Multi-Jurisdictional Hazard Mitigation Plan Onslow County, NC

JULY 2015

Onslow County
Town of Holly Ridge
City of Jacksonville
Town of North Topsail Beach
Town of Richlands
Town of Swansboro

THIS PAGE INTENTIONALLY BLANK

PREFACE

TO: ***The Citizens of Onslow County, the City of Jacksonville, and the Towns of Holly Ridge, North Topsail Beach, Richlands, and Swansboro.***

Mitigation is the cornerstone of emergency management. It is an ongoing effort to lessen the impact that hazards could have on people and property. Mitigation is defined as "sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects". It describes the continuing effort at the federal, state, local and individual levels to lessen the impact of hazards on our families, homes, communities, and economy.

Through the application of mitigation measures, technologies, and an overall multi-jurisdictional team strategy, Onslow County and its five (5) municipalities will ensure that fewer of our citizens and their property become victims of natural hazards.

Mitigation measures will continue to be applied to strengthen your home, local businesses, and industry through code enforcement, so that you family and belongings are better protected from hurricanes, floods, costal storms, fires, and other natural hazards. Mitigation technologies will continue to be used to strengthen critical infrastructure such as our schools, medical facilities, power and utility systems, emergency response organizations, and other vital service facilities to ensure continuity of government. Most importantly our mitigation strategy has been designated to reduce the loss of life and suffering that natural hazard events have the potential of causing during and in the aftermath of their impact on our communities.

A fundamental premise of our hazard mitigation strategy is that dollars invested in mitigation today will significantly reduce the demand for future expenditures by reducing the extent of emergency response and recovery to the hazard; and repair and reconstruction of infrastructure following a disaster.

This comprehensive multi-jurisdictional plan includes resources and information to assist county and municipal residents, public and private sector organizations, and others interested in participating in mitigation planning and implementation. The plan further provides a list of activities that may assist you in reducing the risk to future natural hazard events.

Onslow County, its municipal elected officials, and emergency service organizations remain committed to your safety and the continued economic growth of our area. Thank you for your required support in this crucially important effort.

THIS PAGE INTENTIONALLY BLANK

Revisions

In order to maintain an acceptable level of multi-hazard preparedness, it is necessary to review and update this Emergency Operations Plan (EOP) on at least an annual basis. The Onslow County Department of Emergency Services is the lead agency on the EOP review, and shall coordinate all plan reviews / revision efforts. The Department of Emergency Services shall also be responsible for incorporating all changes to the plan. Such revisions will be prepared based upon the required annual review process or, as the result of periodic drills, tests, and/or functional exercise evaluations of the contents of this plan.

The "Record of Revisions" (Figure 1), is provided in this section to assist plan holders with documenting appropriate plan changes. As revisions are incorporated into this plan, each plan holder will be forwarded a revision package containing the following information:

1. Detailed instructions for inserting plan revisions.

2. The appropriate plan changes as page inserts or directed pen changes.

3. A summary of effective revisions to the plan referencing the section affected, the current revision number, and date.

Revision	Date	Section/Page Reference	Name	Department
2012-01	08/10/2012	Various – grammatical and formatting changes	Stacie Miles	OCES
2012-02	08/12/2012	Various – census and data updates. Removal of critical facility tables.	Stacie Miles	OCES
2014-01	08/01/2014	5 Year FEMA Update. Major changes throughout. New Format	Stacie Miles	OCES

THIS PAGE INTENTIONALLY BLANK

Multi-Jurisdictional Hazard Mitigation Plan

1. Table of Contents

THIS PAGE INTENTIONALLY BLANK

1. INTRODUCTION

This section provides a general introduction to the Brunswick County Multi-Jurisdictional Hazard Mitigation Plan. It consists of the following four subsections:

- 1.1 Background
- 1.2 Purpose
- 1.3 Scope
- 1.4 Authority

1.1.Background

Natural hazards are a part of the world around us. Their occurrence is natural and inevitable, and there is little we can do to control their force and intensity. However, through *hazard mitigation planning*, we can control the results by minimizing the impact natural hazard events have on our environment, and we can influence such events from resulting in disasters.

Onslow County, with a population of approximately 185,220 (*US Census 2013 estimates)*, is located in southeastern North Carolina on the Atlantic Coast. It is a region particularly vulnerable to the effects of a wide range of natural hazards that threaten the life and safety of County and municipal residents, and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life. The County government, its residents and businesses have, in past years suffered disaster losses resulting in severe injuries and loss of life, and economic losses into the millions of dollars.

Hazard Mitigation

Any sustained action taken to reduce or eliminate long-term risk to people and their property from hazards.

Beginning in the mid-1990's, Onslow County established a firm commitment to reduce the potential for future disaster losses. Following a destructive series of hurricanes and coastal storms, Onslow County applied for and received funding to mitigate both public and private property against future storm events. These mitigation projects have already proven themselves very effective.

While the threat from hazards will never be fully eliminated, there is much that we can do to lessen their impact to our community and our citizens. The goal of hazard mitigation is to help prevent events from becoming disasters by instituting policies, procedures and education on methods of risk reduction. There are two primary forms of mitigation: structural such as strengthening of buildings and non-structural such as floodplain management and land use policies. A primary principle of hazard mitigation involves addressing hazard vulnerabilities that exist today as well as planning for hazards that may exist in the future.

Key to the life of the plan is that the communities develop, adopt and update the plan on a regular basis. The plan should be local in nature to ensure it is relevant to the hazards and vulnerabilities to that community. The plan should be a broad vision of guiding principles to help reduce risk and provide a format to propose specific actions that will work to eliminate or reduce the identified vulnerabilities.

Disaster Mitigation Act of 2000 and the National Flood Insurance Reform Act of 2004

The United States Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) in an effort to support and enhance the original Robert T Stafford Act. The DMA 2000 was an opportunity to revitalize approaches to mitigation planning. Specifically Section 322 of the DMA 2000 addresses the need for state and local governments to closely coordinate mitigation planning activities and makes preparation of multi-hazard mitigation plans a precondition for receiving FEMA mitigation project grants. These grants can include the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) program. Meeting the requirements of DMA 2000 will help ensure that communities are available to apply for and potentially receive federal grant funding both before and after a disaster.

The Flood Insurance Reform Act of 2004 also created two new grant programs and modified an existing program designed to assist communities. The Act developed the Severe Repetitive Loss (SRL) program and the Repetitive Flood Claim (RFC) program and modified the Flood Mitigation Assistance (FMA) program. The Act imposed the requirement of a FEMA approved hazard mitigation plan to be eligible for funding under these programs.

1.2.Purpose

The purpose of the OC MJ-HMP is to establish and promote a sound public policy designed to protect citizens, private property, critical infrastructure, and the environment from natural hazards.

This will be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide Onslow County and its municipalities towards building a safer, more sustainable community.

In that, regard the OC MJ-HMP benefits the citizens of Onslow County and its municipalities by:

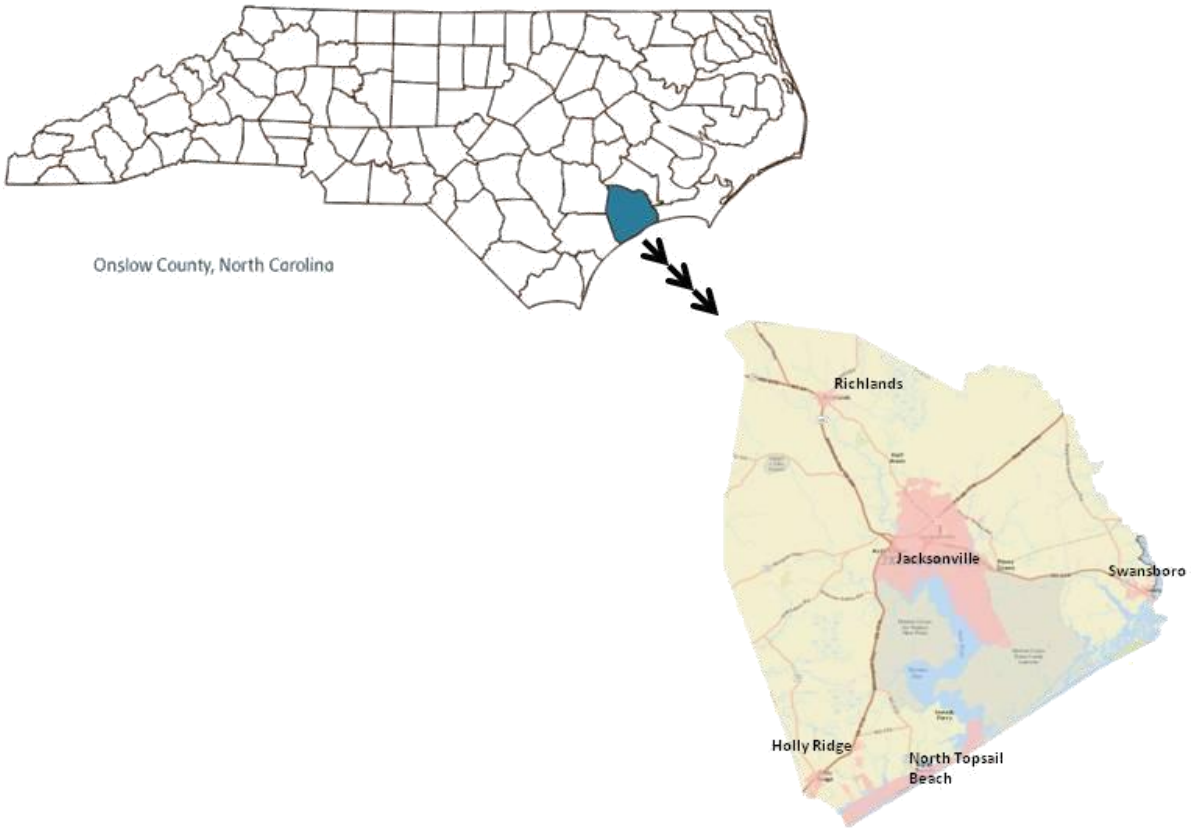
- Protect life and property by reducing the potential for future damages and economic losses that result from natural hazards
- Demonstrate a firm local government commitment to hazard mitigation principles.
- Comply with both State and Federal legislative requirements for local hazard mitigation plans.
- Qualify for grant funding in both the pre-disaster and post-disaster environments
- Support Continuity of Government Operations, maintain critical facilities and protect infrastructure.
- Speed recovery and redevelopment following future disaster events.
- Provide for favorable political consequences for government action.
- Limit legal liability of government and public officials.

1.3.Scope

The original Onslow County Multi-Jurisdictional Plan was developed in 2004 and under the first FEMA update and review in 2009. The plan is reviewed and updated as needed on an annual basis with a full review and FEMA submission every five years. The OC MJ-HMP includes those hazards as prescribed by current FEMA and NCEM guidance. Other hazards will be considered, but are not required to be fully addressed within this Plan

The geographic scope (graphic 1.1) of the OC MJ-HMP includes all unincorporated areas of Onslow County, and all the incorporated areas of its five (5) municipalities, namely; the City of Jacksonville, and the Towns of Holly Ridge, North Topsail Beach, Richlands, and Swansboro. It does not include any State, Federal, or military facility owned lands or infrastructure within Onslow County

Graphic 1.1
Onslow County, NC and Municipalities



In practice, the functional scope of our mitigation strategy may take on many forms. It will involve specific actions such as:

- Promoting sound land use planning based on known hazards.
- Developing, adopting, and enforcing effective building codes and standards.
- Using fire-retardant materials in new construction.
- Installing hurricane straps more securely to attach a structure's roof to its walls and foundation.

- Developing and implementing mitigations plans for individual homes and businesses to reduce susceptibility to hazards.
- Relocating or elevating structures out of the floodplains.
- Buying flood insurance to protect against loss of belongings.
- To achieve the stated purpose, this plan addresses the following major sections:
- Hazard identification and analysis.
- Probability of hazard events.
- Vulnerability to hazards.
- Mitigation capability.
- Acceptability assessment.
- Identification of goals, objectives, and policies.
- Implementation, monitoring, and evaluation and update of the plan once it has been adopted.

1.4.Authority

The Onslow County Multi-Jurisdictional Hazard Mitigation Plan has been developed in accordance to all state and federal rules and regulation governing local hazard mitigation and has been approved and adopted by all participating jurisdictions and partners in accordance with their respective procedures. The plan is monitored and revised to maintain compliance with the following rules, provisions and legislation:

- Section 322, Mitigation Planning, Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000
- FEMA Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201
- National Flood Insurance Act of 1968, as amended 42 U.S.C. 2001 et seq
- NC Senate Bill 300

2. THE PLANNING PROCESS

This section of the plan describes the mitigation planning process undertaken by Onslow County and the participating jurisdictions in preparation of the Hazard Mitigation Plan.

- 2.1 Overview of Hazard Mitigation Planning
- 2.2 History of Hazard Mitigation Planning in Onslow County
- 2.3 Preparing the 2015 Plan
- 2.4 The Planning Team
- 2.5 Community Involvement and Input

2.1.Overview of Hazard Mitigation Planning

Mitigation planning is most effective when it is based on a comprehensive, long-term plan that is developed before a disaster occurs. The purpose of mitigation planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. Local hazard mitigation planning should be community oriented in assessing risk and vulnerability and practices to best minimize or manage those risks.

ELEMENT A1

44 CFR Part 201.6(c)(1): *The plan shall document the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

To ensure a functioning plan each identified mitigation action should be assigned to a specific individual, department or agency along with target completion dates or timelines. The plan should also establish a maintenance schedule to will ensure it remains current and dynamic and can be incorporated into routine local decision making.

Benefits of mitigation planning include:

- Identifying actions for risk reduction
- Focusing resources on the greatest risks and vulnerabilities
- Building partnerships
- Increasing education and awareness through threats and hazards, as well as their risks
- Communicating priorities to State and Federal officials
- Aligning risk reduction with other community objectives

The core assumption of hazard mitigation planning is that the investments made before a hazard event will significantly reduce the demand for post disaster assistance by lessening the need for emergency response, repair, recover and reconstruction.

2.2.History of Hazard Mitigation Planning in Onslow County

In February 2004, Onslow County received a federally funded Hazard Mitigation Plan Grant through the Hazard Mitigation Section, of the North Carolina Emergency Management (NCEM), to prepare a County multi-jurisdictional hazard mitigation plan. This grant was funded with Federal Emergency Management Agency (FEMA) 404 funds pursuant to the Robert T. Stafford Disaster Relief Act, and the Disaster Mitigation Act of 2000 (DMA 2000). The County was required to provide a 25% match that was met by an in-kind contribution of employee hours by the County Emergency Services, Plans, and IT (GIS) Departments.

Onslow County contracted with a consultant to facilitate and guide the mitigation planning process. The consultant became the central repository of all information gathered in the process, and assisted in information analysis, and compiling the information and recommendations into the Onslow County Multi-Jurisdictional Hazard Mitigation Plan (OC MJ-HMP) in compliance with those guidelines recommended by the Federal Emergency Management Agency. A Planning Team, led by the consultant, was developed and met throughout 2003 to develop and review the plan. Two public hearings, held at County Commissioners meetings, were held allowing the public to have involvement, input and information on the planning process and the final plan. The first meeting was held on January 30, 2004 and the second meeting was held on January 30, 2005.

2.3.Preparing the 2015 Plan

Hazard mitigation plans are required to be updated and reviewed by FEMA on a five year cycle to remain eligible for grant funding and disaster assistance. Starting in February of 2014 Onslow County Emergency Services and the City/Town representatives began the process of the 5 year update. The Onslow County Hazard Mitigation Plan Update Advisory Committee was comprised of representatives from Onslow County government, Holly Ridge, the City of Jacksonville, North Topsail Beach, Richlands and Swansboro. The Committee met on February 13, 2014 for its first meeting to discuss what actions needed to be followed to adhere to state guidelines. The Update Advisory Committee set forth a timeline to include several follow-up meetings and scheduled public hearings.

Representatives then returned to their respective jurisdictions to work within their city/town governments at identifying pertinent changes to their annexes. The respective jurisdictions completed necessary research and documentation. Each jurisdiction utilized the Local Hazard Mitigation Plan Update Materials and Supplemental Information as provided by NCEM Recovery Division. Other reference materials are identified in the Section titled “Keeping Natural Hazards from Becoming Disasters.” Jurisdictions also consulted with State and Local offices to assist in changes and updates in information and flood data.

The update resulted in many small changes throughout the document that include minor numerical changes, additions of sections that pertain to the 2015 update and complete revisions of worksheets. A summary of the major changes can be found below:

In September 2014, the updated OC MJ-HMP was then approved as written by the OC Board of Commissioners contingent upon approval by North Carolina Emergency Management (NCEM) and the Federal Emergency Management Agency (FEMA). Upon approval by both NCEM and FEMA the OC Board of Commissioners formally adopted the plan and would officially implement it for the next 5 year period.

2.4.The Planning Team

Onslow County has appointed a County Hazard Mitigation Officer to coordinate hazard mitigation planning activities in the County. Each of the municipalities in the County has also appointed a City/ Town Hazard Mitigation Officer to coordinate hazard mitigation planning activities in their jurisdiction.

The Onslow County Hazard Mitigation Officer, in coordination with the surrounding City/ Town Hazard Mitigation Officers, has formed a County (Multi-Jurisdictional) Hazard Mitigation Plan (HMP) Advisory Committee that is comprised of key representatives from each of the participating jurisdictions which includes Onslow County, the City of Jacksonville, and the Towns of Holly Ridge, North Topsail Beach, Richlands, and Swansboro. Each of the municipalities has also formed a City/ Town HMP Advisory Committee in their respective jurisdictions.

Members of the County and City/ Town HMP Advisory Committees provide a multi-disciplined local capability to identify mitigation opportunities and implement mitigation measures in either a pre-incident or a post-incident situation.

The County and City/ Town HMP Advisory Committees are not a standing organization of rigid membership and regular duties, but rather one of flexible membership whose makeup and duties are dependent upon the particular mitigation activity under consideration. This flexibility allows the County or City/ Town Hazard Mitigation Officers to tailor the group to meet the unique situation in their jurisdiction while ensuring the involvement of appropriate individuals from the community.

The Onslow County Emergency Services Department has sent a representative to Raleigh to attend NCEM training on the Hazard Mitigation Update process. The following table identifies those people chosen to represent the County and the City/Towns during the 2015 OC MJ-HMP update process.

Table 2.1
Mitigation Advisory Committee Members

Name	Jurisdiction
David Cotton	Onslow County
Norman Bryson	Onslow County
Stacie Miles	Onslow County
Andrew Jaspers	Onslow County
Alan Fernandez	Onslow County
Ben Warren	Onslow County
Patricia Pike	Onslow County
Spencer Lee	City of Jacksonville
Heather Reynolds	Town of Holly Ridge

Deborah Hill	Town of North Topsail Beach
Gregg Whitehead	Town of Richlands
Jennifer Holland	Town of Swansboro
Bob Ritchie	Town of Swansboro

Additionally, other subject matter experts, as required, were invited to the planning meetings on an as required basis to include representatives from the Onslow County Tax Office, Onslow County Flood Plain Management Office, American Red Cross – Onslow County Chapter, Marine Corps Base Camp Lejeune Joint Land Use Study Office, and the North Carolina Emergency Management Hazard Mitigation Section.

These representatives, as well as those members of the public who participated, were involved in various aspects of the planning process, advising for the planning process, and in providing background information and analysis.

Onslow County, the surrounding municipalities, and local military installations have formed the Military Civilian Task Force for Emergency Response (MCTFER) group, comprised of emergency management, response, recovery, and support organizations throughout the County. The MCTFER's mission is to improve public safety by coordinating all regional emergency services resources, both military and civilian, in the event of a regional disaster. The MCTFER brings local and Federal military emergency services personnel under an approved and accepted Incident Command System, providing for a unified response to major incidents that impact our community.

The MCTFER's organizational responsibilities are to fulfill its military-civilian mutual-aid charter responsibilities in responding to an emergency situation through coordination of all regional emergency services resources, both military and civilian.

Announcements were made at the monthly Onslow County Military Civilian Task Force for Emergency Response (MCTFER) meetings regarding both the formation of the OC Hazard Mitigation Plan Advisory Committee and soliciting both active participation and input to the committee's efforts.

2.4.1. Multi-Jurisdictional Participation

The Onslow County Multi-Jurisdictional Plan includes one county and five incorporated municipalities. The ensure the multi-jurisdiction plan meets participant requirements, Onslow County and each participating jurisdiction were required to perform the following tasks:

- Designate appropriate official(s) to serve on the HMP Advisory Committee
- Participate in mitigation planning meetings and workshops
- Provide best available data as required for the risk assessment
- Complete the jurisdictional annex update utilizing the FEMA Review Tool
- Identify new and completed mitigation projects and priorities

44 CFR Requirements

44 CFR Part 201.6(a)(3): *Multi-jurisdictional plans may be accepted as long as each jurisdiction has participated in the planning process*

- Approve and adopt the plan at a jurisdictional level

2.5.Community Involvement and Input

Preparation of the plan required a series of meetings for the Advisory Team to facilitate discussion, develop update timelines, initiate data collection and provided for group input and consensus. Meetings were also held to allow for public input and involvement in the plan update process and to serve as an opportunity to ediucate about hazard mitigation. Below is a summary of key meetings and community workshops that were held in support of the 2015 Onslow County Multi-Jurisdictional Hazrad Mitigation Plan.

Kickoff- February13, 2014

The meeting served as the first meeting for the Hazard Mitigation Advsiory Committee that included participants from the County and all five Municipalities. The primary purpose of the kickoff meeting was to review the FEMA Local Mitigation Plan Review Guide and Toolkit, discuss the current plan, and develop calendar to include meeting schedules, plan deadlines, and develop an update timeline.

Midterm Advisory Meeting – May 29, 2014

The meeting served as an opportunity for the group to discuss specific mitigation concerns, hazard history review and collection, data and statistic resources issues, and questions developing from the FEMA Plan Review Guide and Toolkit.

