Hazard Mitigation Planning Committee members, research of past disaster declarations in the participating counties<sup>1</sup>, and review of the North Carolina State Hazard Mitigation Plan (2010). Readily available information from reputable sources (such as federal and state agencies) was also evaluated to supplement information from these key sources.

**Table 4.1** lists the full range of natural hazards initially identified for inclusion in the Plan and provides a brief description for each. This table includes 24 individual hazards. Some of these hazards are considered to be interrelated or cascading, but for preliminary hazard identification purposes these individual hazards are broken out separately.

Next, **Table 4.2** lists the disaster declarations in Wake County.

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<sup>1</sup> A complete list of disaster declarations for Wake County can be found below in Section 4.3.

Next, **Table 4.3** documents the evaluation process used for determining which of the initially identified hazards are considered significant enough to warrant further evaluation in the risk assessment. For each hazard considered, the table indicates whether or not the hazard was identified as a significant hazard to be further assessed, how this determination was made, and why this determination was made. The table works to summarize not only those hazards that *were* identified (and why) but also those that *were not* identified (and why not). Hazard events not identified for inclusion at this time may be addressed during future evaluations and updates of the risk assessment if deemed necessary by the Hazard Mitigation Planning Committee during the plan update process.

Lastly, **Table 4.4** provides a summary of the hazard identification and evaluation process noting that 17 of the 24 initially identified hazards are considered significant enough for further evaluation through this Plan’s risk assessment (marked with a “”).

## **4.2 DESCRIPTION OF FULL RANGE OF HAZARDS**

**TABLE 4.1: DESCRIPTIONS OF THE FULL RANGE OF INITIALLY IDENTIFIED HAZARDS**

<b>Hazard</b>	<b>Description</b>
<b>ATMOSPHERIC HAZARDS</b>	
<b>Avalanche</b>	A rapid fall or slide of a large mass of snow down a mountainside.
<b>Drought</b>	A prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality. High temperatures, high winds, and low humidity can worsen drought conditions and also make areas more susceptible to wildfire. Human demands and actions have the ability to hasten or mitigate drought-related impacts on local communities.
<b>Hailstorm</b>	Any storm that produces hailstones that fall to the ground; usually used when the amount or size of the hail is considered significant. Hail is formed when updrafts in thunderstorms carry raindrops into parts of the atmosphere where the temperatures are below freezing.
<b>Heat Wave</b>	A heat wave may occur when temperatures hover 10 degrees or more above the average high temperature for the region and last for several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a “dome” of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility. A heat wave combined with a drought can be very dangerous and have severe economic consequences on a community.

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<p><b>Hurricane and Tropical Storm</b></p>	<p>Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and with a diameter averaging 10 to 30 miles across. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves and tidal flooding which can be more destructive than cyclone wind. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea and Gulf of Mexico during the official Atlantic hurricane season, which extends from June through November.</p>
<p><b>Lightning</b></p>	<p>Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a “bolt” when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes, but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. On average, 73 people are killed each year by lightning strikes in the United States.</p>
<p><b>Nor’easter</b></p>	<p>Similar to hurricanes, nor’easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their associated strong winds and heavy surf. Nor’easters are named for the winds that blow in from the northeast and drive the storm up the East Coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast. They are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful. Nor’easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding.</p>
<p><b>Tornado</b></p>	<p>A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind speeds ranging from as low as 40 mph to as high as 300 mph. Tornadoes are most often generated by thunderstorm activity when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size and duration of the storm.</p>
<p><b>Severe Thunderstorm</b></p>	<p>Thunderstorms are caused by air masses of varying temperatures meeting in the atmosphere. Rapidly rising warm moist air fuels the formation of thunderstorms. Thunderstorms may occur singularly, in lines, or in clusters. They can move through an area very quickly or linger for several hours. Thunderstorms may result in hail, tornadoes, or straight-line winds. Windstorms pose a threat to lives, property, and vital utilities primarily due to the effects of flying debris and can down trees and power lines.</p>