Final Advisory Meeting – August 14, 2014

The meeting served as a final opportunity for the group to jointly discuss issues, concerns and progress. The group also began discussion on new meeting schedules to begin the following year.

While there were only three in person meetings of the group email chains served to share all information and updates.

ELEMENT A3

44 CFR Part 201.6(b)(1): *The Planning process shall include an opportunity for the public to comment on the plan during the drafting stage and prior to plan*

2.5.1. Public Workshops

A fundamental component of community based hazard mitigation planning involves public participation. Individual participation provides insight into local concerns and ensures a higher degree of mitigation success by developing community "buy-in". The public should be engaged to help identify community assets and problem areas, describe areas of concern, help develop hazard and threat history, help prioritize mitigation priorities and provide ideas for continuing public involvement.

1st Public Hearing(s)

The Onslow County MJ-HMP Advisory Committee made the decision to split the two meeting requirement up into a jurisdictional set of meetings followed by a county level meeting. The initial meetings would be held in the form of public hearings in each of the specific jurisdictions and County council meetings during the approval phase and would address each jurisdictional annex and the County level plan as a whole. Notifications were posted on the County webpage announcing the update process.

2nd Public Hearing

On September 05, 2014, Onslow County held a public meeting at the Onslow County Emergency Operations Center. This was the last opportunity for the public to provide input and comments before the plan was presented to the Board of Commissioners for tentative approval and adoption contingent upon NCEM and FEMA approval. The public meeting was announced in the Jacksonville Daily News, on the Onslow County website and social media platforms, and distributed to all of the various news and media agencies in the county. The announcement also included the address and phone number of Emergency Service personnel available to answer questions. All citizens of the county, neighboring communities, government agencies, businesses and other interested parties were invited to attend. At the meeting copies of the county document, and several jurisdictional documents were available for viewing. Emergency Services personnel were on hand to answer questions as they arose. Representatives from a local news organization and several citizens attended.

Final Public Hearings

Held once the plan was approved by FEMA and was presented to the County for adoption at a regularly scheduled County Commissioners meeting. Citizens were notified through standard public notices which were posted on the County website and through standard medie notifications. A small follow up presentation was given to reintroduce the plan to the Commissioners and the citizens and to discuss the FEMA approval status. The meeting allowed for a final opportunity for citizen input and comments. Any suggestions for revisions would be carried into the next annual review of the plan.

ELEMENT A244 CFR Part 201.6(b)(2): *The Planning process shall include an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have authority to regulate development, as well as business, academia and other non-profit interests to be involved in the planning process.*

2.5.2. Involving Stakeholders

In addition to the HMP Advisory Committee meetings, Onslow County and participating jurisdictions encourages stakeholder participation in the development and update of the plan. Invitational emails were sent to non-governmental agencies including public utilities and community outreach groups. As discussed earlier, announcements and invitations were also sent through the MCTFER group for participation. Stakeholder involvement helps to promote education about the hazards and risks in the local area, develop local impact histories, provide data and information that will improve the overall quality and accuracy of the plan and helps to ensure transparency and build trust.

3. COMMUNITY PROFILE

This Section provides a general overview of Onslow County. It consists of the following sections:

- 3.1 Geography and Environment
- 3.2 Population and Demographics
- 3.3 Housing, Infrastructure, and Land Use
- 3.4 Employment and Industry
- 3.5 Disaster Declarations

3.1.Geography and Environment

North Carolina is subject to many different types of natural hazards including earthquakes, landslides, hurricanes, nor'easters, tornadoes, severe winter weather, wildfires, sinkholes, and flooding. The susceptibility of an area to these events depends largely upon its geographic location.

The climate of North Carolina varies considerably from the mountainous region in the west to the eastern coastline. Average temperatures vary by as much as 20 degrees from west to east. Average annual precipitation is generally around 50 inches statewide, but in the mountains there are significant terrain- induced variations. In light of the west-to-east gradient in climate variability due to topography (and proximity to the Atlantic Ocean) coupled with the north-to-south gradient in temperature due to latitude, North Carolina has been divided into eight climate divisions for purposes of long-term climate assessments. These climate divisions are considered relatively homogeneous in their long-term climatology and generalizations relating to the probability of various hazard events occurring in each climate division can be made.

Onslow County is located in climate division 6 (see the below table - *Natural Hazard Vulnerabilities for Counties within Climate Division 6*) Based on the characteristics of each climate division, the National Climatic Data Center categorized North Carolina's counties into one of three levels of vulnerability for natural disasters (Low, Moderate, and High). Most of the categorizations were made using the particular county's Climate Division number, which was formulated by the National Climatic Data Center.

Onslow County (OC) is in the North Carolina Emergency Management (NCEM) Eastern Branch (EB), and Federal Emergency Management Agency (FEMA) Region IV. It is geographically located in SE North Carolina approximately 100 miles SE of Raleigh, and 30 miles N of Wilmington. It is bordered on the E by the Atlantic Ocean and Carteret County; on the S by the Atlantic Ocean and Pender County; on the W by Pender and Duplin Counties; and on the N by Jones.

Onslow County consists of flat, gently rolling terrain, which slopes easterly from an altitude of 63 feet above sea level in the town of Richlands to sea level. The average elevation is 23 feet. The County includes 27 miles of unspoiled coastline and a total land area of approximately 819 square miles or approximately 524,000 acres. Of this total, 157,000 acres make up Marine Corps Installations in the County.

3.2.Population and Demographics

The population of the County and the municipalities within the County is 185,220 (*US Census 2013 estimates).* Onslow County is the 11th most populated County in NC and is currently ranked as the fastest growing county (NC Office of State Budget and Management 2013). Onslow County sees a moderate increase in population during tourist season and according to the Onslow County Tourism board the estimated peak seasonal population is around 200,000+. There are five incorporated municipalities in Onslow County. The City of Jacksonville is home to the County Seat and is the largest of the municipalities. The areas surrounding the City comprise the major population centers and growth area in the County.

Table 3.1: Onslow County Populations Estimates for 2000 and 2010 Census

Jurisdiction	2000 Census	2010 Census	Increase	% Growth
Onslow County	150,355	177,772	27,417	18
Holly Ridge	831	1,268	437	52
Jacksonville	66,715	70,145	3,430	5
North Topsail Beach	843	743	-100	-11
Richlands	928	1,520	592	63
Swansboro	1,426	2,663	1,237	86

Source: ***US Census 2010***

According to the 2010 US Census the median age for Onslow County is 25.8 which is much younger than the North Carolina median age of 37.4. Nearly 18% of the population ranges between 20-24 years old and 9.4% of the population is over the age of 62.

Almost 53% of the population is identified as male and 46% are female. 74% of the population identifies as Caucasian while the next largest group at 15.6% identify as Black or African American. Table 3.1 displays the 2010 US Census data on Onslow County Demographics.

Table 3.2: Race Percentages in Onslow County, 2010 Census

Race	Population	Percent
White	138,114	77.7
Black	31,426	17.7
American Indian or Alaskan Native	2,897	1.6
Asian	5,757	3.2
Native Hawaiian/Other Pacific Islander	1,031	0.6
Some Other Race	7,089	4.0
Hispanic or Latino	17,896	10.1

Source: US Census 2010

3.3.Housing, Infrastructure, and Land Use

In the 2010 census there were 68,226 total housing units listed in Onslow County, this is a 23% increase from the 200 census. Of the listed housing units 60,092 were listed as occupied with 34,332 (57.1%) being owner occupied and 25,760 (42.9%) being renter occupied. The average household size in Onslow County is 2.0 persons per household (33.9%). The median home value in Onslow County is $149,900.

Transportations networks are vital for Onslow County, not only for local transportation but also in support of tourism and 3 military installations. Onslow County is connected through the major thoroughfares of US Highway 17, NC Highway 24, US Highway 258, NC Highway 50 and NC Highway 210. There are 2 bypasses in Jacksonville serving US Highway 17 and NC Highway 24. There thoroughfares also serve as primary evacuation routes. Onslow County is serviced by one civilian airport, Albert J. Ellis, with carriers to include Delta and US Airways. There are currently two transit services operating in Onslow County; Onslow United Transit Services provides commuter bus service throughout areas of the County and Jacksonville Transit Service offers commuter bus services within the City of Jacksonville.

Onslow County has a person per square mile density of 233.1 which is significantly higher than the North Carolina Average of 196.1 persons per square mile. Development, economic growth and expansion of military installations have resulted in an 18.2% population increase since the 2000 census and NC Data Center projects that Onslow County will see a 43.1% increase in population by the year 2034.

Table 3.3: Projected Population Growth for Onslow County, 2010-2034

Jul 2010	July 2015	July 2020	July 2025	July 2030	July 2034
177,772	200,913	217,809	234,706	251,602	265,120

Source: NC OSBM, 2014

Utilities in Onslow County are provided by a mixture of government and non-government corporations. Currently water and wastewater are provided by two primary providers; Onslow Water and Sewer Authority (ONWASA) and City of Jacksonville Public Services Department. MCB Camp Lejeune also maintains a water/wastewater system that supports the military installation. Power utilities are provided primarily by Duke (Progress) Energy and Jones Onslow Electric Membership Cooperative with 2 out of county providers covering small portions near the County lines. Currently North Carolina Natural Gas, a subsidiary of Piedmont Natural Gas, provides natural gas into Onslow County.

According to the Onslow County 2009 CAMA Plan approximately 57.6% of land in the county is listed as unincorporated, 16.4% is listed as incorporated, and 26.0% is listed as military installation. Roughly 38% of the unincorporated areas of the county are listed as vacant and 40% are listed as non-county jurisdiction (forest lands, State property and military installations). Approximately 18.9% of unincorporated lands are listed as residential use, .19% as Office/Institutional, .22% Commercial and 1.4% as Industrial. Future land use in the CAMA Plan revolves around meeting the demands for each identified use based on the projected population growth.

3.4.Employment and Industry

The median household income for Onslow County is listed as $45,812 in the 2010 US Census (North Carolina median income is $46,450). The average state unemployment rate in 2013 was 6.2% while the average for Onslow County was approximately 6.7%. Approximately 11.1% of the citizens in Onslow County are listed as falling below the national poverty level which is slightly below the North Carolina level of 12.4%.

Onslow County promotes a diversified economy with approximately 66.1% of employment being concentrated in the private sector. As a community with 3 military installations however, government workers make up almost 27.5% of the workforce. This is higher than the North Carolina average of 15.3%. The following table provides an overview of the economic sectors n Onslow County.

Table 3.4: Employment by Sector for Onslow County, 2010 Census

Employment Sector	Workforce	Percentage
Agriculture, forestry, fishing and hunting, and mining	791	1.4%
Construction	5,566	9.6%
Manufacturing	1,553	2.7%
Wholesale trade	1,097	1.9%
Retail trade	7,118	12.3%
Transportation and warehousing, and utilities	2,693	4.7%
Information	898	1.6%
Finance and insurance, and real estate and rental and leasing	2,548	4.4%
Professional/scientific/management/ administrative and waste management	4,874	8.4%
Educational services, and health care and social assistance	11,658	20.2%
Arts/entertainment/recreation/accommodation and food services	8,320	14.4%
Other services, except public administration	3,033	5.2%
Public administration	7,623	13.2%

Source: US Census 2010

3.5.Disaster Declarations

Since 1965 Onslow County has experienced 11 presidential disaster declarations as shown in Table 3.5. There have been many other emergencies and disasters that did not qualify for federal disaster relief.

Table 3.5: Presidential Disaster Declarations

Event	Declaration Date	Declaration Number
Hurricane Diana	09/21/1984	DR-724
Hurricane Bertha	07/18/1996	DR-1127
Hurricane Fran	09/10/1996	DR-1134
Hurricane Bonnie	08/27/1998	DR-1240
Hurricane Floyd	09/21/1999	DR-1292
Hurricane Isabel	09/18/2003	DR-1490
Hurricane Ophelia	10/7/2005	DR- 1608
Tropical Storm Hanna	10/8/2008	DR-1801
Severe Storms/Tornadoes	04/19/2011	DR1969
Tropical Storm Nicole	10/14/2011	DR1942
Hurricane Irene	08/31/2011	DR4019

Source: Federal Emergency Management Agency

4. HAZARD IDENTIFICATION AND ANALYSIS

Onslow County is vulnerable to a wide range of natural hazards that have a potential to threaten life and property. This section of the plan describes the hazards that have been identified as posing a threat to the people and property located within the county and its five jurisdictions. Each hazard is described with an assessment to include background information, location/spatial extent, historical occurrences and probability of future occurrences. The hazards addressed in this plan were identified through research, past disaster declarations, previous hazard identification plans, and by comparing against the current North Carolina Hazard Mitigation Plan. All information used to develop the assessment of each hazard is available online through various agencies including federal, state and academic sites and through library research tools.

The following natural hazards were identified:

- Atmospheric
  - 4.2 Drought and Heat Wave
  - 4.3 Severe Thunderstorm and Hail
  - 4.4 Hurricane and Coastal Storm (includes Nor'easter)
  - 4.5 Tornado
  - 4.6 Winter Storm
- Geologic
  - 4.7 Earthquake
  - 4.8 Landslide and Sinkhole
  - 4.9 Tsunami
- Hydrologic
  - 4.10 Coastal and Riverrine Erosion
  - 4.11 Dam and Levee Failure
  - 4.12 Flooding
  - 4.13 Storm Surge
- Other
  - Wildfire

ELEMENTS B1 & B244 CFR Part 201.6(c)(2)(i):
B1: The Risk assessment shall include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction.

B2: The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Some hazards are considered to be interrelated and cascading (i.e. hurricanes can cause flooding, storm surge and tornadoes), but for hazard identification purposes each hazard is treated as a unique and stand alone hazard. It should also be noted that some hazards, such as earthquakes and winter storms, may impact large areas yet cause little damage, while other hazards, such as tornado, may impact a smaller geographic area but cause substantially more damage.

4.1.Study Area

The study area pertains to all of the unincorporated areas of Onslow County and the municipalities of Holly Ridge, Jacksonville, North Topsail Beach, Richlands, and Swansboro and their relative extraterritorial jurisdictions (ETJ's). While the non-participating areas of Camp Lejeune and their coordinating installations of Camp Johnson, Camp Geiger, Stone Bay Range and MCAS New River are not analyzed specifically the hazard identification and analysis will pertain to the extent that the same hazards will affect those areas. Onslow County and Camp Lejeune work closely together on various planning and response activities and share many of our plans with one another. Camp Lejeune will house a copy of the OC MJ_HMP as Onslow County houses a copy of the Camp Lejeune HMP.

Figure 4.1: Onslow County Study Area

ATMOSPHERIC HAZARDS

4.2.Drought and Heat Wave

4.2.1. Background

Drought refers to a deficiency in precipitation over an extended period, usually a season or more, resulting in water shortages that can cause adverse impacts on vegetation, animals, and/or people. Drought is a normal and recurrent feature of climate that occurs in virtually all climate zones and usually presents as an aberration from normal climatic conditions. Human factors, including water demands and water management, can exacerbate the impacts of a drought on a region. Drought is classified as: 1) meteorological, 2) hydrological and 3) agricultural.

Table 4.1: Drought Classifications

Meteorological	Usually defined based on the degree of dryness (in comparison to some "normal" or average) and the duration of the dry period. Drought onset generally occurs with a meteorological drought.
Hydrological	Usually occurs following periods of extended precipitation shortfalls that impact water supply (i.e. streamflow, reservoir and lake levels, ground water), potentially resulting in significant societal impacts.
Agricultural	Links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipation shortages, soil water deficits, reduced ground water or reservoir levels needed for irrigation, and so forth.

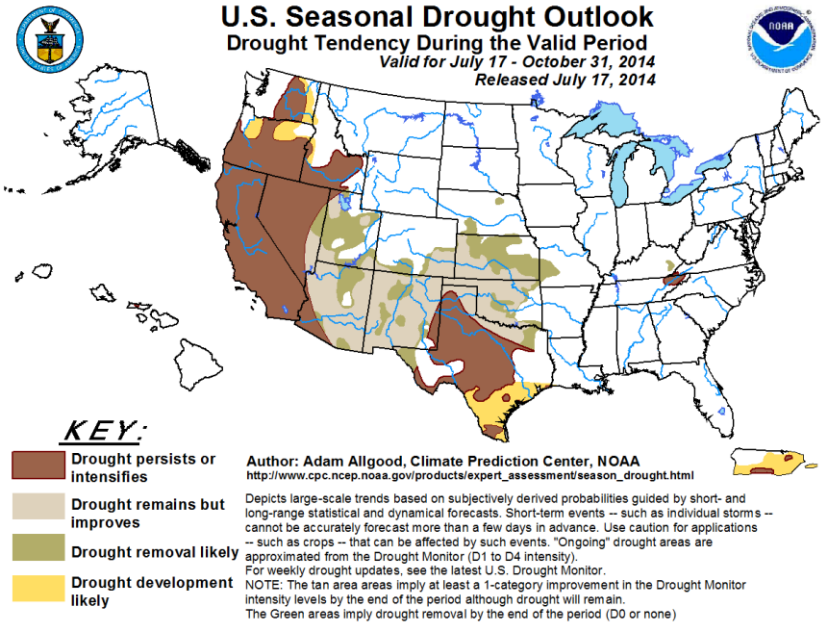
Source: National Weather Service's: NOAA

Drought events are typically slow onset hazards but can, over time, have very widespread damaging affects to crops, public water supplies and recreational activities. Long term, persistant droughts can incidentally increase an areas risk to wildfire.

Drought is currently monitored by the National Integrated Drought Information Systems, a collaborative effort lead by the National Oceanic and Atmospheric Administration (NOAA) and partners including USDA, USGS, US Army Corps of Engineers, and several academic agencies. The NIDIS provides daily drought monitoring reports along with seasonal drought outlooks products. Drought forecast products are produced in 6 month increments showing the potential for development and persistence of drought conditions.

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

Figure 4.2: Drought Outlook Product



While drought and heat wave often coincide the two natural occurrences are not always directly related. The National Weather Service does not offer a direct definition of a heat wave but it is generally accepted as describing a period of three or more days where temperatures reach (90) degrees Fahrenheit or higher. It can however, be described as any event lasting three or more days where temperatures are 10 degrees hotter than the normal temperatures. Heat waves can pose serious threats to life. The National Weather Service began issuing products to help with heat warnings for the general public. Table 4.2 lists each product with a definition.

Table 4.2: NWS Heat Warning Products

Excessive Heat Outlooks	Issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead time to prepare for the event, such as public utility staff, emergency managers and public health officials. See the mean heat index and probability forecasts maps
Excessive Heat Watches	Issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain. A Watch provides enough lead time so that those who need to prepare can do so, such as cities officials who have excessive heat event mitigation plans.
Excessive Heat Warning/Advisories	Issued when an excessive heat event is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurring. The warning is used for conditions posing a threat to life. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life.

Source: National Weather Service

As a part of producing watches and warnings the NWS developed a Heat Index as a mechanism to help better inform the public of the dangers of heart. The Heat Index Chart, listed in Figure 4.3, uses a combination of air temperature and humidity to help determine the heat index (or apparent temperature). Populations such as the elderly and young are more susceptible to heat dangers than other segments of the population.

Figure 4.3: NWS Heat Index

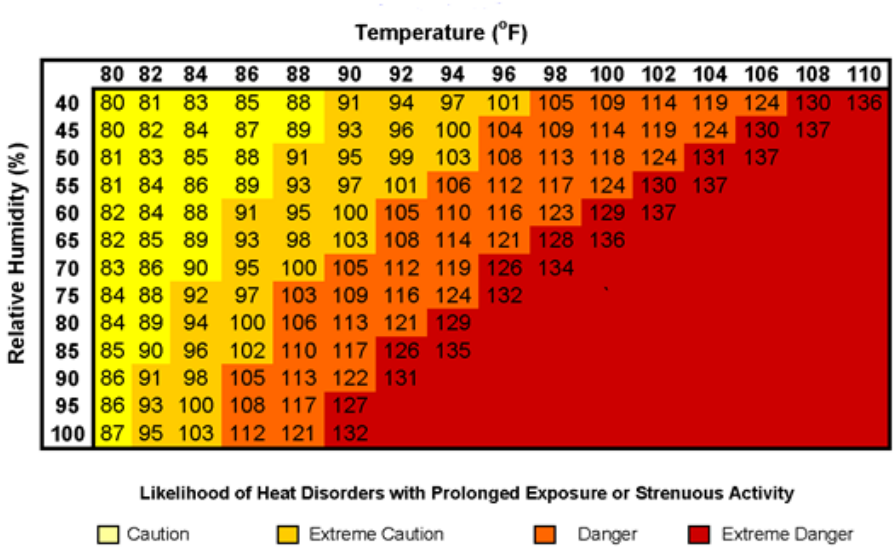


Table 4.3: Heat Index and Heat Disorder

Heat Index	Possible heat disorders for people in higher risk groups
80° - 90°	Fatigue possible with prolonged exposure and/or physical activity.
90°- 105°	Sunstroke, heat cramps and exhaustion possible with prolonged exposure and/or physical activity.
105°- 130°	Sunstroke, heat cramps or heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity.
130° or higher	Heatstroke/sunstroke highly likely with continued exposure.

Source: National Weather Service

During periods of extreme heat, people generally restrict their outdoor activities. However, by retiring indoors there is then an increased demand for air conditioning creating increased electrical demands. Depending on the electrical demand and generation capacity, there is potential for placing stress on the electric grid, which can potentially fail. While this has not been a significant problem for Onslow County residents, other regions of the country, especially the Northeast, have suffered the results of widespread electrical failure and outages significantly impacting daily life and commerce.

Agriculture concerns, such as poultry and swine operations are most susceptible to extreme heat. Extreme heat can and does cause extensive poultry deaths. Livestock, while susceptible to extreme heat can be cared for easier than poultry.

4.2.2. Location and Spatial Extent

Drought typically covers large areas and cannot be confined to geographical or political boundaries. While North Carolina has a relatively low risk for drought hazard local areas may experience more severe and/or frequent drought conditions than other areas. It is assumed that all of Onslow County would experience drought uniformly within its boundaries.

Similar to drought, heat wave can occur anywhere in the U.S. and has no true geographical or political boundaries. It is also assumed that all of Onslow County would experience drought and heat wave uniformly within its boundaries however, coastal areas may have a slightly reduced risk due to ocean winds.

4.2.3. Historical Occurrences

The North Carolina Drought Management Advisory Council reports data on North Carolina drought conditions from January 2000 to June 2009. It classifies counties on a scale of D0 to D4:

CLASSIFICATION	INTENSITY PHRASE	YEAR DECLARED
DO	ABNORMALLY DRY	2000
		2001
		2002
		2004
		2005
		2006
		2007
		2008
		2009
		2010
		2011
		2012
		2013
		2014
D1	MODERATE DROUGHT	2001
		2002
		2007
		2008
		2009
		2010
		2011
		2012
D2	SEVERE DROUGHT	2001
		2002
		2008
		2011
D3	EXTREME DROUGHT	2007
		2008
		2011
D4	EXCEPTIONAL DROUGHT	

SOURCE: North Carolina Drought Monitor

Data from the National Climate Data Center and North Carolina Drought Management Advisory Council were utilized to develop a historical occurrence of Drought. According to these records Onslow County experienced 3 periods documented as extreme drought:

- July 2011-August 2011
- November 2007-Februsary 2008
- September 2007-October 2007

From 1994 thru 2008, the area experienced a rainfall reduction, resulting in near drought and moderate drought conditions. Drought conditions present a danger that is becoming more evident over time. Onslow County pulls water from aquifers and deep water wells and has felt minimal impact in the recent droughts.

In recent years, Onslow County has had no reported extreme heat fatalities due to extreme heat. Onslow Memorial Hospital reports that from 2000 through 2008, 234 outpatients, and 16 in-patients were treated due to the effects of extreme heat. However, statewide there were ten (10) fatalities reported in 2002 and seven (7) in 2003. From 1930 to 1996, normal daily maximum temperatures did not exceed 88.9 degrees (F) with a mean daily maximum of 89.1 degrees (F). However, temperatures have reached 103 degrees (F) and above in 1954, 1983 and 1986, with a maximum high of 104 degrees (F) in September of 1954.

4.2.4. Probability of Future Occurrences

Given uniform exposure, climatic changes and the history of previous drought events it is assumed that there is a likely probability of future drought and heat wave occurances in Onslow County.

4.3.Severe Thunderstorm and Hail

4.3.1. Background

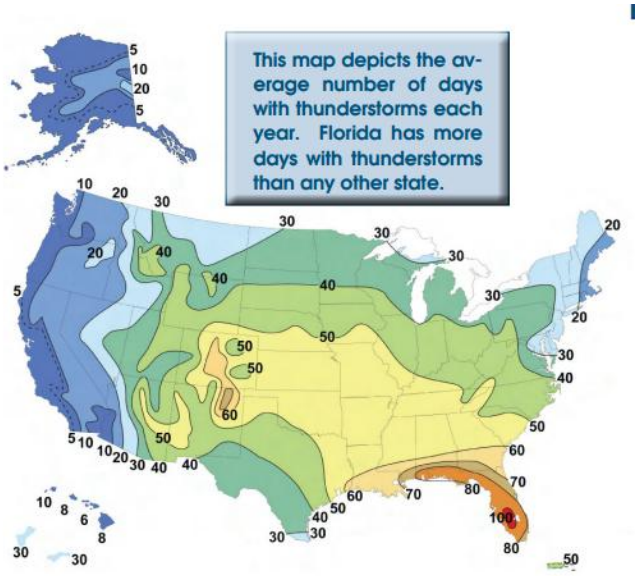
Thunderstorms are the result of convection in the atmosphere. They are typically the by-product of atmospheric instability, where air masses of varying temperatures meet. Rapidly rising warm moist air serves as the engine for thunderstorms. .

A typical thunderstorm may be three miles wide at its base, rise to between 40,000 to 60,000 feet in the troposphere, and contain half a million tons of condensed water. Conglomerations of thunderstorms along cold fronts (with squall lines) can extend for hundreds of miles.

Thunderstorms contain tremendous amounts of energy derived from water condensation. According to the National Weather Service, thunder storm is classified as severe when it produces one of three elements: 1) a tornado, 2) hail at least 0.75 inches in diameter, or 3) winds at least 58 miles per hour.

While thunderstorms can occur in all regions of the United States, they are most common in the central and southern states because atmospheric conditions in these regions are most favorable for generating powerful storms. Figure 4.4 illustrates thunderstorm hazard severity based on the annual average number of thunder events.

Figure 4.4: Annual Average Severe Thunderstorm



Source: NOAA: Storm Prediction Center

Hailstorms are a potentially damaging formation of severe thunderstorms. Hail is created when strong rising currents of air within the storm, called updrafts, carry water droplets to a height where they freeze. Ice particle will continue to grow in size, eventually (larger than .75 inches) becoming too heavy to be supported by the updraft, and fall to the ground. Hail is larger than sleet and will only form inside a thunderstorm. The size of the hailstones are a direct function of the size

and severity of the storm.

4.3.2. Location and Spatial Extent

Thunderstorms are common throughout the State and have occurred in all months. Thunderstorm-related deaths and injuries in North Carolina (1959-1992) have peaked during July and August.

Hail events may occur anywhere throughout Onslow County and will not be confined by geographic boundaries. Hail events typically are widespread.

4.3.3. Historical Occurrences

According to the National Climatic Data Center there were 101 thunderstorm events in Onslow County between January 1, 1950 and April 30, 2014. These events resulted in over $157 thousand in property damage (2014 estimates). Table 4.4 lists historical occurrences of thunderstorm events in Onslow County.

Table 4.4: Thunderstorm Occurrences in Onslow County

Location	Date of Occurrence	Type	Magnitude	Death/ Injury	Property Damage (2014 Dollars)
Onslow County	05/28/1965	Thunderstorm Wind	51 kts.	0/0	0.00K
Onslow County	07/04/1979	Thunderstorm Wind	55 kts.	0/0	0.00K
Onslow County	12/24/1979	Thunderstorm Wind	63 kts.	0/0	0.00K
Onslow County	07/10/1980	Thunderstorm Wind	55 kts.	0/0	0.00K
Onslow County	06/05/1982	Thunderstorm Wind	50 kts.	0/0	0.00K
Onslow County	06/16/1982	Thunderstorm Wind	54 kts.	0/0	0.00K
Onslow County	03/21/1983	Thunderstorm Wind	78 kts.	0/0	0.00K
Onslow County	09/12/1983	Thunderstorm Wind	61 kts.	0/0	0.00K
Onslow County	05/08/1984	Thunderstorm Wind	50 kts.	0/0	0.00K
Onslow County	07/17/1984	Thunderstorm Wind	55 kts.	0/0	0.00K
Onslow County	09/15/1984	Thunderstorm Wind	50 kts.	0/0	0.00K
Onslow County	07/27/1986	Thunderstorm Wind	65 kts.	0/0	0.00K
Onslow County	06/03/1987	Thunderstorm Wind	50 kts.	0/0	0.00K
Onslow County	07/13/1988	Thunderstorm Wind	54 kts.	0/0	0.00K
Sneads Ferry	06/12/1995	Thunderstorm Wind	60 kts.	0/0	5.00K
Swansboro	10/28/1995	Thunderstorm Wind	74 kts.	0/0	0.00K
SWANSBORO	10/08/1996	Thunderstorm Wind	51 kts.	0/0	0.00K
SNEADS FERRY	02/15/1997	Thunderstorm Wind	51 kts.	0/0	0.00K
HUBERT	06/03/1997	Thunderstorm Wind	50 kts.	0/0	0.00K
PINEY GREEN	06/14/1997	Thunderstorm Wind	50 kts.	0/0	0.00K
SWANSBORO	08/18/1997	Thunderstorm Wind	50 kts.	0/0	0.00K

JACKSONVILLE	09/15/1997	Thunderstorm Wind	52 kts.	0/0	15.00K
RICHLANDS	05/23/1998	Thunderstorm Wind	59 kts.	0/0	0.00K
HUBERT	06/13/1998	Thunderstorm Wind	50 kts.	0/0	0.00K
RICHLANDS	06/23/1998	Thunderstorm Wind	61 kts.	0/0	0.00K
HOLLY RIDGE	06/23/1998	Thunderstorm Wind	50 kts.	0/0	0.00K
CAMP LEJEUNE	06/23/1998	Thunderstorm Wind	51 kts.	0/0	0.00K
NORTH TOPSAIL BEACH	06/23/1998	Thunderstorm Wind	50 kts.	0/0	0.00K
JACKSONVILLE	06/30/1998	Thunderstorm Wind	50 kts.	0/0	0.00K
JACKSONVILLE	08/29/1998	Thunderstorm Wind	51 kts.	0/0	0.00K
HAW	03/03/1999	Thunderstorm Wind	55 kts.	0/0	0.00K
JACKSONVILLE	06/10/1999	Thunderstorm Wind	50 kts.	0/0	0.00K
JACKSONVILLE	07/24/1999	Thunderstorm Wind	50 kts.	0/0	0.00K
(NCA)MCAS NEW RIVER	11/02/1999	Thunderstorm Wind	52 kts.	0/0	0.00K
RICHLANDS	06/22/2000	Thunderstorm Wind	55 kts. E	0/0	0.00K
CATHERINE LAKE	04/01/2001	Thunderstorm Wind	56 kts. E	0/0	5.00K
HUBERT	04/01/2001	Thunderstorm Wind	61 kts. E	0/0	0.00K
SWANSBORO	08/28/2001	Thunderstorm Wind	52 kts. M	0/0	0.00K
HALF MOON	06/14/2002	Thunderstorm Wind	61 kts. E	0/0	10.00K
SNEADS FERRY	07/05/2002	Thunderstorm Wind	52 kts. M	0/0	0.00K
CAMP LEJEUNE	07/10/2002	Thunderstorm Wind	62 kts. E	0/0	20.00K
PINEY GREEN	07/10/2002	Thunderstorm Wind	62 kts. E	0/0	1.00K
BELGRADE	07/20/2002	Thunderstorm Wind	52 kts. E	0/0	0.00K
CAMP LEJEUNE	07/31/2002	Thunderstorm Wind	56 kts. M	0/0	0.00K
JACKSONVILLE	08/20/2002	Thunderstorm Wind	52 kts. E	0/0	0.00K
North Topsail Beach	11/12/2002	Thunderstorm Wind	52 kts. M	0/0	0.00K
SWANSBORO	11/12/2002	Thunderstorm Wind	54 kts. M	0/0	0.00K
JACKSONVILLE	02/22/2003	Thunderstorm Wind	50 kts. EG	0/0	0.00K
JACKSONVILLE	07/17/2003	Thunderstorm Wind	50 kts. EG	0/0	0.00K
HUBERT	07/09/2004	Thunderstorm Wind	50 kts. EG	0/0	1.00K
JACKSONVILLE	07/11/2004	Thunderstorm Wind	50 kts. EG	0/0	0.00K
RICHLANDS	03/08/2005	Thunderstorm Wind	50 kts. EG	0/0	25.00K
SWANSBORO	03/08/2005	Thunderstorm Wind	53 kts. MG	0/0	10.00K
JACKSONVILLE	07/28/2005	Thunderstorm Wind	50 kts. EG	0/0	0.00K
CAMP LEJEUNE	08/23/2005	Thunderstorm Wind	51 kts. EG	0/0	0.00K
CAMP LEJEUNE	04/17/2006	Thunderstorm Wind	52 kts. MG	0/0	0.00K
JACKSONVILLE	05/26/2006	Thunderstorm Wind	50 kts. EG	0/0	0.00K
RICHLANDS	05/26/2006	Thunderstorm Wind	60 kts. EG	0/0	50.00K

SWANSBORO	06/03/2006	Thunderstorm Wind	50 kts. EG	0/0	0.00K
HUBERT	07/15/2006	Thunderstorm Wind	51 kts. EG	0/0	0.00K
HALF MOON	07/23/2006	Thunderstorm Wind	51 kts. EG	0/0	0.00K
GREGORY FORKS	03/04/2008	Thunderstorm Wind	50 kts. EG	0/0	0.00K
HUBERT	03/05/2008	Thunderstorm Wind	50 kts. EG	0/0	0.00K
SHELL ROCK LNDG	03/05/2008	Thunderstorm Wind	68 kts. MG	0/0	0.00K
ERVINTOWN	04/12/2008	Thunderstorm Wind	50 kts. EG	0/0	0.00K
BELL FORK	06/01/2008	Thunderstorm Wind	52 kts. EG	0/0	0.00K
CATHERINE LAKE	06/29/2008	Thunderstorm Wind	50 kts. EG	0/0	0.00K
CAMP LEJEUNE JCT	06/29/2008	Thunderstorm Wind	52 kts. EG	0/0	0.00K
FRANKTOWN	06/29/2008	Thunderstorm Wind	60 kts. EG	0/0	5.00K
MORTON FORK	06/13/2009	Thunderstorm Wind	50 kts. EG	0/0	0.00K
HOLLY RIDGE	06/26/2009	Thunderstorm Wind	50 kts. EG	0/0	0.00K
KELLUM	07/17/2009	Thunderstorm Wind	50 kts. EG	0/0	0.00K
ERVINTOWN	08/11/2009	Thunderstorm Wind	50 kts. EG	0/0	0.00K
GREGORY FORKS	05/16/2010	Thunderstorm Wind	50 kts. EG	0/0	0.00K
ERVINTOWN	05/16/2010	Thunderstorm Wind	50 kts. EG	0/0	0.00K
MIDWAY PARK	06/13/2010	Thunderstorm Wind	50 kts. EG	0/0	0.00K
ERVINTOWN	06/16/2010	Thunderstorm Wind	63 kts. MG	0/0	0.00K
HALF MOON	06/29/2010	Thunderstorm Wind	50 kts. EG	0/0	0.00K
GREGORY FORKS	06/29/2010	Thunderstorm Wind	50 kts. EG	0/0	0.00K
NORTH TOPSAIL BEACH	07/18/2010	Thunderstorm Wind	50 kts. EG	0/0	0.00K
RICHLANDS	04/05/2011	Thunderstorm Wind	50 kts. EG	0/0	0.40K
GREGORY FORKS	04/05/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
ONSLOW CO.	06/17/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
ONSLOW CO.	06/23/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
JCKSNVLL ELLIS ARPT	07/23/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
(NCA)MCAS NEW RIVER	07/24/2011	Thunderstorm Wind	59 kts. MG	0/0	0.00K
PUMPKIN CENTER	07/24/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
KELLUM	07/24/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
BELL FORK	07/24/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
KELLUMTOWN	07/24/2011	Thunderstorm Wind	50 kts. EG	0/0	0.00K
GUM BRANCH	05/22/2012	Thunderstorm Wind	50 kts. EG	0/0	0.00K
ERVINTOWN	07/01/2012	Thunderstorm Wind	50 kts. EG	0/0	0.00K
(OAJ)ELLIS FLD JACKS	07/01/2012	Thunderstorm Wind	50 kts. EG	0/0	0.00K
HAWKSIDE	07/01/2012	Thunderstorm Wind	50 kts. EG	0/0	0.00K
(NCA)MCAS NEW RIVER	07/01/2012	Thunderstorm Wind	54 kts. MG	0/0	0.00K

BELL FORK	07/24/2012	Thunderstorm Wind	50 kts. EG	0/0	0.00K
TAR LNDG	01/31/2013	Thunderstorm Wind	50 kts. EG	0/0	0.00K
WILLIS LNDG	11/26/2013	Thunderstorm Wind	55 kts. EG	0/0	10.00K
JARMANTOWN	02/21/2014	Thunderstorm Wind	50 kts. EG	0/0	0.00K
BELL FORK	04/30/2014	Thunderstorm Wind	52 kts. EG	0/0	0.50K
BELL FORK	04/30/2014	Thunderstorm Wind	52 kts. EG	0/0	0.00K
Totals:				0/0	157.90K

According to the National Climatic Data Center there have been 160 hail events in Onslow County that documented hail of .75 inches in diameter or larger. The largest recorded hailstone in Onslow County is 2.75 inches in diameter. No causalities or damages were reported from these events. Standard sizes for Onslow County are the size of a penny or a nickel. Table 4.5 lists historical occurrences of hail events in Onslow County. Figure 4.5 shows recorded occurrences of hail throughout Onslow County.

Table 4.5: Hail Occurrences in Onslow County

Location	Date	Type	Magnitude	Death/ Injury	Property Damages (2014 dollars)
Totals:				0	0.00K
Onslow County	06/23/1974	Hail	0.75 in.	0	0.00K
Onslow County	04/26/1978	Hail	0.75 in.	0	0.00K
Onslow County	08/21/1979	Hail	1.75 in.	0	0.00K
Onslow County	05/19/1981	Hail	1.75 in.	0	0.00K
Onslow County	03/21/1983	Hail	0.75 in.	0	0.00K
Onslow County	03/21/1983	Hail	0.75 in.	0	0.00K
Onslow County	06/15/1984	Hail	1.75 in.	0	0.00K
Onslow County	09/15/1984	Hail	1.75 in.	0	0.00K
Onslow County	05/25/1986	Hail	1.75 in.	0	0.00K
Onslow County	05/10/1988	Hail	1.75 in.	0	0.00K
Onslow County	04/27/1989	Hail	1.75 in.	0	0.00K
Onslow County	05/20/1990	Hail	1.00 in.	0	0.00K
Onslow County	06/21/1992	Hail	2.50 in.	0	0.00K
Onslow County	06/21/1992	Hail	1.75 in.	0	0.00K
Richlands	03/24/1993	Hail	0.75 in.	0	0.00K
Holly Ridge	05/15/1995	Hail	0.75 in.	0	0.00K
SNEADS FERRY	05/06/1996	Hail	0.75 in.	0	0.00K
Jacksonville	07/03/1996	Hail	0.75 in.	0	0.00K
Jacksonville	07/03/1996	Hail	1.00 in.	0	0.00K

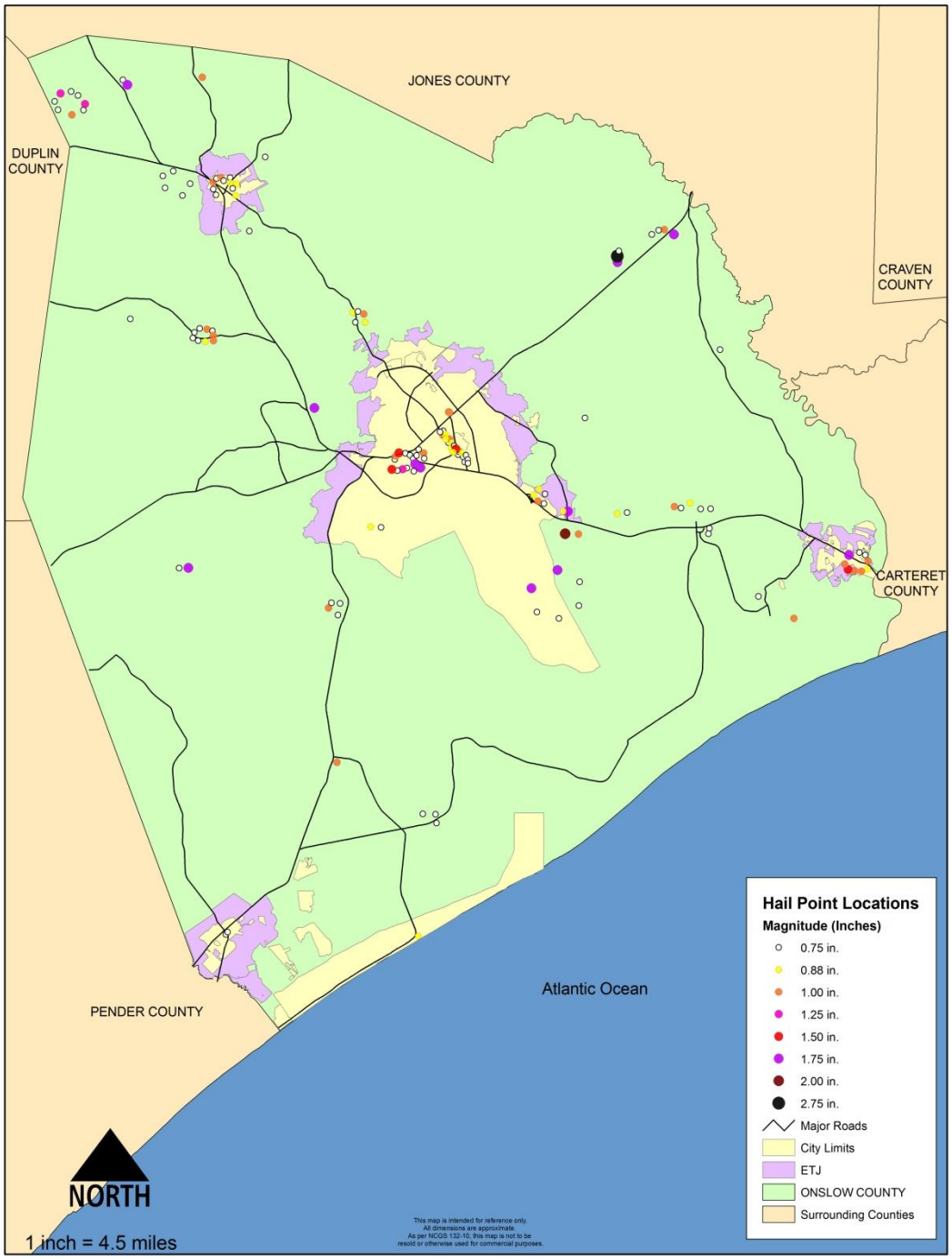
Jacksonville	07/28/1996	Hail	1.50 in.	0	0.00K
Richlands	04/21/1997	Hail	1.00 in.	0	0.00K
Deppe	04/21/1997	Hail	1.75 in.	0	0.00K
Deppe	04/21/1997	Hail	2.75 in.	0	0.00K
Richlands	05/13/1997	Hail	0.75 in.	0	0.00K
Jacksonville	07/05/1997	Hail	0.75 in.	0	0.00K
Catherine Lake	08/05/1997	Hail	1.00 in.	0	0.00K
Jacksonville	05/04/1998	Hail	0.75 in.	0	0.00K
Jacksonville	05/04/1998	Hail	0.75 in.	0	0.00K
Sneads Ferry	05/04/1998	Hail	0.75 in.	0	0.00K
Holly Ridge	05/08/1998	Hail	0.75 in.	0	0.00K
Bear Creek	05/27/1998	Hail	0.75 in.	0	0.00K
Swansboro	05/27/1998	Hail	0.75 in.	0	0.00K
Richlands	06/23/1998	Hail	1.00 in.	0	0.00K
Jacksonville	06/23/1998	Hail	1.75 in.	0	0.00K
Camp Lejeune	06/23/1998	Hail	1.75 in.	0	0.00K
Verona	02/28/1999	Hail	0.75 in.	0	0.00K
Halfmoon	08/11/1999	Hail	0.88 in.	0	0.00K
Sneads Ferry	04/18/2000	Hail	0.75 in.	0	0.00K
Richlands	05/28/2000	Hail	0.75 in.	0	0.00K
Verona	08/13/2000	Hail	0.75 in.	0	0.00K
Swansboro	08/13/2000	Hail	0.75 in.	0	0.00K
Haw Branch	04/01/2001	Hail	0.75 in.	0	0.00K
(OAJ)ELLIS FLD JACKS	04/01/2001	Hail	0.75 in.	0	0.00K
Catherine Lake	04/01/2001	Hail	0.75 in.	0	0.00K
Jacksonville	04/01/2001	Hail	1.75 in.	0	0.00K
Haw Branch	05/12/2001	Hail	1.25 in.	0	0.00K
Richlands	05/20/2001	Hail	0.75 in.	0	0.00K
Haw Branch	05/26/2001	Hail	0.75 in.	0	0.00K
Jacksonville	05/28/2001	Hail	0.75 in.	0	0.00K
Camp Lejeune	07/06/2001	Hail	0.75 in.	0	0.00K
Richlands	06/14/2002	Hail	0.88 in.	0	0.00K
Haw Branch	07/10/2002	Hail	0.75 in.	0	0.00K
Haw Branch	08/19/2002	Hail	1.25 in.	0	0.00K
Richlands	03/06/2003	Hail	0.88 in.	0	0.00K
Catherine Lake	04/30/2003	Hail	1.00 in.	0	0.00K
Belgrade	07/17/2003	Hail	1.00 in.	0	0.00K