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<p><b>Winter Storm and Freeze</b></p>	<p>Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Blizzards, the most dangerous of all winter storms, combine low temperatures, heavy snowfall, and winds of at least 35 miles per hour, reducing visibility to only a few yards. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property, and cause fatalities and injuries to human life.</p>
<p><b>GEOLOGIC HAZARDS</b></p>	
<p><b>Earthquake</b></p>	<p>A sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the surface. This movement forces the gradual building and accumulation of energy. Eventually, strain becomes so great that the energy is abruptly released, causing the shaking at the earth’s surface which we know as an earthquake. Roughly 90 percent of all earthquakes occur at the boundaries where plates meet, although it is possible for earthquakes to occur entirely within plates. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.</p>
<p><b>Expansive Soils</b></p>	<p>Soils that will exhibit some degree of volume change with variations in moisture conditions. The most important properties affecting degree of volume change in a soil are clay mineralogy and the aqueous environment. Expansive soils will exhibit expansion caused by the intake of water and, conversely, will exhibit contraction when moisture is removed by drying. Generally speaking, they often appear sticky when wet, and are characterized by surface cracks when dry. Expansive soils become a problem when structures are built upon them without taking proper design precautions into account with regard to soil type. Cracking in walls and floors can be minor, or can be severe enough for the home to be structurally unsafe.</p>
<p><b>Landslide</b></p>	<p>The movements of a mass of rock, debris, or earth down a slope when the force of gravity pulling down the slope exceeds the strength of the earth materials that comprise to hold it in place. Slopes greater than 10 degrees are more likely to slide, as are slopes where the height from the top of the slope to its toe is greater than 40 feet. Slopes are also more likely to fail if vegetative cover is low and/or soil water content is high.</p>
<p><b>Land Subsidence</b></p>	<p>The gradual settling or sudden sinking of the Earth’s surface due to the subsurface movement of earth materials. Causes of land subsidence include groundwater pumpage, aquifer system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost.</p>
<p><b>Tsunami</b></p>	<p>A series of waves generated by an undersea disturbance such as an earthquake. The speed of a tsunami traveling away from its source can range from up to 500 miles per hour in deep water to approximately 20 to 30 miles per hour in shallower areas near coastlines. Tsunamis differ from regular ocean waves in that their currents travel from the water surface all the way down to the sea floor. Wave amplitudes in deep water are typically less than one meter; they are often barely detectable to the human eye. However, as they approach shore, they slow in shallower water, basically causing the waves from behind to effectively “pile up”, and wave heights to increase dramatically. As opposed to typical waves which crash at the shoreline, tsunamis bring with them a continuously flowing ‘wall of water’ with the potential to cause devastating damage in coastal areas located immediately along the shore.</p>

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<b>Volcano</b>	A mountain that opens downward to a reservoir of molten rock below the surface of the earth. While most mountains are created by forces pushing up the earth from below, volcanoes are different in that they are built up over time by an accumulation of their own eruptive products: lava, ash flows, and airborne ash and dust. Volcanoes erupt when pressure from gases and the molten rock beneath becomes strong enough to cause an explosion.
<b>HYDROLOGIC HAZARDS</b>	
<b>Dam and Levee Failure</b>	Dam failure is the collapse, breach, or other failure of a dam structure resulting in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream of the dam. Dam failure can result from natural events, human-induced events, or a combination of the two. The most common cause of dam failure is prolonged rainfall that produces flooding. Failures due to other natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning.
<b>Erosion</b>	Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year.
<b>Flood</b>	The accumulation of water within a water body which results in the overflow of excess water onto adjacent lands, usually floodplains. The floodplain is the land adjoining the channel of a river, stream ocean, lake or other watercourse or water body that is susceptible to flooding. Most floods fall into the following three categories: riverine flooding, coastal flooding, or shallow flooding (where shallow flooding refers to sheet flow, ponding and urban drainage).
<b>Storm Surge</b>	A storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to five feet in a Category 1 hurricane up to more than 30 feet in a Category 5 storm. Storm surge heights and associated waves are also dependent upon the shape of the offshore continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Storm surge arrives ahead of a storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Storm surge can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast. Further, water rise caused by storm surge can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas.

OTHER HAZARDS	
<b>Hazardous Materials Incident</b>	Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation’s highways and on the water. HAZMAT incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and possibly wildlife as well.
<b>Terror Threat</b>	Terrorism is defined by FEMA as, “the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom.” Terrorist acts may include assassinations, kidnappings, hijackings, bomb scares and bombings, cyber attacks (computer-based), and the use of chemical, biological, nuclear and radiological weapons.
<b>Wildfire</b>	An uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase risk for people and property located within wildfire hazard areas or along the urban/wildland interface. Wildfires are part of the natural management of forest ecosystems, but most are caused by human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.
<b>Nuclear Accident</b>	A nuclear and radiation accident is defined by the International Atomic Energy Agency as “an event that has led to significant consequences to people, the environment or the facility. Often, this type of incident results from damage to the reactor core of a nuclear power plant which can release radioactivity into the environment. The degree of exposure from nuclear accidents has varied from serious to catastrophic.