Richlands	06/11/2004	Hail	0.75 in.	0	0.00K
Piney Green	07/11/2004	Hail	1.75 in.	0	0.00K
Jacksonville	10/13/2004	Hail	0.75 in.	0	0.00K
NORTH TOPSAIL BEACH	05/24/2005	Hail	0.88 in.	0	0.00K
Camp Lejeune	08/03/2005	Hail	0.75 in.	0	0.00K
Camp Lejeune	08/16/2005	Hail	0.75 in.	0	0.00K
Jacksonville	04/03/2006	Hail	1.25 in.	0	0.00K
(NCA)MCAS NEW RIVER	04/17/2006	Hail	0.75 in.	0	0.00K
Swansboro	04/17/2006	Hail	1.00 in.	0	0.00K
Jacksonville	05/26/2006	Hail	0.75 in.	0	0.00K
Jacksonville	05/26/2006	Hail	1.50 in.	0	0.00K
Catherine Lake	06/03/2006	Hail	1.00 in.	0	0.00K
Camp Lejeune	06/05/2006	Hail	0.75 in.	0	0.00K
Swansboro	06/05/2006	Hail	0.88 in.	0	0.00K
Jacksonville	06/06/2006	Hail	0.75 in.	0	0.00K
Piney Green	06/06/2006	Hail	0.75 in.	0	0.00K
Swansboro	06/06/2006	Hail	1.00 in.	0	0.00K
Camp Lejeune	06/06/2006	Hail	1.75 in.	0	0.00K
HUBERT	06/06/2006	Hail	0.75 in.	0	0.00K
Richlands	06/12/2006	Hail	0.88 in.	0	0.00K
Jacksonville	06/28/2006	Hail	1.00 in.	0	0.00K
Richlands	06/28/2006	Hail	1.00 in.	0	0.00K
Jacksonville	06/30/2006	Hail	0.75 in.	0	0.00K
Jacksonville	07/29/2006	Hail	0.75 in.	0	0.00K
HUBERT	08/05/2006	Hail	0.75 in.	0	0.00K
Haw Branch	06/05/2007	Hail	0.75 in.	0	0.00K
(NCA)MCAS NEW RIVER	06/05/2007	Hail	0.88 in.	0	0.00K
Bell Fork	06/05/2007	Hail	1.00 in.	0	0.00K
Bell Fork	06/05/2007	Hail	0.75 in.	0	0.00K
SKY MANOR ARPT	06/05/2007	Hail	1.75 in.	0	0.00K
CATHERINE LAKE	06/05/2007	Hail	0.88 in.	0	0.00K
ERVINTOWN	06/05/2007	Hail	0.75 in.	0	0.00K
MORTON FORK	06/12/2007	Hail	0.75 in.	0	0.00K
Belgrade	06/16/2007	Hail	0.75 in.	0	0.00K
Swansboro	04/21/2008	Hail	1.00 in.	0	0.00K
Swansboro	04/21/2008	Hail	1.50 in.	0	0.00K
Swansboro	04/21/2008	Hail	1.00 in.	0	0.00K

SKY MANOR ARPT	04/21/2008	Hail	0.75 in.	0	0.00K
ERVINTOWN	04/21/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/05/2008	Hail	0.88 in.	0	0.00K
MIDWAY PARK	05/05/2008	Hail	0.88 in.	0	0.00K
Bell Fork	05/05/2008	Hail	0.75 in.	0	0.00K
KELLUMTOWN	05/05/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/05/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/05/2008	Hail	0.75 in.	0	0.00K
Catherine Lake	05/05/2008	Hail	0.75 in.	0	0.00K
ERVINTOWN	05/10/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/10/2008	Hail	1.00 in.	0	0.00K
Halfmoon	05/10/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/10/2008	Hail	0.75 in.	0	0.00K
HUBERT	05/10/2008	Hail	0.75 in.	0	0.00K
Haw Branch	05/11/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/11/2008	Hail	0.88 in.	0	0.00K
PALO ALTO	05/11/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/11/2008	Hail	0.88 in.	0	0.00K
Bell Fork	05/11/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/11/2008	Hail	0.88 in.	0	0.00K
MIDWAY PARK	05/11/2008	Hail	0.75 in.	0	0.00K
MIDWAY PARK	05/11/2008	Hail	0.88 in.	0	0.00K
CATHERINE LAKE	05/20/2008	Hail	0.75 in.	0	0.00K
Bell Fork	05/20/2008	Hail	0.75 in.	0	0.00K
Verona	05/20/2008	Hail	0.75 in.	0	0.00K
Bell Fork	06/01/2008	Hail	0.75 in.	0	0.00K
Bell Fork	06/01/2008	Hail	0.75 in.	0	0.00K
KELLUMTOWN	06/01/2008	Hail	0.88 in.	0	0.00K
MIDWAY PARK	06/01/2008	Hail	1.00 in.	0	0.00K
Bell Fork	06/01/2008	Hail	0.75 in.	0	0.00K
Bell Fork	06/29/2008	Hail	1.50 in.	0	0.00K
Camp Lejeune	06/29/2008	Hail	2.00 in.	0	0.00K
Bell Fork	06/29/2008	Hail	0.88 in.	0	0.00K
Halfmoon	06/29/2008	Hail	1.00 in.	0	0.00K
HUBERT	07/21/2008	Hail	0.88 in.	0	0.00K
Belgrade	10/01/2008	Hail	0.75 in.	0	0.00K
Belgrade	06/13/2009	Hail	1.75 in.	0	0.00K

Belgrade	06/13/2009	Hail	0.75 in.	0	0.00K
Deppe	06/13/2009	Hail	0.75 in.	0	0.00K
Catherine Lake	07/23/2009	Hail	0.75 in.	0	0.00K
Catherine Lake	07/24/2009	Hail	0.75 in.	0	0.00K
GUM BRANCH	07/24/2009	Hail	0.75 in.	0	0.00K
Halfmoon	07/24/2009	Hail	0.88 in.	0	0.00K
Verona	07/24/2009	Hail	0.88 in.	0	0.00K
Halfmoon	07/24/2009	Hail	0.75 in.	0	0.00K
MIDWAY PARK	07/24/2009	Hail	0.75 in.	0	0.00K
JARMANTOWN	08/05/2009	Hail	0.75 in.	0	0.00K
ERVINTOWN	08/05/2009	Hail	0.75 in.	0	0.00K
TAR LNDG	10/13/2010	Hail	1.00 in.	0	0.00K
Onslow County	06/29/2011	Hail	0.75 in.	0	0.00K
Onslow County	06/29/2011	Hail	0.88 in.	0	0.00K
HAWKSIDE	07/24/2011	Hail	0.88 in.	0	0.00K
HAWKSIDE	07/24/2011	Hail	1.00 in.	0	0.00K
Camp Lejeune	08/12/2011	Hail	1.00 in.	0	0.00K
ERVINTOWN	09/30/2011	Hail	0.75 in.	0	0.00K
Haw Branch	02/24/2012	Hail	1.00 in.	0	0.00K
HAWKSIDE	03/25/2012	Hail	1.00 in.	0	0.00K
BROCKS	03/30/2012	Hail	0.75 in.	0	0.00K
HUFFMANTOWN	03/30/2012	Hail	1.00 in.	0	0.00K
Bell Fork	05/05/2012	Hail	0.88 in.	0	0.00K
JARMANTOWN	07/01/2012	Hail	1.75 in.	0	0.00K
STARLING	03/22/2014	Hail	0.75 in.	0	0.00K
DIXON	03/22/2014	Hail	1.00 in.	0	0.00K
STARLING	03/22/2014	Hail	1.75 in.	0	0.00K
HUBERT	03/22/2014	Hail	1.00 in.	0	0.00K
SHELL ROCK LNDG	03/22/2014	Hail	0.75 in.	0	0.00K
Swansboro	03/22/2014	Hail	1.75 in.	0	0.00K
Totals:				0	0.00K

Figure 4.5: Hail Occurrences in Onslow County



4.3.4. Probability of Future Occurrences

Given the history of occurrences and the natural climatic patterns around Southeastern North Carolina the probability of future occurrences for severe thunderstorm events in Onslow County is high. This will result in the probability of future hail occurrences in Onslow County remaining high.

4.4.Hurricane & Coastal Storm (includes Nor'easter)

4.4.1. Background

Hurricanes, coastal storms and Nor'easter are all forms of cyclones. Hurricanes and coastal storms are a tropical cyclone that is a rotating, organized system of cloud and thunderstorms that originate in tropical or subtropical waters and have closed low-level circulation. Tropical cyclones in the northern hemisphere rotate counterclockwise. Tropical cyclones are warm-core, low pressure systems that thrive on the warmer airs and warmer waters. There are four primary types of tropical cyclones:

- Tropical Depression – max sustained winds of 38mph or less
- Tropical Storm – max sustained winds of 39-73mph
- Hurricane – max sustained winds of 74mph and higher.
- Major Hurricane – max sustained winds of 111mph or higher. (Category 3, 4 and 5).

A Nor'easter is a form of a cyclone that forms, typically, along the upper East Coast of the United States and Canada. Nor'easters also rotate counterclockwise. Nor'easters differ from tropical cyclones in that nor'easters are cold-core, low pressure systems, meaning they thrive on colder temperatures and waters.

The primary damaging forces associated with these types of storms include high-level sustained winds, heavy precipitation, tornadoes, storm surge, coastal erosion, and flooding. Nor'easters may also include snow and blizzard conditions due to the colder air temps.

Hurricane seasons runs from June 1 until November 30th each year. The peak period for named storms runs from around mid-August until late October. The key

Tropical cyclones can develop in the Gulf of Mexico, the Caribbean Sea, the Pacific and Atlantic Oceans. They are born in moist tropical air. About every four to five days, a tropical wave of low pressure moves along with westerly winds. In developing tropical cyclones, strong thunderstorms occur. Air pressure drops at the surface of these storms. This low pressure attracts warm moist air from the ocean's surface. The Coriolis force causes the resulting low-level winds to spiral in a counterclockwise direction around the center of the low in the Northern Hemisphere. Sinking air at the center clears the tropical cyclone of clouds and forms the "eye", but an eye is not necessary for a tropical cyclone to become a hurricane. Falling surface pressure can occur only if air mass is removed from the circulation center. This is accomplished by wind flowing away from the circulation in the upper atmosphere.

When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale (Table 4.6) which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

Table 4.6: Saffir-Simpson Hurricane Wind Scale (2012 revision)

Storm Category	Sustained Winds	Damage Level	Types of Damages
1	74-95 mph 64-82 kt	MINIMAL	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt	MODERATE	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129 mph 96-112 kt	EXTENSIVE	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130-156 mph 113-136 kt	EXTREME	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months
5	157 mph+ 137 kt +	CATASTROPHIC	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 categorization based on the hurricane's intensity at the indicated time. The scale – originally developed by wind engineer Herb Saffir and meteorologist Bob Simpson. The scale provides examples of the type of damage and impacts in the United States associated with winds of the indicated intensity. In general, damage rises by about a factor of four for every category increase. The maximum sustained surface wind speed associated with the cyclone is the determining factor in the scale. The 2012 revision to the scale was designed to help reduce public confusion about the impacts associated with the various hurricane categories as well as to provide a more scientifically defensible scale. As a result, the storm surge ranges, flooding impact and central pressure statements were removed from the scale and only peak winds were employed.

As mentioned above a Nor'easter is a type of cyclone that forms in the north eastern area of North America. These storms can cause similar damages to the tropical cyclones and are most notably different because of their snowfall amounts and the time of year. There are two main components of the Nor'easter: 1) a Gulf-Stream low pressure system that gathers warm air and moisture and is pulled up the coast by the northeasterly winds of the storm and 2) an Arctic high-pressure system that brings in cold, arctic air blowing down from Canada. Nor'easters tend to be much larger in scale than hurricanes and also much slower. With prolonged increased winds speeds and stronger surfs coastline damages are a greater concern. The most common categorical scale used to describe Nor'easters is the Dolan-Davis Nor'Easter Intensity Scale as seen below in Table 4.7.

Table 4.7: Dolan-Davis Nor'easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Over wash	Property Damage
1 (Weak)	Minor changes	None	No	No
2 (Moderate)	Modest; mostly to lower beach	Minor	No	Modest
3 (Significant)	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 (Severe)	Severe beach erosion/ recession	Severe dune erosion/ destruction	On low beaches	Loss of many structures at community-scale
5 (Extreme)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of $

Source: NC Division of Emergency Management, Local Hazard Mitigation Planning Manual

4.4.2. Location and Spatial Extent

Hurricanes and coastal storms threaten the entire Eastern Coast and Gulf Coast region of North America. Coastal areas are most directly exposed to the dangers of these types of storms however, depending on the diameter and the track of the storm, their impacts may be felt quite far inland. Onslow County is situated along the coast of North Carolina and will remain susceptible to the hazards of hurricanes, coastal storms and Nor'easters. All jurisdictions and areas of the county will be at risk to hazards such as flooding, tornadoes, and wind damage however only the coastal areas will be susceptible to storm surge, wave action and coastal erosion.

4.4.3. Historical Occurrences

North Carolina has had an extensive hurricane history dating back to colonial times. During the nineteenth century, storms occurred in 1837, 1846, 1856, 1879, 1883, and 1899. During the 1950s, the State was ravaged by several hurricanes, including Hazel, Connie, Diane, and Ione. The years 1960 thru 1990 saw a decrease in land falling hurricanes, with the exception of Hurricane Donna in 1960. The last decade has seen Hurricanes Hugo (1989), Emily (1993), Opal (1995), Bertha (1996), Fran (1996), Bonnie (1998), Dennis (1999), Floyd (1999), Irene (1999), Isabel (2003), Alex (2004), and Ophelia (2005), all leaving their mark on the State. However, these storms had varying impacts on Onslow County. Hurricanes passing thru Onslow County have produced floods as well as extensive structural damage. The following table provides a brief description of several hurricanes, which significantly impacted Onslow County.

According to NOAA historical track records, 104 hurricanes or tropical storm tracks have passed within a 75 mile radius of Jacksonville and Onslow County since 1842. This includes no (0) category 5, two (2) category 4, five (5) category 3, eleven (11) category 2, twenty-six (26) category 1, fifty-one (51) tropical storms and one (1) sub-tropical storm. Of the 104 recorded events 16 were direct hits in Onslow County and 24 have passed through Onslow County resulting in approximately $611 million in property damages and $56 million in crop damages (in 2014 dollars). Table 4.8 provides the historical occurrences of hurricanes and coastal storms providing name (if available), date, category, and max winds speeds (as recorded within 75 miles of Onslow County). Figure 4.6 provides a visual track of each of these storms in relation to Onslow County.

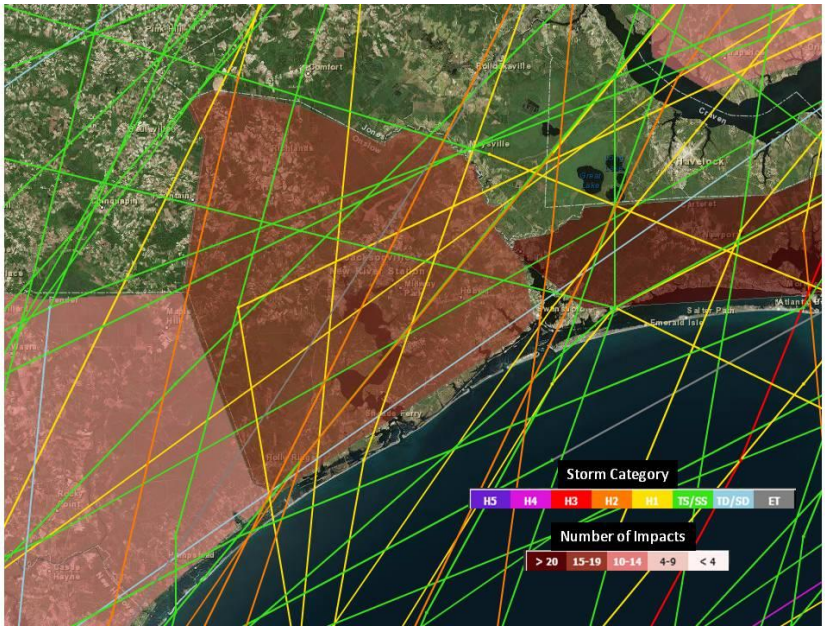
Table 4.8: Significant Hurricane History Storm Tacks within 75 Miles of Onslow County (1848-2014)

Name of Storm	Date of Occurrence	Storm Category	Max Wind Speeds (kts)
Not Named	8/25/1851	Tropical Storm	40
Not Named	08/28/1852	Tropical Storm	40
Not Named	10/10/1852	Tropical Storm	50
Not Named	08/19/1856	Tropical Storm	50
Not Named	09/01/1856	Tropical Storm	50
Not Named	09/13/1857	Category 2	90
Not Named	09/27/1861	Category 1	70
Not Named	11/02/1861	Category 1	70
Not Named	09/18/1863	Tropical Storm	60
Not Named	10/24/1872	Category 1	70
Not Named	09/28/1874	Category 1	80
Not Named	09/17/1876	Category 1	80
Not Named	10/11/1878	Tropical Storm	50
Not Named	10/23/1878	Category 2	90
Not Named	08/18/1879	Category 3	100
Not Named	09/09/1880	Category 1	70
Not Named	09/09/1881	Category 1	80
Not Named	09/22/1882	Tropical Storm	60
Not Named	10/12/1882	Category 1	70
Not Named	09/11/1883	Category 1	70
Not Named	08/25/1885	Category 1	80
Not Named	10/11/1888	Tropical Storm	60
Not Named	06/16/1893	Tropical Storm	50
Not Named	10/04/1893	Tropical Storm	40
Not Named	09/27/1894	Tropical Storm	60
Not Named	10/09/1894	Tropical Storm	60
Not Named	09/22/1897	Tropical Storm	60
Not Named	07/11/1901	Tropical Storm	40
Not Named	09/18/1901	Tropical Storm	35
Not Named	07/30/1908	Category 1	70
Not Named	09/01/1908	Tropical Storm	45
Not Named	10/20/1910	Tropical Storm	60
Not Named	09/03/1913	Category 1	75
Not Named	05/16/1916	Tropical Storm	35
Not Named	09/06/1916	Tropical Storm	45
Not Named	08/24/1918	Category 1	65
Not Named	09/18/1928	Tropical Storm	60
Not Named	09/15/1932	Tropical Storm	35
Not Named	08/01/1944	Category 1	80
Not Named	06/05/1945	Tropical Storm	60
Not Named	07/05/1946	Tropical Storm	40
Hazel	10/15/1954	Category 3	110
Connie	08/11/1955	Category 2	90
Diane	08/17/1955	Category 1	75
Ione	09/19/1955	Category 3	100
Helene	09/27/1958	Category 4	115
Brenda	07/30/1960	Tropical Storm	50
Donna	09/12/2960	Category 2	95

Not Named	09/14/1961	Tropical Storm	35
Dora	09/13/1964	Tropical Storm	45
Isabell	10/16/1964	Category 1	80
Not Named	06/16/1965	Tropical Storm	40
Gladys	10/19/1968	Category 1	75
Doria	08/27/1971	Tropical Storm	55
Ginger	09/30/1971	Category 1	75
Agnes	06/21/1972	Tropical Storm	40
Dennis	08/20/1981	Tropical Storm	55
Diana	09/12/1984	Category 4	115
Kate	11/22/1985	Tropical Storm	50
Charley	08/17/1986	Category 1	65
Arthur	06/19/1996	Tropical Storm	40
Bertha	07/12/1996	Category 2	90
Fran	09/05/1996	Category 3	100
Bonnie	08/26/1998	Category 3	100
Dennis	08/30/1999	Category 2	90
Floyd	09/16/1999	Category 2	90
Helene	09/23/2000	Tropical Storm	35
Kyle	10/11/2002	Tropical Storm	35
Charley	08/14/2004	Category 1	65
Ophelia	09/14/2005	Category 1	75
Ernesto	08/31/2006	Tropical Storm	60
Gabrielle	09/09/2007	Tropical Storm	50
Cristobal	07/19/2008	Tropical Storm	45
Hanna	09/06/2008	Tropical Storm	60
Irene	08/27/2011	Category 1	75
Arthur	07/03/2014	Category 2	100

Source: National Oceanic and Atmospheric Administration, National Coastal Services Center

Figure 4.6: Historical Storm Tracks in Onslow County



Source: National Oceanic and Atmospheric Administration, National Coastal Services Center

Some of the more notable hurricanes to impact Onslow County are:

- July 12, 1996: Hurricane Bertha

The eye of Bertha passed 12 miles west of downtown Jacksonville making a northward track through the western portions of Onslow County. Berth caused approximately $42 million in damges and resulted in one fatality and 10 storm related injuries. Most wind measurements were around 90-99mph with gusts of 108mph recorded at MCAS New River. Damages in Onslow County included storm surge, flooding, beach erosion, roof damage, and fallen trees. Heaviest damage was in Topsail Beach and Onslow County where 199 structures were destroyed (117 of which were mobile homes). Rainfall of up to 14 inches was reported at Hoffman Forest, also just east of where the center made landfall.

- September 5, 1996: Hurricane Fran

The eye of Hurricane Fran passed within 43 miles of Jacksonville, NC and brought hurricane force winds to all of Onslow County. Storm surges of 10-12 feet and winds over 100mph recorded at North Topsail Beach. Approximately 90% of the homes on North Topsail Beach were damaged or destroyed. Damages in Onslow County exceeded $500 million and over 6,688 structures were damaged or destroyed countywide. A total of 409 business and 4,926 homes were included in these damages. Damages to schools totaled approximately $1.6 million. Dune erosion ranged from 5-20 feet along the North Carolina coastline. Torrential rains resulted in flooding throughout Onslow County with over 1 foot of water on Highway 24 in Richlands. Many bridges in the county suffered damages as a result. Some notable facts (*NC Emergency Management)*:

- Debris removal costs: $15 million
- Agricultural losses: $35 million
- Forestry losses: $30 million
- Temporary housing payments: $3,317 (2,034 applicants)
- Individual/family grants: $$2,048,317 (739 applicants)
- SBA Loans: $$13,214,500 (478 applicants)
- Public Assistance: $17,229,596 (193 applicants)
- Economic impact: $347 million
- Deaths: 4
- Injuries: 4

- August 26, 1998: Hurricane Bonnie

The eye of slow-moving Hurricane Bonnie made landfall at Cape Fear during the late afternoon and moved up the coast, with the stronger east side of the storm remaining offshore. Wind gusts were generally around 100 MPH along the coast and lighter inland. At the Wilmington Airport, gusts reached 62 MPH. Rainfall amounts were around 11 inches, causing ponding of water and flooding across county. Storm surge was 7 to 9 feet, with most barrier island overwash from the sound side, not the ocean side. A Federal Disaster was declared. Onslow County had approximately $2 million in damages.

- September 15, 1999: Hurricane Floyd

Hurricane Floyd, with wind gusts around 100 mph, affected five North Carolina counties, causing downed trees and power outages. The eye of the hurricane passed directly over Onslow County passing within 1 mile of downtown Jacksonville. Ocean storm surge was 9 to 10 feet, inundating barrier islands and causing extensive dune erosion on North Topsail Beach. Record rainfall distinguished Floyd – with Jacksonville receiving around 8.26", causing widespread flooding.

- September 18, 2003: Hurricane Isabel

The eye of Hurricane Isabel passed within 75 miles of downtown Jacksonville however, the hurricane force winds extended out to almost 90 miles from the center track of the storm. The storm had a northwest track making landfall in Drum Inlet in Carteret County placing the entire north eastern portion of Onslow County within the hurricane force winds.

- September 14, 2005: Hurricane Ophelia

At 11:00 am on September 14th, Category 1 Ophelia was centered about 25 miles southeast of Cape Fear. The storm mainly affected Brunswick, Pender, and New Hanover counties. The large eyewall (50 miles in diameter) however, allowed hurricane force winds to grave North Topsail Beach. There were unofficial reports of wind gusts to 75mph on North Topsail Beach. Average rainfall over Onslow County was around 5.2 inches. Damage over the area was mainly minor roof damage and flooding. Cosmetic and minor damage to beach homes was reported throughout the affected area. Beach erosion was also a problem. Damage to the area and the cost for clean up would be approximately $35 million, primary for removing debris.

- August 24, 2011: Hurricane Irene

Irene made landfall near Cape Lookout, North Carolina with an intensity of 75 kt, producing category 1 hurricane-force winds within a swath primarily to the east of the center over the North Carolina sounds and the Outer Banks. Hurricane forces winds extended 43 miles from the center of the track and the eye passed within 50 miles of downtown Jacksonville. Storm surges were recorded at around 4 foot in Surf City, NC and wind gusts of 50-60mph. A total of approximately 12 inches of rainfall was recorded. A total of 635 residences and 10 businesses suffered damages. There was approximately $17 million in damages to agriculture and about 233,000 cubic yards of debris costing around $2.8 million to remove. Countywide, including the municipalities' damages to government property totaled around $2.5 million. The total cost of the storm in Onslow County was approximately $29 million (2011 dollars). Onslow County had 1 reported death as a secondary result of the storm.

Analysis of nor'easter frequency by researchers reveals fewer nor'easters during the 1980s. However, the frequency of major nor'easters (class 4 and 5 on the Dolan-Davis scale) has increased in recent years. In the period 1987 to 1993, at least one class 4 or 5 storm has occurred each year along the Atlantic seaboard of the United States, a situation duplicated only once in the last 50 years.

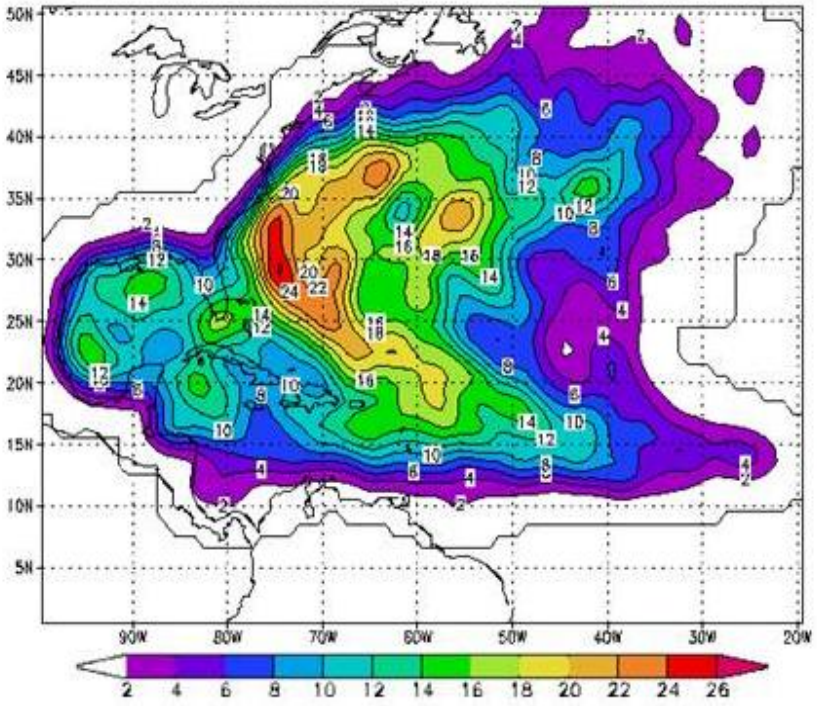
A number of notable nor'easters have impacted North Carolina in recent decades, including the Ash Wednesday Storm of March 1962, but they were typically only of local concern. One exception to this was the nor'easter of late October and early November 1990, which loosened a dredge barge that struck and destroyed approximately five roadway segments of the Bonner Bridge in Dare County. Another Nor'easter struck the Outer Banks on Halloween, 1991, causing substantial beach erosion.

4.4.4. Probability of Future Occurrences

North Carolina's geographic location on the Atlantic Ocean and its proximity to the Gulf Stream makes it prone to hurricanes. In fact, North Carolina has experienced the fourth greatest number of hurricane landfalls of any State in the twentieth century (trailing Florida, Texas, and Louisiana). Figure 4.7 shows what the chance is that a tropical storm or hurricane will affect an area sometime during the Atlantic hurricane season. This illustration was created by the National Oceanic and Atmospheric Administration's Hurricane Research Division using data from 1944 to 1999 and counting hits when a storm or hurricane was within approximately 100 miles (165 km) of each location. According to this figure, Onslow County (located at approximately 34N, 77N) is in an area with an annual probability of a named storm between 36 and 48 percent.

Although nor'easters are more diffuse and less intense than hurricanes, they occur more frequently and cover larger areas and longer coastal reaches at one time. As a result, the likelihood of a Nor'easter occurring in Onslow County is much higher than that of a hurricane.

Figure 4.7: Empirical Probability of a Hurricane



Source: NOAA: National Hurricane Center

The National Hurricane Center, after studying the average impact rate over 100 years, developed a "rate of return" probability for hurricanes (>= 64kts). Based on the probability rating in a 100 year period Onslow County can expect a hurricane within 50 nautical miles of its coast 15 times, or a probability of return once every 7 years. These numbers are a probability and hurricanes can strike more often than once every seven years. The probability of storm occurrences will vary significantly based on the return interval for different categories of magnitude. The probability of less intense storms is higher than the more intense storms.

4.5.Tornado

4.5.1. Background

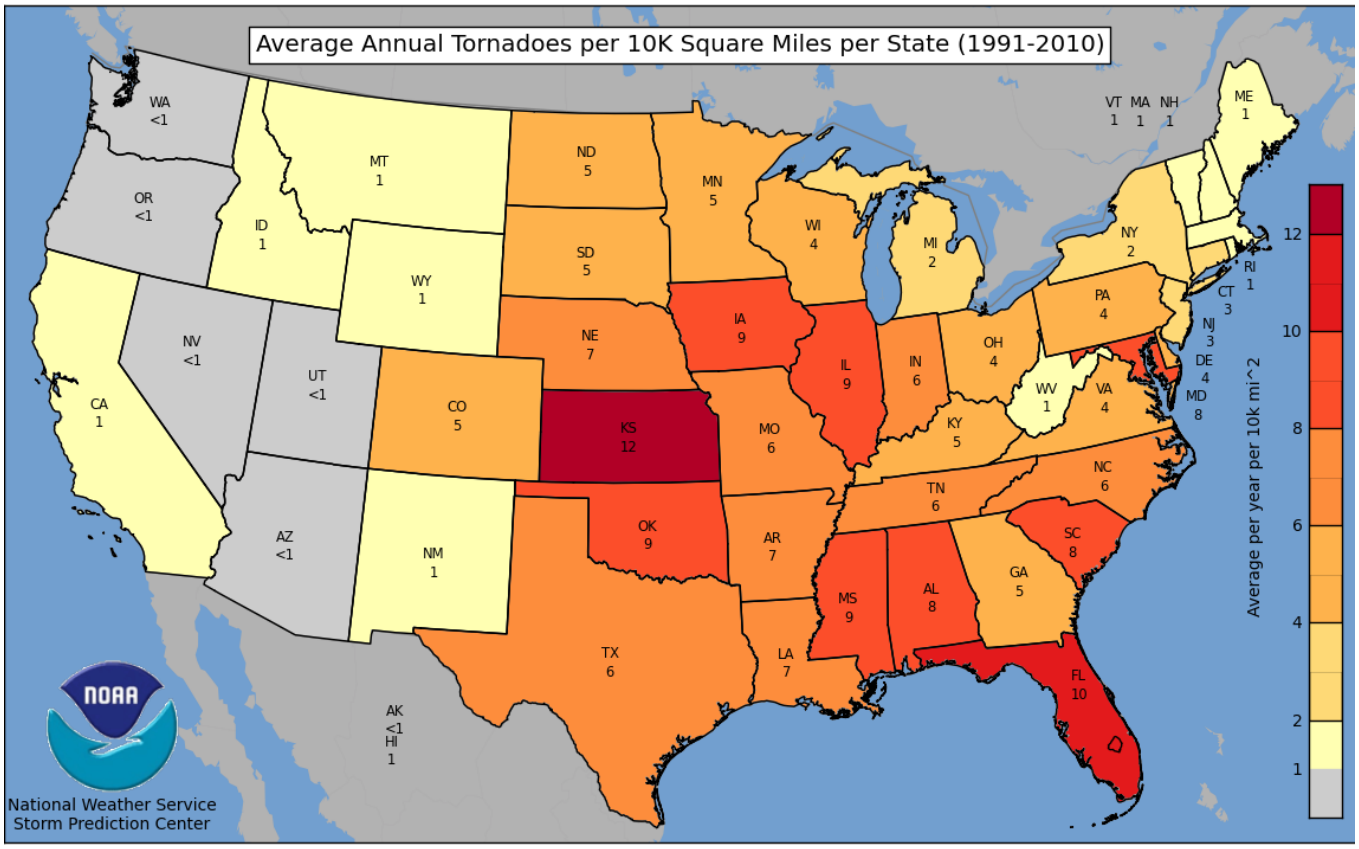
A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. It is hard to see a tornado until it forms condensation within the funnel made of water droplets, dust or debris. Tornadoes are the most violent of all atmospheric storms. While tornadoes occur throughout the world the United States averages around 1,200 a year, one of the highest concentrations in the world.

Tornados form primarily from supercell thunderstorms, those with well defined radar circulation. A rotating updraft is key to the development of the supercell and eventually the tornado itself. Often winds at ground level are slowed by friction while winds in the upper levels of the supercell move much faster. Rising air, often warm and moist, begins to develop the "tube" which then creates vertical rotation. This vertical updraft fed by the warm moist air can lead to the formation of the tornado. Tornadoes can also form in non-supercell thunderstorms, hurricanes and other coastal storms. The National Weather Service reports that on average only 20% of supercell storms will develop tornadic activity. Damages caused by tornadoes are usually the result of the high wind velocities and wind-blown debris. Lightening and hail usually accompany these storms and can also result in damages. While the National Weather Service's has methods of measure the winds, most often these are in the slower tornadoes. The highest radar motion detected was over 300mph.

On average, tornadoes kill about 60 people per year, mostly from falling or flying debris. According to the NOAA Storm Predication Center Oklahoma City has the highest concentration of tornado activity for a city and Kansas, Florida, Oklahoma, Iowa, and Illinois have the highest concentration for states. Figure 4.8 show an average annual tornado per year per 10,000 square miles per state. North Carolina, and Onslow County, is in an area that received approximately 1-6 tornadoes per average year.

Waterspouts are weak tornadoes that form over water and are most common along the Gulf Coats and Southeastern United States. Waterspouts will occasionally move inland, becoming a tornado that can cause damage and injury. Most waterspouts will dissipate over open water causing the highest threat to marine and boating interests. Typically, waterspouts are weak and short lived and most go unreported unless they cause damages.

Figure 4.8: Average Annual Tornadoes per 10K square miles per State



Source: National Weather Services, Storm Prediction Center

Peak tornado season in the Southeast is March through May and in the northern states it runs late spring through early summer. They can occur at any time of the day, but are most likely to occur between 3pm and 9pm. Structures of light construction, such as mobile homes, are at greatest risk for damages from tornadoes.

A tornado is reported by its magnitude according to the Enhanced Fujita Scale (EF Scale). The EF Scale became operational on February 1, 2007 replacing the original Fujita Scale. The scale assigns a "rating" based on estimated wind speeds and related damage. After a tornado occurs, field surveyors will compare a list of Damage Indicators (DI) and degrees of damage (DoD) to help estimate the range of wind speeds that were likely produced. Table 4.9 shows the Enhanced Fujita Scale with probable associated damages.

Table 4.9: Enhanced Fujita Scale

EF Scale Rating	3 Second Gust (mph)	Expected Types of Damages
0	65-85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
1	86-110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
2	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
3	136-165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in

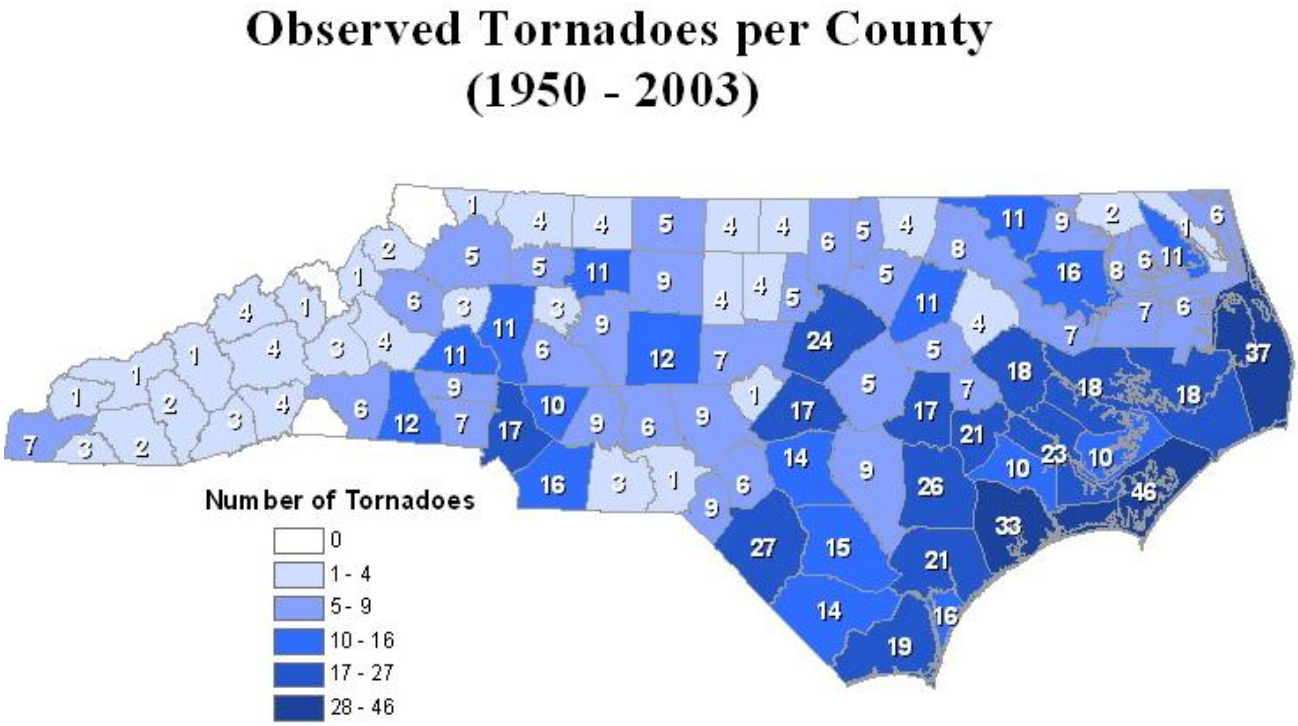
		forest uprooted.
4	166-200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
5	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Source: National Weather Service

4.5.2. Location and Spatial Extent

Tornadoes can occur throughout the state of North Carolina. When compared with other states North Carolina currently ranks 20th in the nation for number of tornado events and 17th for tornado fatalities. These figures were derived by FEMA for a 60 year study period running from 1950-2010. Figure 4.10 shows total tornado occurrences for all of North Carolina, by county, from 1950-2003. Onslow County has recorded a total of 33 tornadoes.

Figure 4.10: Tornado Occurrences in North Carolina by County



Source: State Climate Office of North Carolina

4.5.3. Historical Occurrences

According to the National Climatic Data Center there have been a total of 44 recorded tornadoes and 1 recorded waterspout in Onslow County since 1950. It is highly likely that small tornadoes and many waterspouts have gone unrecorded during this time period. Tornadoes have caused an estimated $15.42 million in damages and resulted in three deaths and 59 injuries. Table 4.9 provides of list of reported tornadoes and Table 4.10 provides a list of recorded waterspouts. The magnitudes of tornadoes are listed as F0-F5 for the original Fujitsu Scale (all tornadoes before February 1, 2007) and EF0-EF5 for the Enhanced Fujitsu Scale (all tornadoes after February 1, 2007). Figure 4.11 shows a visual representation of impact locations and their recorded magnitudes.