### 4.3 DISASTER DECLARATIONS

Disaster declarations provide initial insight into the hazards that may impact the Wake County planning area. Since 1968, thirteen presidential disaster declarations have been reported in Wake County. This includes five storms related to severe winter weather, three events related to severe storms, tornadoes, and flooding, three hurricanes or tropical storms, and two drought related events.

**TABLE 4.2: WAKE COUNTY DISASTER DECLARATIONS**

Year	Disaster Number	Description
1968	234	Severe Ice Storm
1977	3033	Drought & Freezing
1977	3049	Drought

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Year	Disaster Number	Description
1988	818	Severe Storms & Tornadoes
1993	3110	Severe Snowfall & Winter Storm
1996	1087	Blizzard Of 96
1996	1134	Hurricane Fran
1998	1211	Severe Storms Tornadoes, And Flooding
1999	1292	Hurricane Floyd Major Disaster Declarations
2000	1312	Severe Winter Storm
2002	1448	Severe Ice Storm
2003	1490	Hurricane Isabel
2011	1969	Severe Storms, Tornadoes, And Flooding

## 4.4 HAZARD EVALUATION

**TABLE 4.3: DOCUMENTATION OF THE HAZARD EVALUATION PROCESS**

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
<b>ATMOSPHERIC HAZARDS</b>			
Avalanche	NO	<ul style="list-style-type: none"> <li>• Review of US Forest Service National Avalanche Center web site</li> <li>• Review of the NC State Hazard Mitigation Plan</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• There is no risk of avalanche events in North Carolina. The United States avalanche hazard is limited to mountainous western states including Alaska, as well as some areas of low risk in New England.</li> <li>• Avalanche hazard was removed from the North Carolina State Hazard Mitigation Plan after determining the mountain elevation in Western North Carolina did have enough snow not produce this hazard.</li> <li>• Avalanche is not included in any of the previous Wake County or municipal mitigation plans.</li> </ul>
Drought	YES	<ul style="list-style-type: none"> <li>• Review of the NC State Hazard Mitigation Plan</li> <li>• Review of the North Carolina Drought Monitor website</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• There are reports of drought conditions in each of the last fourteen years in Wake County, according to the North Carolina Drought Monitor.</li> <li>• Droughts are discussed in NC State Hazard Mitigation Plan as a lesser hazard.</li> <li>• The NC State Hazard Mitigation Plan lists drought as a hazard for the Piedmont 4 Region which includes Wake County.</li> <li>• Drought is included in 12 of 13 previous hazard mitigation plans.</li> </ul>



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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Hailstorm	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Hailstorm events are discussed in the state plan under the Severe Thunderstorm hazard.</li> <li>• NCDC reports 261 hailstorm events (3/4 inch size hail to 4 inches) for Wake County between 1966 and 2013. For these events there were \$9,000 (2013 dollars) in property damages.</li> <li>• Although hail is not addressed as an individual hazard in any of the previous hazard mitigation plans, it is addressed as a sub-item under thunderstorms in many of the plans. Given the frequency of the event, individual analysis is warranted.</li> </ul>
Heat Wave	YES	<ul style="list-style-type: none"> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of the North Carolina State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• NCDC reports 2 extreme heat events for Wake County.</li> <li>• The NC State Hazard Mitigation Plan includes Heat Wave as a top hazard for the Piedmont 4 Region which includes Wake County.</li> <li>• The NC State Hazard Mitigation Plan reports the central portion of the state as having a moderate vulnerability.</li> <li>• Heat wave was mentioned in two of the 13 previous hazard mitigation plans in tandem with the drought hazard.</li> </ul>