Table 4.9: Tornado Events in Onslow County

Location	Date	Magnitude	Death / Injuries	Property Damage
ONSLOW CO.	05/30/1955	F1	0/0	2.50K
ONSLOW CO.	08/01/1961	F1	0/0	250.00K
ONSLOW CO.	01/20/1963	F1	0/0	25.00K
ONSLOW CO.	05/20/1963	F1	0/0	2.50K
ONSLOW CO.	10/24/1972	F2	0/0	25.00K
ONSLOW CO.	06/27/1977	F0	0/0	0.25K
ONSLOW CO.	04/19/1978	F2	0/3	250.00K
ONSLOW CO.	03/14/1986	F0	0/0	25.00K
ONSLOW CO.	03/14/1986	F1	0/0	25.00K
ONSLOW CO.	07/02/1986	F2	3/10	250.00K
ONSLOW CO.	11/10/1987	F0	0/0	25.00K
ONSLOW CO.	06/09/1988	F1	0/2	2.500M
ONSLOW CO.	02/21/1989	F1	0/0	250.00K
ONSLOW CO.	06/29/1990	F0	0/0	0.00K
ONSLOW CO.	08/02/1991	F0	0/0	0.00K
ONSLOW CO.	08/02/1991	F1	0/1	0.00K
ONSLOW CO.	08/02/1991	F0	0/0	0.00K
ONSLOW CO.	08/18/1991	F0	0/0	0.00K
Sneads Ferry	10/28/1995	F0	0/0	5.00K
Camp Lejeune	10/28/1995	F0	0/0	50.00K
Hubert	10/28/1995	F0	0/0	0.50K
JACKSONVILLE	10/08/1996	F1	0/0	60.00K
DEPPE	04/21/1997	F0	0/0	0.00K
RICHLANDS	04/15/1999	F1	0/7	2.000M
SNEADS FERRY	09/15/1999	F0	0/0	0.00K
JACKSONVILLE	10/17/1999	F0	0/0	0.00K
RICHLANDS	03/16/2000	F0	0/0	20.00K
CATHERINE LAKE	05/21/2000	F0	0/0	0.00K
JACKSONVILLE	02/22/2003	F0	0/0	0.00K
JACKSONVILLE	07/02/2003	F1	0/0	60.00K
HALF MOON	07/02/2003	F0	0/0	0.00K
RICHLANDS	07/02/2003	F0	0/0	0.00K
SWANSBORO	06/22/2004	F0	0/0	10.00K
RICHLANDS	08/13/2004	F0	0/0	25.00K

JACKSONVILLE	08/14/2004	F0	0/0	10.00K
JACKSONVILLE	04/17/2006	F0	0/0	0.00K
JACKSONVILLE	07/23/2006	F0	0/0	0.00K
SNEADS FERRY	08/31/2006	F0	0/0	0.00K
BELGRADE	05/11/2008	EF2	0/0	150.00K
MORTON FORK	05/11/2008	EF0	0/0	0.00K
ONSLOW BEACH	09/25/2008	EF0	0/0	0.00K
MIDWAY PARK	05/07/2009	EF0	0/0	0.00K
MIDWAY PARK	04/16/2011	EF3	0/30	9.400M
CAMP LEJEUNE JCT	06/10/2013	EF1	0/0	0.50K
Totals:			3/59	15.421M

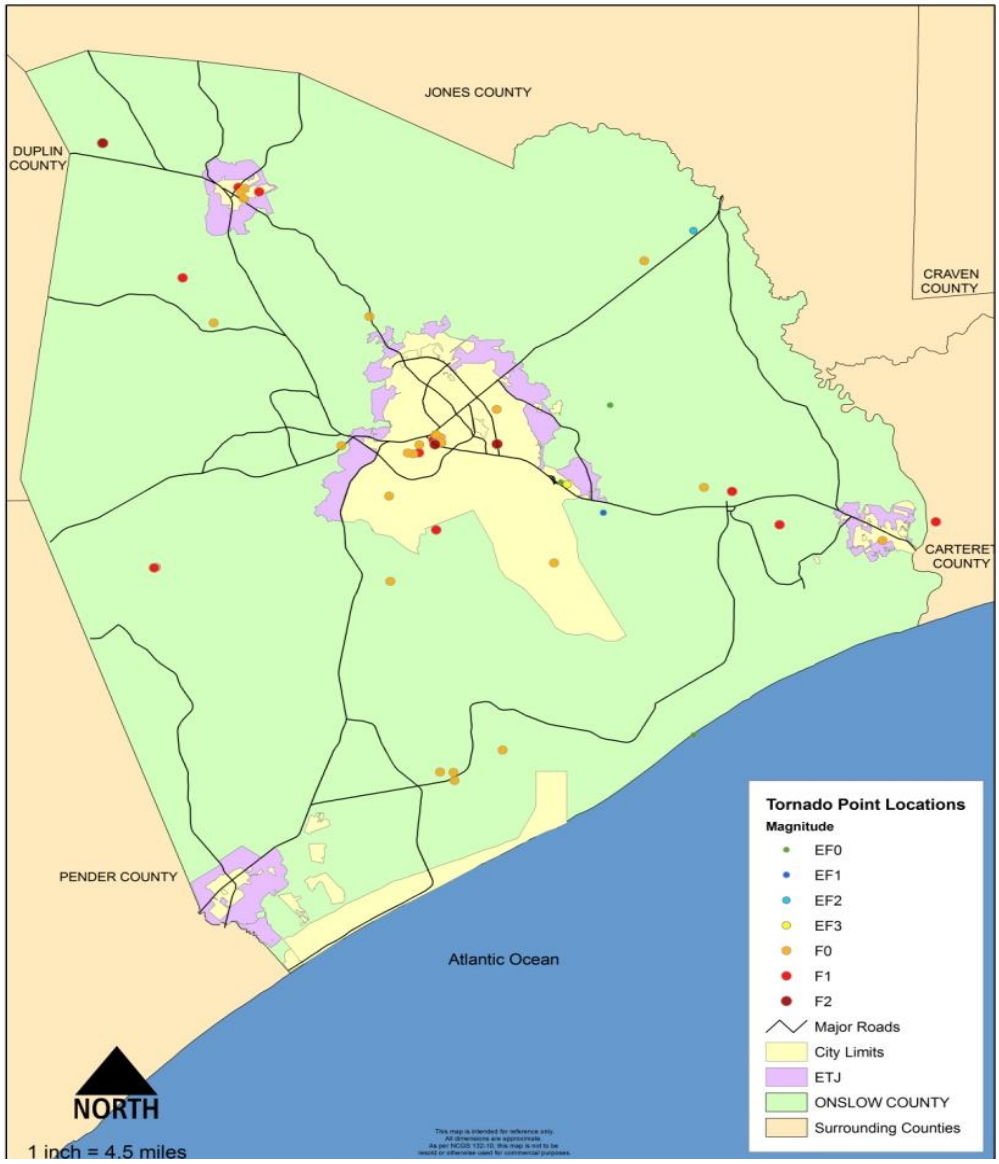
Source: National Climatic Data Center

Table 4.10: Waterspout Events in Onslow County

Location	Date	Magnitude	Death / Injuries	Property Damage
NORTH TOPSAIL BEACH	09/10/1997		0/0	0.00K
Totals:			0/0	0.00K

Source: National Climatic Data Center

Figure 4.11: Location History and Magnitude of Tornadoes in Onslow County



4.5.4. Probability of Future Occurrences

Onslow County will continue to have a high susceptibility to tornadoes. While the majority of these events have been historically small in terms of size, intensity (27 of 44 are classified as F0/EF0), and duration they will continue to pose a significant threat to the County as a whole.

4.6. Winter Storm

4.6.1. Background

Winter storms can range from a moderate snow over a few hours to a blizzard with blinding, wind-driven snow that lasts for several days. Many winter storms are accompanied by dangerously low temperatures and sometimes by strong winds, icing, sleet, and freezing rain. Some winter storms may affect the entire state or be geographically local to the southeastern coastal plains.

Snow accumulation on the roadways in Jacksonville (photo from NOAA)

Sleet is formed when raindrops freeze to for an ice pellet before reaching the ground where it will bounce but does not usually stick to objects. However, sleet can accumulate, like snow, and create hazardous driving conditions. Freezing rain is rain that falls to the ground where the temperature is below freezing and allows the rain to create a glaze of ice on roadways. An ice storm occurs when freezing rain falls and freezes upon impact with objects and creates hazards for power lines, roads, and trees.

A freeze event is marked by low temperatures below the freezing point (thirty-two degrees Fahrenheit). Freeze events are particularly dangerous. Exposure to freeze events can result in wind chill, hypothermia and frost bite. More than 50% of the cold injuries occur in people over the age of 60 and more than 75% are males. Around 20% of cold injuries occur in the home. In the south, near freezing temperatures are considered extreme cold. Freezing temperatures can be a danger to agricultural production especially when freezes occur late in the season and persist over an extended period of time.

4.6.2. Location and Spatial Extent

Onslow County is located in a region that is not particulary susceptible to winter storm and freeze events. However, when such events do occur the effects will often be felt much greater and over a widespread area. The inland areas, particularly the northwest portions of Onslow County, are at slightly higher risk to these storms due to naturally warmer air temperatures closer to the ocean. Extreme temperatures will most often create greater effects on the elderly and homeless populations, but larger snowstorms may have widespread effects.

4.6.3. Historical Occurrences

The National Climatic Data Center has documented twenty-four winter storm events in Onslow County. These events have resulted in approximately 35 injuries and $145 thousand in property damage.

Table 4.11: Winter Weather Events in Onslow County

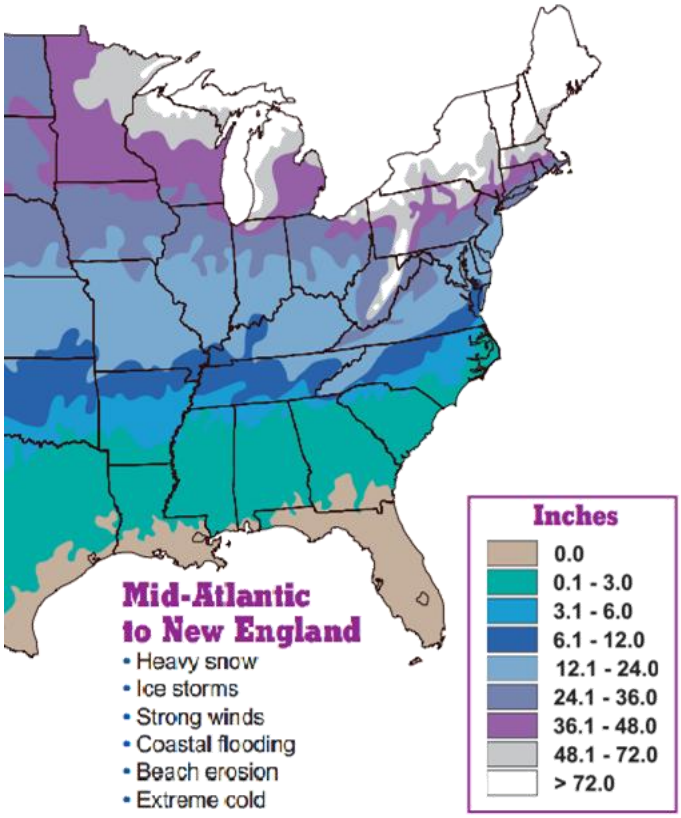
Location	Date of Occurrence	Type	Death/ Injury	Magnitude	Property Damages (2014 dollars)	Crop Damages (2014 dollars)
Onslow County	02/03/1996	Winter Storm	0/35		45.00K	0.00K
Onslow County	02/10/1997	Winter Storm	0/0		0.00K	0.00K
Onslow County	01/19/1998	Winter Storm	0/0		0.00K	0.00K
Onslow County	01/27/1998	Winter Storm	0/0		0.00K	0.00K
Onslow County	02/03/1998	Winter Storm	0/0		100.00K	0.00K
Onslow County	02/17/1998	Winter Storm	0/0		0.00K	0.00K
Onslow County	03/02/1998	Sleet	0/0		0.00K	0.00K
Onslow County	03/11/1998	Cold/Wind Chill	0/0		0.00K	0.00K
Onslow County	01/03/2002	Winter Storm	0/0		0.00K	0.00K
Onslow County	01/23/2003	Winter Storm	0/0		0.00K	0.00K
Onslow County	01/09/2004	Winter Weather	0/0		0.00K	0.00K
Onslow County	01/25/2004	Winter Storm	0/0		0.00K	0.00K
Onslow County	01/26/2004	Winter Storm	0/0		0.00K	0.00K
Onslow County	02/16/2004	Winter Weather	0/0		0.00K	0.00K
Onslow County	02/26/2001	Winter Weather	0/0		0.00K	0.00K
Onslow County	03/23/2004	Frost/Freeze	0/0		0.00K	0.00K
Onslow County	12/20/2004	Winter Weather	0/0		0.00K	0.00K
Onslow County	12/26/2004	Winter Storm	0/0		0.00K	0.00K
Onslow County	01/20/2009	Heavy Snow	0/0	3 inches	0.00K	0.00K
Onslow County	02/12/2010	Heavy Snow	0/0	8 inches	0.00K	0.00K
Onslow County	12/26/2010	Heavy Snow	1/0	4 inches	0.00K	0.00K
Onslow County	01/10/2011	Heavy Snow	0/0	5 inches	0.00K	0.00K
Onslow County	01/28/2014	Winter Storm	0/0	2 inches	0.00K	0.00K
Onslow County	02/11/2014	Winter Storm	0/0	4 inches	0.00K	0.00K
Totals:			1/35		145.00K	0.00K

4.6.4. Probability of Future Occurrences

The entire State has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal areas typically face their greatest threat from nor'easters and other severe winter coastal storms. These storms can contain strong waves and result in extensive beach erosion and flooding. Freezing rain and ice storms typically occur once every several years at coastal locations and severe snowstorms have been recorded occasionally in coastal areas. Out of the eight (8) total climate divisions in North Carolina, Onslow County's climate division (#6) ranked eighth in terms of average one-day extreme snowfall. *Extreme Average Snowfall by Climate Division* provides a summary of average one-day extreme snowfall for each North Carolina climate division

The probability of future winter storm events in Onslow County remains moderate. Figure 4.12 shows the annual mean snowfall hazard for the U.S.

Figure 4.12: Average Annual Snowfall for the U.S.



GEOLOGIC

4.7. Earthquake

4.7.1. Background Information

Earthquakes are geologic events that involve movement or shaking of the Earth's crust. Earthquakes are usually caused by the release of stresses accumulated because of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes generally follow the outlines of the continents. Earthquakes can result from crustal strain, volcanoes, landslides, or the collapse of caverns. Earthquakes can affect hundreds of thousands of square miles causing damages to property, loss of life and disruption of social and economic infrastructure in the affected area.

Most earthquakes occur as a result of the release of accumulated stresses. These stresses build up when two opposing tectonic plates of the Earth's crust become lodged on one another. The areas where these blocks meet are known as fault lines. The areas of greatest instabilities occur at the perimeters of the lines where two plates are moving in opposite directions and at opposite speeds. When the plates become locked together energy begins to accumulate. Eventually, this energy will exceed the rock's strength and a rupture will occur. The rocks on both sides of the fracture will snap releasing the stored energy which generates seismic waves.

Earthquakes may last only a few seconds or may continue for up to several minutes. They can occur at any time of the day or night and at any time of the year. Although thousands of earthquakes occur in the United States each year, most are too small to affect us. Earthquakes of larger magnitude, however, which release more energy during fault ruptures, can be hazardous, exposing us to the risk of harm or loss. The primary risk to people is what the ground motions can do to the natural and man-made environments.

Aerial view of collapsed sections of the Cypress viaduct of Interstate Highway 880. Oakland, California. Photographer: H.G. Wilshire, USGS.

The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (mountain regions and along hillsides), and liquefaction, in which ground soil loses the ability to resist shear and flows much like quick sand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture or collapse.

Magnitude and Intensity measure different characteristics of earthquakes. Magnitude measures the energy released at the source of the earthquake. Magnitude is determined from measurements on seismographs. Intensity measures the strength of shaking produced by the earthquake at a certain location. Intensity is determined from effects on people, human structures, and the natural environment. Each unit increase in magnitude typically corresponds to a ten-fold increase in wave amplitude, or a 244-fold increase in energy intensity.

Table 4.12 provides a comparison of the magnitude scales and intensity scales with associated potential impacts as identified by the Modified Mercalli Scale.

Table 4.12: Magnitude and Intensity Scales

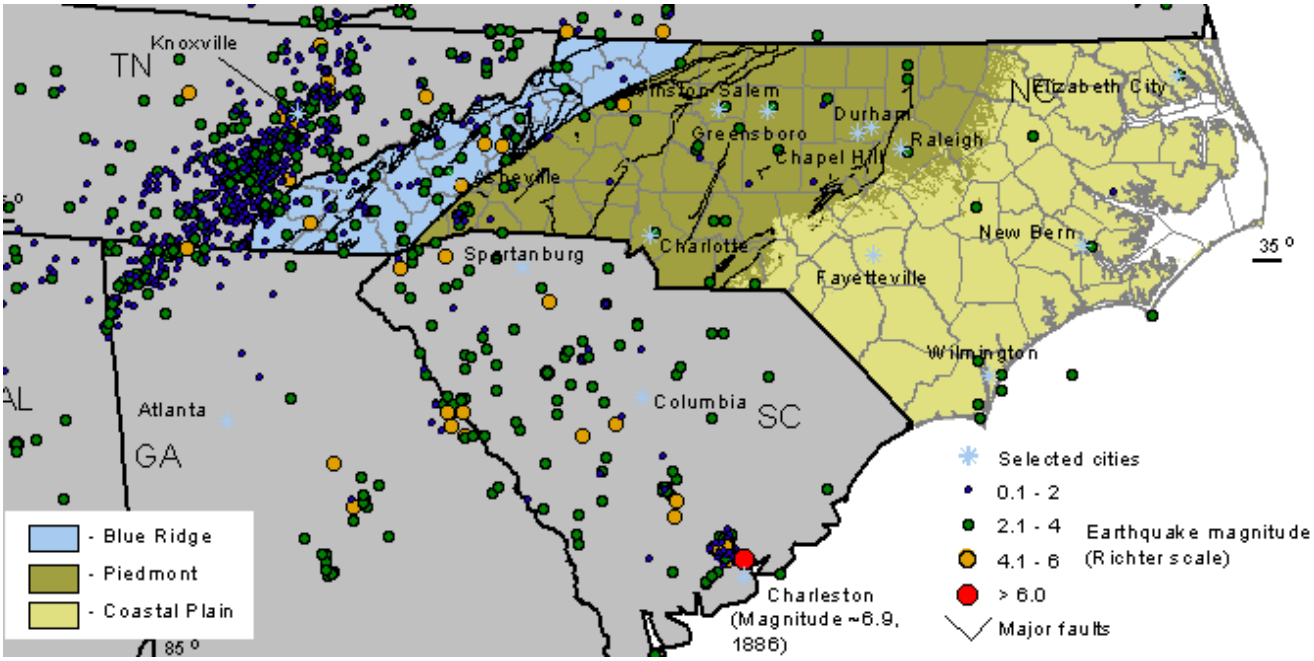
Magnitude	Typical Maximum Modified Mercalli Intensity	Abbreviated Modified Mercalli Intensity Scale
1.0-3.0	I	**I**. Not felt except by a very few under especially favorable conditions.
3.0-3.9	II-III	**II**. Felt only by a few persons at rest, especially on upper floors of buildings
		III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated
4.0-4.9	IV-V	**IV**. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
		V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0-5.9	VI-VII	**VI**. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
		VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6.0-6.9	VII-IX	**VIII**. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
		IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VII or higher	**X**. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent
		XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
		XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air

Source: United States Geological Society

4.7.2. Location and Spatial Extent

In North Carolina, earthquake epicenters are generally concentrated in the active Eastern Tennessee Seismic Zone. North Carolina is affected by both the Charleston Fault in South Carolina and the New Madrid Fault in Missouri. Both of these faults have generated earthquakes measuring greater than a magnitude of 8 during the last 200 years. Onslow County is most at risk from the Charleston fault, as noted in the Great Charleston Earthquake of 1886. Figure 4.13 shows earthquake activity in the North Carolina region. The picture indicates that Onslow County, in the Coastal Plain, resides in a band of uniformly limited seismic risk.

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



Source: North Carolina Department of Environment and Natural Resources, Division of Energy, Mineral and Land Resources.

4.7.3. Historical Occurrences

Earthquakes while relatively infrequent are not uncommon in North Carolina. In 2011 Onslow County experienced tremors as a result of a 5.8 magnitude earthquake centered in Mineral, Virginia. There were no recorded damages in Onslow County. Local records and the NOAA: National Geophysical Data Center there is no recorded events of earthquake damages in Onslow County**.**

4.7.4. Probability of Future Occurrences

The probability of Earthquakes events in Onslow County is moderated to low and should face only minimal effects from seismic activity.

4.8. Landslide and Sinkhole

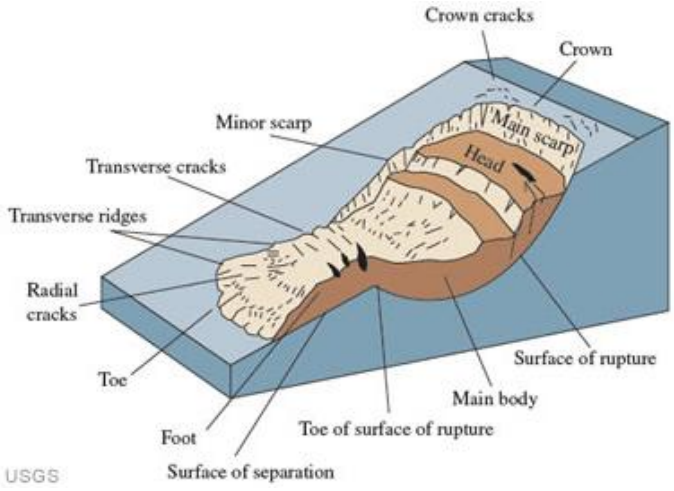
4.8.1. Background

The term landslide includes a wide range of ground movement, typically driven by gravity and resulting in the downward and outward movement of soil, rock and vegetation. Landslides occur in every state and U.S. Territories and can be triggered by both natural and human-caused changes in the environment including heavy rains, rapid snow melt, erosion, earthquakes, volcanic eruptions and changes in groundwater levels.

There are several types of landslides: rotational slide, transitional slide, block slide, fall, topple, debris flow, debris avalanche, earth flow, creep and lateral spreads. Each of the slides (rotational, transitional and block) refer to only mass movements, where there is a distinct zone of weakness that separates the slide material from the more stable material underneath. Falls are described as abrupt movement of masses of geologic material that become detached from steep slopes or cliffs. Separation in falls occurs along joints or fractures and movement occurs by free-fall.

A Topple is distinguished by a forward rotational unit(s) about some pivot point below or low in the unit. A Debris Flow is formed by loose soil, rock, organic matter, air and water and mobilizes as slurry that flows down slope. They are most commonly caused by heavy precipitation or rapid snowmelt.

Earthflows occur when slope material liquefies and runs out of the area, creating an hourglass shape. The flow is typically elongated and occurs in fine grained materials or clay bearing rocks on moderate slopes under saturated conditions. A second type of flow is a mudflow, which are typically wet materials. Creep refers to an imperceptibly slow, steady, downward movement of slope forming rock or soil. Movement occurs as a result of shear stress sufficient enough to develop deformation but too weak to form shear failure. The last type, lateral spread, usually occurs on gentle slops or flat terrain. Failures are caused by liquefaction and failure is usually triggered by ground motion such as an earthquake.



An Idealized slump-earth flow showing commonly used nomenclature for labeling the parts of a landslide. (*Geology.com)*

Landslides typically occur during periods of heavy rainfall or rapid snowmelt and can worsen the effects of flooding that accompany these events. Some landslide move slowly while other can occur rapidly, as described above, and pose a severe risk to property and life. In the United States, it is estimated that landslides cause up to $2 billion in damages and from 25 to 50 deaths annually. An additional geologic hazard that is naturally occurring but may be exacerbated by human activity is sinkhole.

Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by groundwater circulating through them. As the rock dissolves, spaces and caverns develop underground. Sinkholes are dramatic because the land usually stays intact for a while until the underground spaces just get too big. If there is not enough support for the land above the spaces then a sudden

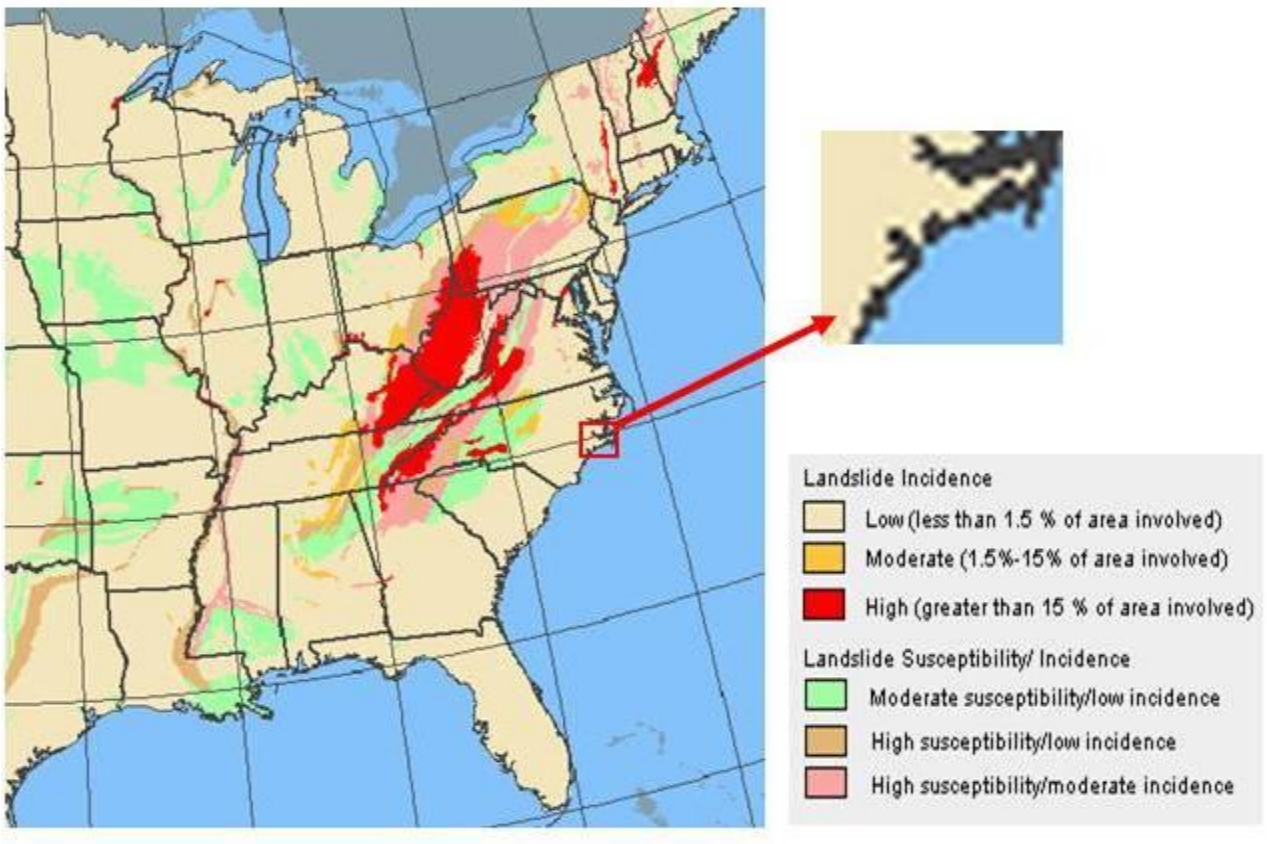
collapse of the land surface can occur. These collapses can be small, or, as this picture shows, or they can be huge and can occur where a house or road is on top.

There are three primary types of sinkholes: Dissolution, subsidence and cover-collapse. Dissolution sinkholes occur when rainfall and surface water percolate through joints in limestone. The dissolved material is carried away from the surface and a depression gradually forms. Cavities may be formed beneath the surface. These are the most common type of sinkhole in Florida. Cover-subsidence sinkholes develop gradually when the covering sediment is permeable and contains sand. The small sediment and sand will drain into the underlying bedrock creating a vacated space allowing overlying sediment to settle. As the dissolution and infilling continue a noticeable depression will form. The slow downward erosion eventually forms a small surface depression. The final type of sinkhole is a cover-collapse sinkhole. These may develop abruptly (over a period of hours) and can cause catastrophic damages. These types of sinkholes occur where covering sediments contain a significant amount of clay which drains into a cavity in the underlying bedrock. New cavity will form in the overlying sediment and as erosion and dissolution continue the overlying cavity will migrate toward the surface. The cavity will eventually breach the ground surface creating a sudden and dramatic collapse. Sinkholes can also be created by poor land use practices resulting from ground water pumping and construction and development practices. Development increases water usage, alters drainage pathways, overloads the ground surface and redistributes soil. According to FEMA, the number of human-induced sinkholes has doubled since 1930 and insurance claims for damages as a result of sinkholes has increased 1,200 percent from 1987 to 1991, costing nearly $100 million.

4.8.2. Location and Spatial Extent

In the eastern United States, landslides are common throughout the mountainous Appalachian region and New England, predominantly from sliding of clay-rich soils. The Piedmont and Coastal Plain regions also have landslides that are commonly related to human activity such as making a road cut too steep. Areas that are generally prone to landslide hazards include previous landslide areas; the bases of steep slopes; the bases of drainage channels; and developed hillsides where leach-field septic systems are used. Figure 4.14 indicates that Onslow County uniformly resides in an area of low incidence and low susceptibility. This means that any landslide event would, at most, affect less than 1.5 percent of the total land area of the county.

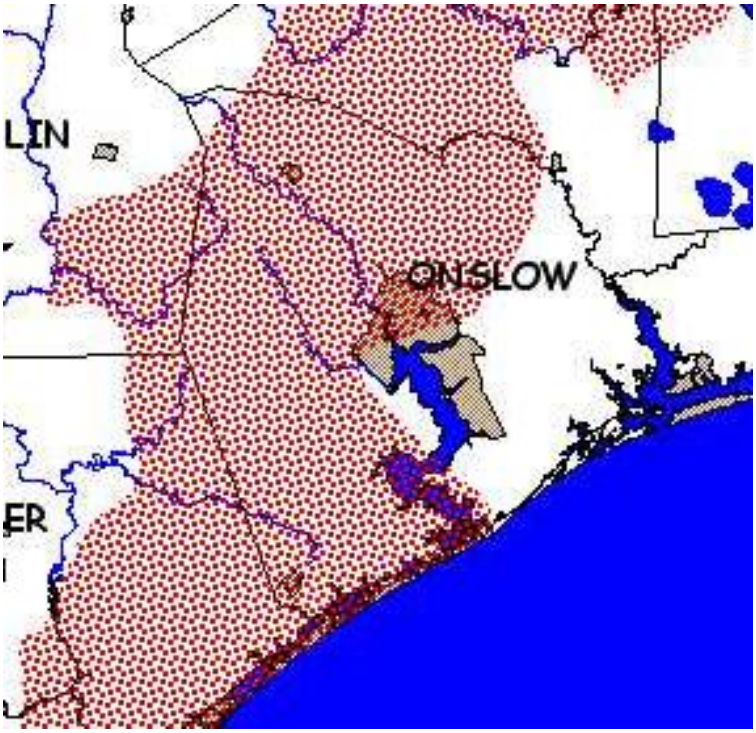
Figure 4.14 Landslide Incidences and Susceptibility Map



The susceptible areas are shown in Figure 5.13. In addition to natural processes and conditions resulting in sinkholes, areas of groundwater pumping may acceleration their formation.

In North Carolina, sinkholes are common features of the outer coastal plains where variable thicknesses of sand, silt, and clay lay over limestone rock formations. Due to these conditions, sinkholes will pose a greater threat to Onslow County than landslides do. Figure 4.15 shows susceptible areas of Onslow County created by the Castle Hayne and Riverbend limestone formations.

Figure 4.15: Areas of Sinkhole Susceptibality



Source: NC Division of Environment and Natural Resources: Division of Water Resources

4.8.3. Historical Occurrences

There is no recorded historical evidence of significant landslide activity in Onslow County.

There is 1 recorded incident of a significant sinkhole in Onslow County in the Catherine Lake area. The property that was affected was classified as a total loss. There are multiple investigations of sinkholes throughout the county on an annual basis however; only seven other incidents have been determined to be a sinkhole of unknown origin (not related to drainage washout, collapsed culverts or rotting organic material).

4.8.4. Probability of Future Occurrences

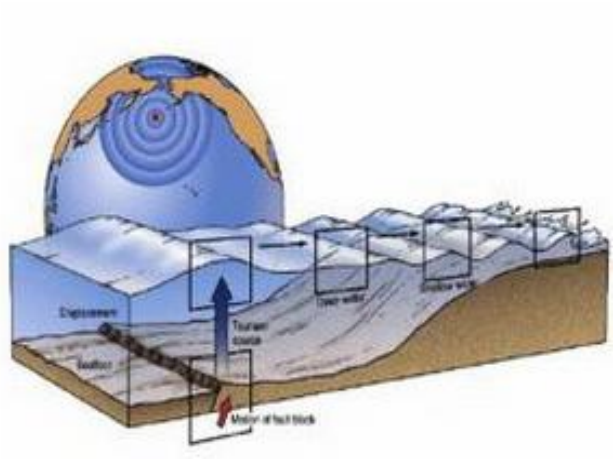
Susceptibility to land sliding is defined by the USGS as the probable degree of response of geologic formations to natural or artificial cutting, loading of slopes, or to unusually high precipitation. Generally, it is assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Onslow County's geography makes it least susceptible to landslides.

Susceptibility to sinkhole formation Onslow County will remain moderate due to the karst formations as described above and to continued development and industrial growth.

4.9. Tsunami

4.9.1. Background

Tsunami is a set of ocean waves caused by any large, abrupt disturbance of the sea-surface. If the disturbance is close to the coastline, local tsunamis can demolish coastal communities within minutes. A very large disturbance can cause local devastation AND export tsunami destruction thousands of miles away. Tsunamis rank high on the scale of natural disasters. Since 1850 alone, tsunamis have been responsible for the loss of over 420,000 lives and billions of dollars of damage to coastal structures and habitats. Most of these casualties were caused by local tsunamis that occur about once per year somewhere in the world. Predicting when and where the next tsunami will strike is currently impossible. Once the tsunami is generated, forecasting tsunami arrival and impact is possible through modeling and measurement technologies.



Basic tsunami formation. National Oceanic and Atmospheric Administration

Tsunamis are most commonly formed from earthquakes in marine and coastal areas. Most are produced by large, shallow earthquakes. Tsunamis are most common in the Pacific region where dense oceanic plates slide under the lighter continental plates. Underwater landslides, often associated with smaller earthquakes, are also capable of generating tsunamis as seen in 1998 in the Papua New Guinea event. Underwater volcanoes and asteroid impacts are also capable of creating tsunamis.

Tsunamis have very long wavelengths and periods and can have an average speed of 450 miles per hour. They can travel unnoticed in deep ocean waters sometimes with a wave height of only twelve inches. However, when the waves reach shallower water the wave speed slows and the wave height increases significantly. Some tsunamis can reach 100 feet in height and can cause devastation to a coastline.

An indication of an approaching tsunami would be rapid change in water levels on the coastline. The successive crests and troughs can occur from five to ninety minutes apart. Typically, the first wave is not the biggest one; therefore, it is not safe to return to the area until authorities deem it safe to return. Areas less than fifty feet above sea level and one mile inland would be at greatest risk for the impact of a tsunami. There are two types of bulletins to inform an area of the possibility of a tsunami. A Tsunami Watch Bulletin is released following an earthquake of a 6.75 or greater and a Tsunami Warning Bulletin is released when information from a tidal station indicates that the characteristics of the sea match those of a destructive tsunami. Fortunately, 75% of all warnings since 1948 have been false alarms.

According to a research paper published by the National Geophysical Data Center (*Tsunamis and Tsunami-Like Waves of the Eastern United States, Lockridge, et al., 2002*) since the 1600's there have been only 40 cataloged tsunami and tsunami-like wave events that have occurred in the Eastern United States. The most notable events were the 1755 Queen Anne's earthquake, the New Madrid earthquakes of 1811-1812, the Charleston earthquake of 1886, and the Grand Banks event of 1929. While East Coast tsunamis are rare the paper discusses two areas

of investigation off of the coasts of North Carolina and Virginia. Fault-like cracks in the outer continental shelf are situated in areas with large deposits of methane hydrate and pressurized water that could create unstable shelf wall leading to an underwater landslide.

4.9.2. Location and Spatial Extent

Tsunami hazard locations and extent would be similar to flood hazard areas focused slightly more primarily on the coastal areas and areas affected by tidally driven rivers and creeks.

4.9.3. Historical Occurrences

There are no historical records of tsunami events or effects in Onslow County. While these events are considered rare the potential for tsunami impacts in Eastern North Carolina does exists as evidenced by the documented occurrences along the East Coast.

4.9.4. Probability of Future Occurrences

The probability of tsunami events in Onslow County is considered to be very low. The most likely scenario, as described above, would be a landslide event on the outer continental shelf. This type of event is predicted to produce maximum wave heights of a few to several meters. Varying effects would occur from this event based on the timing of the arrival as it coincides with tidal fluctuations.

HYDROLOGIC

4.10. Coastal and Riverine Erosion

4.10.1. Background

Long-term coastal erosion effects as seen in Wasque, Massachusetts. *The Coastlines Project*

Erosion is a hazard defined as events in which earth is worn away, often by wind, water or ice. The process of erosion moves bits of rock, soil or sand from one place to another. Most erosion is caused by forces of moving water. This can come in the form of rain washing away soil and sand, rushing streams and rivers wearing away their banks and tides and storm surge washing away the coastal sands. Erosion is measured by its rate of change in horizontal displacement inward. Short-term riverine erosion is often secondary to heavy rainfall events, flodding and human activities such as development and removal of vegetation. Long-term riverine erosion is often a result of natural water flow forces on the banks of the river or creeks casuing slow displacement of soil, sediment and rocks. Short-term coastal erosion is often caused by hurricanes, coastal storms, and storm surge but may be exacerbated by human activities such as removal of dune and vegetative buffers and shoreline hardening and dredging. Long-term coastal erosion is a function of multi-year impacts such as normal wave action, sea level rise, sediment loss, subsidence and climate change.

Natural recover from erosion can take years to decades and can cause coastal and upland properties to be exposed to further damages in subsequent events. Erosion control is the process of reducing erosion by wind and water. Erosion control can be done by physically changing the landscape. Living shorelines are constructed by placing native plants, stone, sand, and even living organisms such as oysters along wetland coasts. These plants help anchor the soil to the area, preventing erosion. By securing the land, living shorelines establish a natural habitat. They protect coastlines from powerful storm surges as well as erosion. Physical structures such as sea walls, groins and jetties can also help mitigate coastal and riverine erosion but may also exacerbate the problem under some circumstances.

While death and injury are not typically associated with erosion issues, property damage and economic losses are.

4.10.2. Location and Spatial Extent

All of Onslow County's coastal and riverine areas are susceptible to erosion hazards.

4.10.3. Historical Occurrences

Oceanfront shoreline change rates have been calculated using the end-point method since the first study completed in 1979. This method simply uses the earliest and most current shoreline data points where they intersect any given shore-perpendicular transect line. The distance between the two shorelines (shore-transect intersect) divided by the time between the two establishes the rate. The use of current mapping and spatial

analysis technology make this process repeatable and precise; ESRI's Geographic Information Systems (GIS), and USGS's Digital Shoreline Analysis System (DSAS).

The North Carolina Department of Environment and Natural Resources (NCDENR), Division of Coastal Management developed maps for Onslow County coastal zones that document the long-term average annual erosion rates. These maps were produced in 2011 and are on file at Onslow County Emergency Services. Each mapped zone and the annual erosion rate are listed as follows:

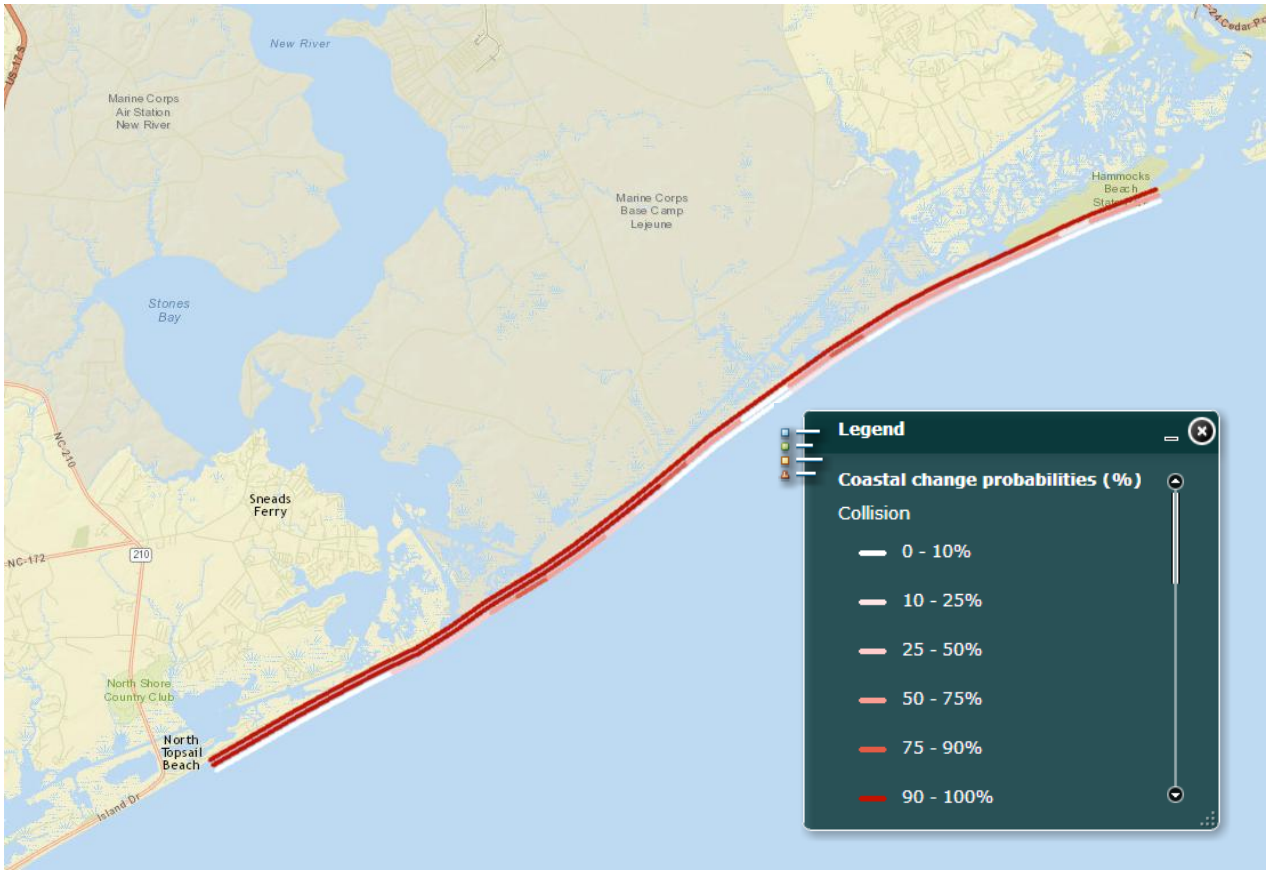
- North Topsail Beach (South) – average 2 foot/year uniform
- North Topsail Beach (North) – average 2 foot/year, section of 2.5 foot/year, and section identified as inlet hazard area.
- Onslow Beach – (South) – varying averages. Extreme south section is recorded at 11 foot/year and followed by sections that progressively decrease from 10 foot/year – 2 foot per year.
- Onslow Beach (North) – overall average is 2 foot/year. Area of Browns Inlet identified as Inlet Hazard Area. Area just north of Browns Inlet recorded as averaging 2.5 foot/year.
- Browns Island (between brown Inlet and Bear Inlet) – southern section recorded as 2.5 foot/year. Northern sections approaching Bear Inlet recorded as 3 foot/year, 4.5 foot/year and 6 foot/year progressing north.
- Bear Island (between Bear Inlet and Bouge Inlet) – majority is recorded as 2 foot/year with the northern section recorded at 3.5 foot/year. Southern and northern ends of Bear Island are listed as Inlet Hazard Areas.

Many, if not all, of the hurricanes that have impacted Onslow County have contributed to coastal erosion issues.

4.10.4. Probability of Future Occurrences

Erosion will remain a natural, dynamic and continual process for all coastal and riverine areas of Onslow County and thus these areas have a high probability of future occurrences. While the impacts of coastal erosion can be lessened through continuous beach re-nourishment programs, it is likely that the impacts will increase in severity over time due to the anticipated slow-onset, long-term effects of climate change and sea-level rise. Figure 4.16 shows the probabilities of coastal change along the Onslow County coastline.