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Hurricane and Tropical Storm	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Analysis of NOAA historical tropical cyclone tracks and National Hurricane Center Website</li> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of historical presidential disaster declarations</li> <li>• FEMA Hazus-MH storm return periods</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Hurricane and tropical storm events are discussed in the state plan and are listed as a top hazard in the Piedmont 4 Region which includes Wake County</li> <li>• NOAA historical records indicate 8 hurricanes, 55 tropical storms and 24 tropical depressions have come within 75 miles of Wake County since 1850.</li> <li>• Three out of thirteen disaster declarations in Wake County are directly related to hurricane and tropical storm events.</li> <li>• Hurricane and tropical storm hazard was addressed in all of the previous plans.</li> </ul>
Lightning	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> <li>• Review of NOAA NCDC Storm Events Database, NOAA lightning statistics</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Lightning events are discussed in the state plan as part of the severe thunderstorm hazard.</li> <li>• NCDC reports 34 lightning events for Wake County since 1950. These events have resulted in a recorded 2 deaths and \$3.3 million (2013 dollars) in property damage.</li> <li>• Although lightning is not addressed as an individual hazard in any of the previous hazard mitigation plans, it is addressed under thunderstorms in several plans. Given the damage and reported deaths, individual analysis is warranted.</li> </ul>

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Nor'easter	NO	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Nor'easters are discussed in the state plan. The Piedmont Region, which includes Wake County, has the lowest vulnerability in the state.</li> <li>• NCDC does not report any nor'easter activity for Wake County. However, nor'easters may have affected the area as severe winter storms. In this case, the activity would be reported under winter storm events.</li> <li>• Nor'easters were not identified in any of the previous hazard mitigation plans.</li> </ul>
Tornado	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of FEMA's Multi-Hazard Identification and Risk Assessment</li> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Tornado events are discussed in the NC State Hazard Mitigation Plan.</li> <li>• NCDC reports 33 tornado events in Wake County since 1956. These events have resulted in 7 recorded deaths and have caused 213 injuries and \$706.3 million (2013 dollars) in property damage with the most severe being an F4.</li> <li>• Tornado events were addressed in all of the previous plans.</li> </ul>
Severe Thunderstorm	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of FEMA's Multi-Hazard Identification and Risk Assessment</li> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Severe thunderstorm events are discussed in the NC State Hazard Mitigation Plan. The Piedmont 4 Region, including Wake County, has a moderately high vulnerability.</li> <li>• NCDC reports 351 thunderstorm wind events in Wake County between since 1950. These events have resulted in 1 death, 6 injuries and \$1.2 million (2013 dollars) in property damage.</li> <li>• Severe thunderstorm events were addressed in all of the previous plans.</li> </ul>

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Winter Storm and Freeze	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> <li>• Review of historical presidential disaster declarations.</li> <li>• Review of NOAA NCDC Storm Events Database</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Severe winter storms, including snow storms and ice storms, are discussed in the state plan. They are listed as a hazard in the Piedmont 4 Region which includes Wake County.</li> <li>• NCDC reports that Wake County has been affected by 28 snow and ice events since 1993. These events resulted in over \$900,000 (2013dollars) in damages but did not cause any deaths or injuries in Wake County.</li> <li>• Five of the region’s thirteen disaster declarations were directly related to winter storm events.</li> <li>• Winter storm events were addressed in all of the previous plans.</li> </ul>

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<b>GEOLOGIC HAZARDS</b>			
Earthquake	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County USGS Earthquake Hazards Program web site</li> <li>• Review of the National Geophysical Data Center</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> </ul>	<ul style="list-style-type: none"> <li>• Earthquake events are discussed in the state plan and all of the participating jurisdictions in Wake County are considered to be at low to moderate risk to an earthquake event.</li> <li>• Twelve of thirteen previous plans address earthquake.</li> <li>• Earthquakes have occurred in and around the State of North Carolina in the past. The state is affected by the Charleston and the New Madrid (near Missouri) Fault lines which have generated a magnitude 8.0 earthquake in the last 200 years.</li> <li>• 13 events are known to have occurred in the region according to the National Geophysical Data Center. The greatest MMI reported was an 8.</li> <li>• According to USGS seismic hazard maps, the peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years for Wake County is approximately 2%. Although FEMA recommends that earthquakes be further evaluated for mitigation purposes in areas with a PGA of 3%g or more, this is close enough to warrant consideration given the history of some earthquake activity.</li> </ul>

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Expansive Soils	NO	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> <li>• Review of USDA Soil Conservation Service’s Soil Survey</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Expansive soils are identified in the state plan; however Piedmont 4 Region does not identify expansive soils as a top hazard.</li> <li>• Although Wake County is located in an area that has some clay swelling potential, it is not great enough to consider evaluating in terms of mitigation.</li> <li>• Only one of the previous hazard mitigation plans identify expansive soils as a potential hazard.</li> </ul>
Landslide	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of USGS Landslide Incidence and Susceptibility Hazard Map</li> <li>• Review of the North Carolina Geological Survey database of historic landslides</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Landslide/debris flow events are discussed in the state plan, and ranked as a hazard in the Piedmont 4 Region which includes Wake County.</li> <li>• USGS landslide hazard maps indicate that a moderate incidence rate is found in at least part of the county.</li> <li>• Data provided by NCGS indicate 11 recorded landslide events in the Wake County. There were no recorded deaths or injuries but some reports of damage to houses and roads.</li> <li>• All but 4 of the previous hazard mitigation plans address landslides.</li> </ul>
Land Subsidence	NO	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• The state plan delineates certain areas that are susceptible to land subsidence hazards in North Carolina; however none of these areas are located in Wake County.</li> <li>• The plan identifies Wake County as having scored low to moderate for the land subsidence hazard.</li> <li>• Only one of the previous hazard mitigation plans identifies land subsidence as a potential hazard.</li> </ul>

**SECTION 4: HAZARD IDENTIFICATION**

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Tsunami	NO	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> <li>• Review of FEMA’s Multi-Hazard Identification and Risk Assessment</li> <li>• Review of FEMA “How-to” mitigation planning guidance (Publication 386-2, “Understanding Your Risks – Identifying Hazards and Estimating Losses”).</li> </ul>	<ul style="list-style-type: none"> <li>• Tsunamis are discussed in the state plan and described as a “greater” hazard for the state. However, the Piedmont Region scored a zero for tsunami hazard risk.</li> <li>• Although several of the previous plans mention the tsunami hazard, it is not fully addressed in any of the plans as it is identified as being highly unlikely to occur.</li> <li>• No record exists of a catastrophic Atlantic basin tsunami impacting the mid-Atlantic coast of the United States.</li> <li>• Tsunami inundation zone maps are not available for communities located along the U.S. East Coast.</li> <li>• FEMA mitigation planning guidance suggests that locations along the U.S. East Coast have a relatively low tsunami risk and need not conduct a tsunami risk assessment at this time.</li> </ul>
Volcano	NO	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of USGS Volcano Hazards Program web site</li> </ul>	<ul style="list-style-type: none"> <li>• There are no active volcanoes in North Carolina.</li> <li>• There has not been a volcanic eruption in North Carolina in over 1 million years.</li> <li>• No volcanoes are located near Wake County.</li> </ul>

**SECTION 4: HAZARD IDENTIFICATION**

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
<b>HYDROLOGIC HAZARDS</b>			
Dam and Levee Failure	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of North Carolina Division of Land Management web site</li> <li>• Review of U.S. Army Corps of Engineers National Inventory of Dams database</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Dam failure is discussed in the state plan as a hazard of concern for Wake County. It is a hazard for Piedmont Region 4 which Wake County. However, the region does not have the greatest vulnerability in the state.</li> <li>• Of the 401 dams reported on the National Inventory of Dams, 144 are high hazard (36%), (High hazard is defined as “where failure or mis-operation will probably cause loss of human life.”)</li> <li>• 12 of 13 of the previous hazard mitigation plans address dam failure.</li> </ul>
Erosion	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion is addressed directly in few of the previous mitigation plans. However, it is considered a cascading hazard that results from other hazards in many plans.</li> <li>• Riverine erosion has the potential to affect Wake County since several rivers/streams run through the county.</li> </ul>



**SECTION 4: HAZARD IDENTIFICATION**

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Flood	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of historical disaster declarations</li> <li>• Review of NOAA NCEM Storm Events Database</li> <li>• Review of FEMA’s NFIP Community Status Book and Community Rating System (CRS)</li> <li>• Review of previous hazard mitigation plans in Wake County</li> </ul>	<ul style="list-style-type: none"> <li>• The flood hazard is thoroughly discussed in the state plan.</li> <li>• Three out of thirteen Presidential Disaster Declarations were flood-related and an additional three were hurricane or tropical storm-related which caused flooding issues.</li> <li>• NCEM reports that Wake County has been affected by 100 flood events since 1993. These events in total caused an estimated \$10.6 million (2013 dollars) in property damages.</li> <li>• Roughly 10% of Wake County is located in an identified floodplain (100 or 500 year).</li> <li>• All jurisdictions participate in the NFIP.</li> <li>• All of the previous plans address flood hazard.</li> </ul>
Storm Surge	NO	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> <li>• Review of NOAA NCEM Storm Events Database</li> </ul>	<ul style="list-style-type: none"> <li>• Storm surge is discussed in the state plan under the hurricane hazard and indicates that the Piedmont 4 Region has zero vulnerability to storm surge.</li> <li>• None of the previous hazard mitigation plans address storm surge.</li> <li>• No historical events were reported by NCEM</li> <li>• Given the inland location of the Piedmont 4 Region, storm surge would not affect the area.</li> </ul>
<b>OTHER HAZARDS</b>			
Hazardous Materials Incident	YES	<ul style="list-style-type: none"> <li>• Review of previous hazard mitigation plans in Wake County</li> <li>• Review of hazardous materials spills in the county</li> </ul>	<ul style="list-style-type: none"> <li>• Although few of the previous hazard mitigation plans include hazardous materials incidents, several identify man-made hazards.</li> <li>• There is a moderate history of hazardous materials incidents in Wake County</li> </ul>

**SECTION 4: HAZARD IDENTIFICATION**

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Terror Threat	YES	<ul style="list-style-type: none"> <li>• Review of previous hazard mitigation plans in Wake County</li> <li>• Review of local official knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Some of the previous hazard mitigation plans for the region included terrorism threat as a hazard under human caused or man-made hazards.</li> <li>• There are several high profiles targets in the area that caused the planning committee to determine that the hazard should be evaluated further.</li> </ul>
Wildfire	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> <li>• Review of Southern Wildfire Risk Assessment (SWRA) Data</li> <li>• Review of the NC Division of Forest Resources website</li> </ul>	<ul style="list-style-type: none"> <li>• Wildfires are discussed in the state plan as a “greater” hazard of concern.</li> <li>• Most of the previous plans addressed wildfire.</li> <li>• The state plan lists wildfire as a hazard in the Piedmont 4 Region.</li> <li>• A review of SWRA data indicates that there are some areas of elevated concern in Wake County.</li> <li>• According to the North Carolina Division of Forest Resources, Wake County experiences an average of 16 fires each year which burn a combined 98 acres.</li> <li>• Wildfire hazard risks will increase as low-density development along the urban/wildland interface increases.</li> </ul>
Nuclear Accident	YES	<ul style="list-style-type: none"> <li>• Review of NC State Hazard Mitigation Plan</li> <li>• Review of previous hazard mitigation plans in Wake County</li> <li>• Review of IAEA data on the location of nuclear reactors</li> </ul>	<ul style="list-style-type: none"> <li>• Although nuclear accidents are not specifically identified in the State Hazard Mitigation Plan, the location of nuclear reactors in the county is well known.</li> <li>• Although most of the previous plans did not address a nuclear accident, this is not uncommon given the natural hazard focus of previous mitigation plans.</li> <li>• A nuclear accident is unlikely to occur, but could cause severe damage in the event of a major incident.</li> </ul>

## 4.5 HAZARD IDENTIFICATION RESULTS

**TABLE 4.4: SUMMARY RESULTS OF THE HAZARD IDENTIFICATION AND EVALUATION PROCESS**

ATMOSPHERIC HAZARDS	GEOLOGIC HAZARDS
<input type="checkbox"/> Avalanche	<input checked="" type="checkbox"/> Earthquake
<input checked="" type="checkbox"/> Drought	<input type="checkbox"/> Expansive Soils
<input checked="" type="checkbox"/> Hailstorm	<input checked="" type="checkbox"/> Landslide
<input checked="" type="checkbox"/> Heat Wave	<input type="checkbox"/> Land Subsidence
<input checked="" type="checkbox"/> Hurricane and Tropical Storm	<input type="checkbox"/> Tsunami
<input checked="" type="checkbox"/> Lightning	<input type="checkbox"/> Volcano
<input type="checkbox"/> Nor'easter	<b>HYDROLOGIC HAZARDS</b>
<input checked="" type="checkbox"/> Tornado	<input checked="" type="checkbox"/> Dam and Levee Failure
<input checked="" type="checkbox"/> Severe Thunderstorm	<input checked="" type="checkbox"/> Erosion
<input checked="" type="checkbox"/> Winter Storm and Freeze	<input checked="" type="checkbox"/> Flood
	<input type="checkbox"/> Storm Surge
	<b>OTHER HAZARDS</b>
	<input checked="" type="checkbox"/> Hazardous Materials Incident
	<input checked="" type="checkbox"/> Wildfire
	<input checked="" type="checkbox"/> Nuclear Accident
	<input checked="" type="checkbox"/> Terror Threat

= Hazard considered significant enough for further evaluation in the Wake County hazard risk assessment.