Figure 4.16: Coastal Change Probabilities



Source: United States Geological Society, St. Petersburg Coastal and Marine Science Center

4.11. Dam and Levee Failure

4.11.1. Background

Dam and Levee failures are a result of aging infrastructure. The primary concerns of these types of hazards stems from their direct impacts on citizens. Growing populations in areas around and downstream of dams and levees has increased the emphasis on safety, operation, maintenance and risk.

While there are approximately 80,000 dams in the United States, owned by private individual, state and local authorities, public utilities and federal agencies. North Carolina currently has an inventory of over 5,000 dams. Dams provide numerous benefits to include: providing drinking water, navigation, agricultural irrigation, hydroelectric power, recreational and flood mitigation.

Should a dam or levee fail, the stored energy of the ater would create flash flood events for areas downstream that would result in property damage and possible loss of life. Failures of dams and levees have the potential to place large numbers of people and large areas of property in harm's way.

In North Carolina the regulating agency for dams and levees is the North Carolina Department of Environment and Natural Resources; Division of Energy, Mineral and Land Resources. The division classifies dams for hazard potential and has developed a hazard classification system as outlined in Table 4.13.

Table 4.13: North Carolina Dam Hazard Classifications

Hazard Classification	Description	Qualitative Guidelines
Low	Interruption of road service (low volume roads)	Less than 25 vehicles a day
	Economic Damage	Less than $30,000
Intermediate	Interruption of road service (low volume roads)	25- 250 vehicles a day
	Economic Damage	$30,000-$200,000
	Loss of Human Life	Probable loss of 1 or more lives
High	Interruption of road service (low volume roads)	Greater than 250 vehicles a day
	Economic Damage	More than $200,00
	Loss of Human Life	Probable loss of 1 or more lives

Source: North Carolina Department of Environment and Natural Resources, Division of Energy, Mineral and Land Resources

4.11.2. Location and Spatial Extent

Onslow County currently has seven earthen dams listed in the North Carolina Dam Inventory, produced by the NCDENR, Division of Energy, Mineral and Land Resources. One is federally owned and on Camp Lejeune proper. There are four listed as local government and serve as wastewater treatment lagoons. There are three listed as private, with one serving as a waste/treatment lagoon and two serving as recreational. The list of dams and their hazard classification is given below:

Table 4.14: Onslow County Dam Inventory

Dam Name	Hazard Potential	Conditional Assessment	Surface Area	Max Capacity (Acres/Foot)	Type of Owner
Yow-Williams Dam	Low	Satisfactory		176	Private
Henderson Lake Dam (DoD)	Low	Not Rated		90	Federal
Kenan Pond Dam	Low	Satisfactory			Private
Jacksonville Wastewater Lagoon	High	Satisfactory	500	15	Local Govt.
Jacksonville LTS – South Storage Lagoon	High	Satisfactory			Local Govt.
North Topsail Water & Sewer Lagoon (Pluris)	High	Satisfactory	10	180	Local Govt.
Oceanview Farms (Coharie Farms)	Low	Satisfactory	8	90	Private
Elizabeth Lake (Dewitt Pond, Preston Pond)	REMOVED	Not Rated	N/A	N/A	N/A

Source: North Carolina Department of Environment and Natural Resources, Division of Energy, Mineral and Land Resources

4.11.3. Historical Occurrences

There are no recorded events of dam/levee failure in Onslow County. The Elizabeth Lake dam is listed as "breeched" however, this was an intentional breech in an effort to drain and remove the dam. No damages occurred as a result of this incident.

4.11.4. Probability of Future Occurrences

There is a low probability of dam or levee failure in Onslow County. However, as indicated in Table 4.14 three dams exist that have a potential to create catastrophic damages to property and loss of life.

4.12. Flooding

4.12.1. Background

Flooding is a coast to coast threat in the United States and its territories in all months of the year. It is the most frequent and costly hazard with approximately 75 percent of all presidential disaster declarations resulting from natural events where flooding was the major component. In most years it causes more damage in the United States than any other severe weather related event – an average of $5.3 billion a year for the 30-year period, 1975-2004. During this same period, an annual average of 93 people lost their lives due to flooding.

Flooding typically occurs when prolonged rain falls over several days, when intense rain falls over a short period of time, or when an ice or debris jam causes a river or stream to overflow onto the surrounding area. Flooding can also be caused by the failures of water control structures such as dams and levees. The most common cause of flooding is water due to rain and/or snowmelt that accumulates faster than soils can absorb it or rivers can carry it away. The severity of flood events is typically determined by a combination of river basin topography and physiography, precipitation and weather patterns, recent soil moisture condition, and the degree of vegetation and/or cleared/impervious surfaces.

There are two primary categories of flood types: general and flash. General flooding is typically a long term event that may last for several days. General flooding can be further divided into three categories. 1) Riverine flooding occurs when river levels rise and overflow their banks or the edges of their main channels. River flooding can be caused by heavy rainfall, dam failures, rapid snowmelt and ice jams. 2) Coastal flooding is typically a result of storm surge, wind driven waves, and heavy rainfall produced by hurricanes or other coastal storms. 3) Urban flooding results because urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and occasionally overwhelming sewer systems.

WHAT ARE THE ODDS OF BEING FLOODED?

The term "100-year flood" has caused much confusion for people not familiar with statistics. Another way to look at flood risk is to think of the odds that a 100-year flood will happen sometime during the life of a 30-year mortgage—a 26% chance for a structure located in the SFHA.

Chance of Flooding over a Period of Years

Time Period	Flood Size 10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During a 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the only 1-2% chance that the house will catch fire during the same 30-year mortgage.

Flash Floods, the second general type of flood, can be caused by slow moving thunderstorms and dam or levee failures. These types of events are rapid and usually occur within six hours of the immediate cause and result in a very rapid rise of water over ow-lying areas. Steep, hilly or mountainous terrain are at greater risk of flash flooding as are urban areas due to the large expanses of concrete and asphalt surface that do not allow for adequate water absorption.

Periodic flooding of lands adjacent to non-tidal rivers and streams (area known as a floodplain) is a natural and inevitable occurrence and can be expected to take place within regular recurrence intervals. The recurrence interval of a flood is defined as the average time, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Periodic flooding of lands adjacent to non-tidal rivers and streams is a natural and inevitable occurrence. Floodplains are defined by the frequency of a flood that is large enough to cover it. For example, a reference to a 100 year floodplain means that a 100 year flood will cover that specified area. To help better define the

floodplain the National Flood Insurance Program (NFIP) developed a common standard of baseline probability. The "base" flood is the 1% (1 out of 100) annual chance of a flood occurring during any given year. The base flood is thus refered to, informally, as the 100 year flood. Often misunderstood, the term 100 year flood does not mean that a flood will only occur once in a 100 year span but instead means that on any given year an area has a 1% chance of a flood occurring. Thus an area could see a 100 year flood twice in the same year, two years in a row or not at all over a 200 year span.

The NFIP has developed a mapping system to identify flood plone area in an effort to help communities understand their risk. Three main categories of risk areas are defined: 1) High-Risk Area (special flood hazard area or SFHA) where there is a 1 in 4 chance of flooding during a 30 year period. These are typically indicated on a flood map zones with a letter A or V. 2) Moderate-To-Low Risk Areas (non-special flood hazard area or NSFA) are areas that are at risk of being flooded but not completely removed. They will typically be identified on flood map zones with letter B, C or x (or a shaded x). 3) Undetermined-Risk Areas are areas where no flood-hazard analysis has been conducted but a flood risk may still exist. These areas will be labeled with a letter D on flood maps. Table 4.15 provides a full breakdown of the flood zones found on typical flood zone maps.

Table 4.15: NFIP Flood Insurance Rate Map Designations

Zone	Designation
A	The flood insurance rate zone that corresponds to the 100-year floodplains that is determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.
A99	The flood insurance rate zone that corresponds to areas of the 100-year floodplains that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.
AE and A1-A30	The flood insurance rate zone that corresponds to the 100-year floodplains that is determined in the Flood Insurance Study by detailed methods. In most instances, Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
AEFW	100-year floodway; The floodway is an area that includes the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water-surface elevation by more than a designated height.
AH	The flood insurance rate zone that corresponds to the areas of the 100-year shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet. The Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
AO	The flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. The depth should be averaged along the cross section and then along the direction of flow to determine the extent of the zone. Average flood depths derived from the detailed hydraulic analyses are shown within this zone. In addition, alluvial fan flood hazards are shown as Zone AO on the Flood Insurance Rate Map. Mandatory flood insurance purchase requirements apply.
AR	The flood insurance rate zone that results from the decertification of a previously accepted flood protection system that is being restored to provide protection from the 100-year or greater flood event.
D	Designation on National Flood Insurance Program maps used for areas where there are possible, but undetermined, flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted. Mandatory flood insurance purchase requirements do not apply, but coverage is available. The flood insurance rates for properties in Zone D are commensurate with the uncertainty of the flood risk.

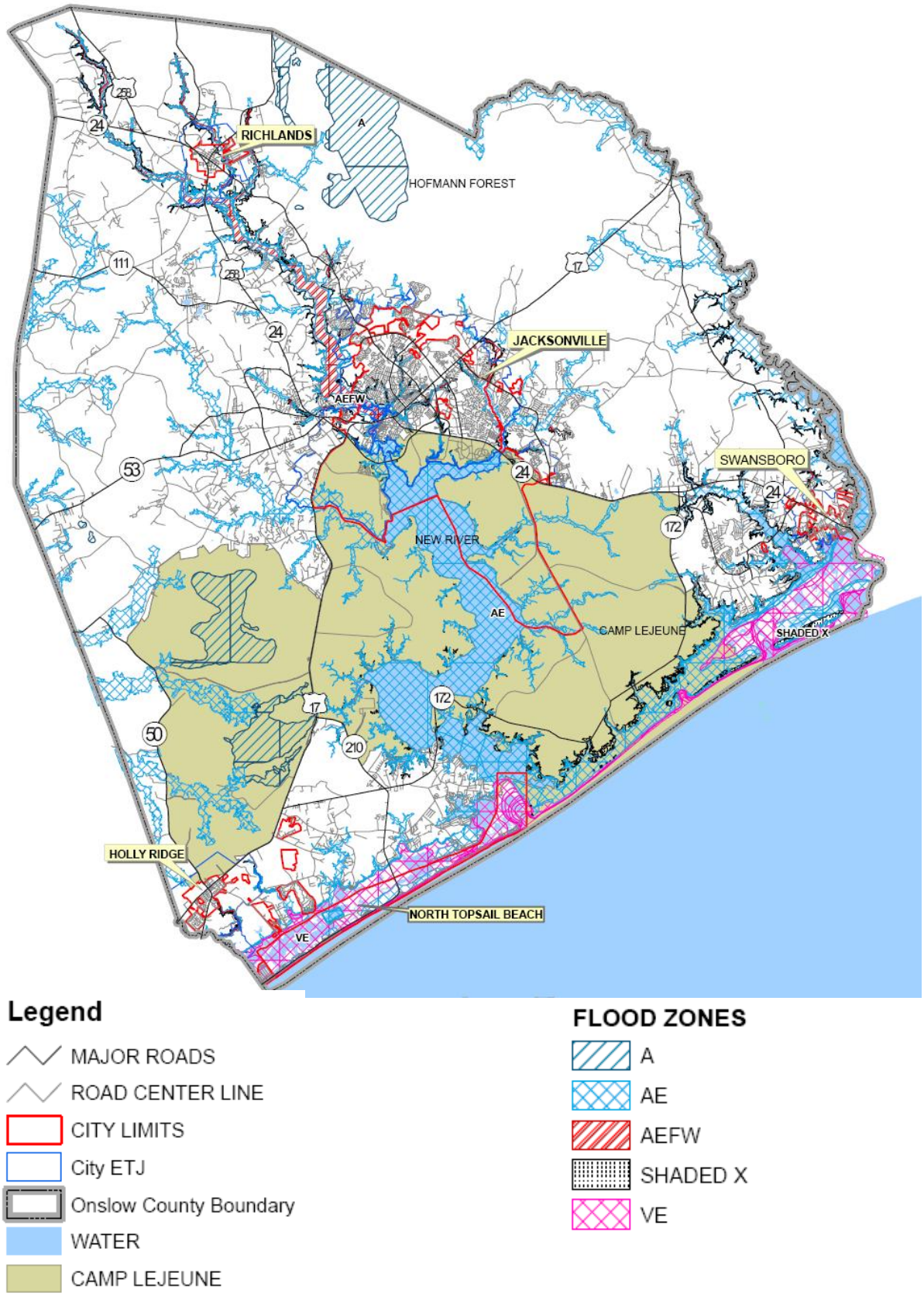
V	The flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no Base Flood Elevations are shown within this zone. Mandatory flood insurance purchase requirements apply.
VE	The flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
B,C,X (shaded X)	Zones B, C, and X are the flood insurance rate zones that correspond to areas outside the 100-year floodplains, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No Base Flood Elevations or depths are shown within this zone.

Source: Federal Emergency Management Agency, National Flood Insurance Program

4.12.2. Location and Spatial Extent

Many areas in Onslow County are susceptible to riverine, urban (storm water), and coastal flooding. It is estimated that almost 21 % (161 square miles) of Onslow County are located in one of the Special Flood Hazard Areas. Figure 4.17 illustrates the flood zone classifications within Onslow County based on current Flood Insurance Rate Maps. This map includes zones A, AE, AEFW, Shaded x and VE as described above. It is important to note that while FEMA digital flood insurance rate maps are recognized as the best available data for planning purposes; it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood-related losses often do occur outside of delineated special flood hazard areas.

Figure 4.17: Special Flood Hazard Areas in Onslow County



Sources: Federal Emergency Management Agency, National Flood Insurance Program, Onslow County GIS

4.12.3. Historical Occurrences

Onslow County has areas that are prone to generalized flooding. These areas include:

- Bachelor's Delight Swamp/ Tributary
- Blue Creek, Brinson Creek
- Brynn Mar
- Cowford Branch, Half Moon Creek
- Half Moon Creek Tributary
- Jenkins Swamp
- Mill Swamp
- Mott Creek
- New River
- New River Tributary
- North Branch at Lauradale Subdivision
- Northeast Creek
- Wolf Swamp
- Rocky Run
- Scales Creek
- South Branch at Lauradale Subdivision

The National Climatic Data Center lists 28 reported flood events throughout Onslow County since 1996. This list also includes two documented events that are not reported by the NCDC; one in 1994 and one in 1995. Both are documented in local histories.

Table 4.16: Historical Flood Events in Onslow County

Location	Date	Type	Death / Injury	Property Damage	Crop Damage
Onslow County	12/23/1994	Flooding	0/0	0.00K	0.00K
Onslow County	09/08/1995	Coastal Flooding	0/0	500.00K	0.00K
Richlands	07/23/1996	Flash Flood	0/0	0.00K	0.00K
Richlands	09/11/1996	Flash Flood	0/0	0.00K	0.00K
Jacksonville	10/08/1996	Flash Flood	0/0	80.00K	0.00K
Jacksonville	05/17/1998	Flash Flood	0/0	0.00K	0.00K
Countywide	09/15/1999	Flash Flood	0/0	0.00K	0.00K
Countywide	09/16/1999	Flash Flood	0/0	0.00K	0.00K
Countywide	10/17/1999	Flash Flood	0/0	0.00K	0.00K
Camp Lejeune	08/04/2000	Flash Flood	0/0	100.00K	0.00K
Sneads Ferry	08/04/2000	Flash Flood	0/0	0.00K	0.00K
Countywide	09/18/2000	Flash Flood	0/0	1.000M	0.00K
Jacksonville	07/31/2002	Flash Flood	0/0	0.00K	0.00K
Countywide	05/23/2003	Flash Flood	0/0	0.00K	0.00K

Richlands	07/02/2003	Flash Flood	0/0	0.00K	0.00K
Jacksonville	07/11/2004	Flash Flood	0/0	0.00K	0.00K
Countywide	08/14/2004	Flash Flood	0/0	0.00K	0.00K
Countywide	10/07/2005	Flood	0/0	0.00K	0.00K
Countywide	06/28/2006	Flood	0/0	50.00K	0.00K
Richlands	06/30/2006	Flash Flood	0/0	0.00K	0.00K
Bell Fork	04/15/2007	Flood	0/0	0.00K	0.00K
Bell Fork	08/06/2009	Flood	0/0	0.00K	0.00K
Bell Fork	08/12/2009	Flood	0/0	0.00K	0.00K
Folkstone	09/07/2009	Flood	0/0	0.00K	0.00K
Swansboro	11/12/2009	Flood	0/0	0.00K	0.00K
Bell Fork	06/25/2010	Flood	0/0	0.00K	0.00K
Jacksonville Ellis Airport	09/29/2010	Flood	0/0	0.00K	0.00K
Catherine Lake	09/30/2010	Flash Flood	0/0	1.000M	6.000M
Countywide	06/29/2011	Flood	0/0	0.00K	0.00K
Half Moon	08/06/2011	Flood	0/0	0.00K	0.00K
Totals:			0/0	2.230M	6.000M

Source: NOAA, National Climatic Data Center

4.12.4. Historical Summary of Insured Flood Losses

According to the Federal Emergency Management Agency flood insurance policy records, as of May 2014, there have been more than 3,245 flood losses reported in Onslow County through the National Flood Insurance Program since 1978. These losses have totaled over $40 million in claims payments. Table 4.17 lists flood losses and payments by jurisdiction. These losses include both inland and coastal flood events. It should be noted that these numbers include only those losses to structures that were insured, reported and paid out through NFIP policies. It is highly probable that additional flood losses have occurred in Onslow County that were uninsured or not reported.

Table 4.17: NFIP Claims for Onslow County (1978-2014)

Community Name	Total Losses	Total Payments
Holly Ridge	1	$7,231.05
Jacksonville	144	$1,784,230.08
NTB	1,214	$14,571,476.53
Onslow County (unincorporated areas)	1,787	$22,070,474.74
Richlands	1	$ 6,685.92
Swansboro	98	$2,165,835.84
	3245	$40,605,934.16

Source: Federal Emergency Management Agency

4.12.5. Repetitive Loss Properties

FEMA defines a repetitive loss (RL) property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10 year period since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Severe Repetitive Losses (SRL) are classified as any property that has at least four claims payments, each over $5,000 and a cumulative amount that exceeds $20,000 or any property with at least two separate claims payments in which the cumulative amount of the building portion exceeds the market value of the building.

According to the North Carolina Emergency Management, Onslow County has 446 repetitive loss properties and 29 severe repetitive loss properties. Of the repetitive loss properties, 20 are in the City of Jacksonville, 254 in the Town of North Topsail Beach, 21 in the Town of Swansboro and 151 in the unincorporated areas of the county. Of the severe repetitive loss properties 20 are in North Topsail Beach, 2 are in Swansboro, and 4 are in the unincorporated areas of Onslow County. Total losses paid for all of the RL's and SRL's is approximately $25 million.

4.12.6. Probability of Future Occurrences

Flood events will remain frequent events in Onslow County and the probability of future occurances is high and almost certain. The probability based on magnitude and best data is illustrated in Figure 4.15 above. Further, as describe in other hazard profiles riverine and coastal flooding are closely associated with tropical storms, hurricanes and other coastal storms.

It should be discussed that data supporting sea level rise will most probably increase the intensity and probability of future tidal flooding events. As is also discussed in Section 4.10 erosion will also contribute to the increased magnitude of flood events.

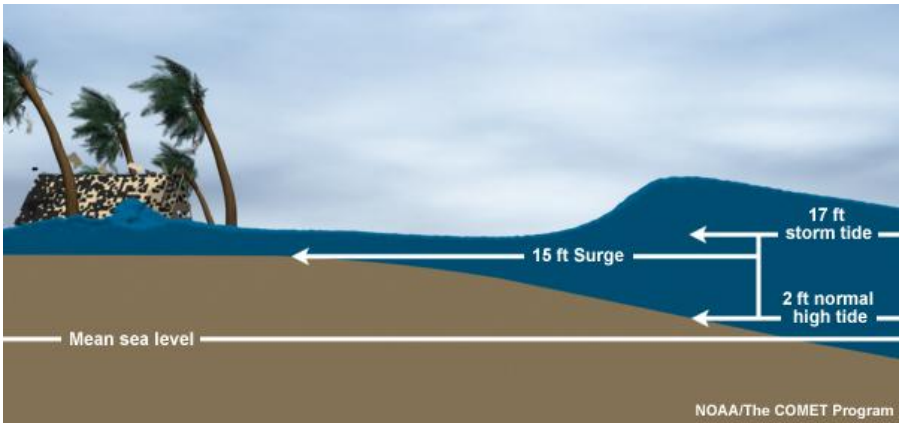
4.13. Storm Surge

4.13.1. Background

Along the coast, storm surge is often the greatest threat to life and property from a hurricane. In the past, large death tolls have resulted from the rise of the ocean associated with many of the major hurricanes that have made landfall. Hurricane Katrina (2005) is a prime example of the damage and devastation that can be caused by surge. At least 1500 persons lost their lives during Katrina and many of those deaths occurred directly, or indirectly, as a result of storm surge.

Storm surge is an abnormal rise in water generated by a storm. This is over and above the predicted astronomical tide. Storm surge is sometimes confused with storm tide. Storm tide is defined as the water level rise due to the combination of storm surge and astronomical tide (thus it is an accumulative level). Storm surge can casue significant flooding particularly when it occurs in relation to normal high tide. Figure 4.18 provides a visual representation of storm sruge and storm tide.

Figure 4.18: Storm Surge vs. Storm Tide



Source: NOAA: National Hurricane Center

Storm surge is produced when water is pushed toward the shore by the forces of winds moving cyclonically around a storm. The impacts of low barometric pressures are minimal on surge when compared to the wind driven forces. The maximal storm surge for any given area is complex as it can be affected by slight changes in strom intensity, forward speed, radius of maximum winds, angle of approach, central pressures, and the shape and characteristics of coastline features. A shallow slope has the potential for a great more intense storm surge to develop than sharp steep slope. Storm surge will inundate coastal floodplains by dune overwash, tidal elevation rise in inland bays and backwater flooding through coastal river mouths.

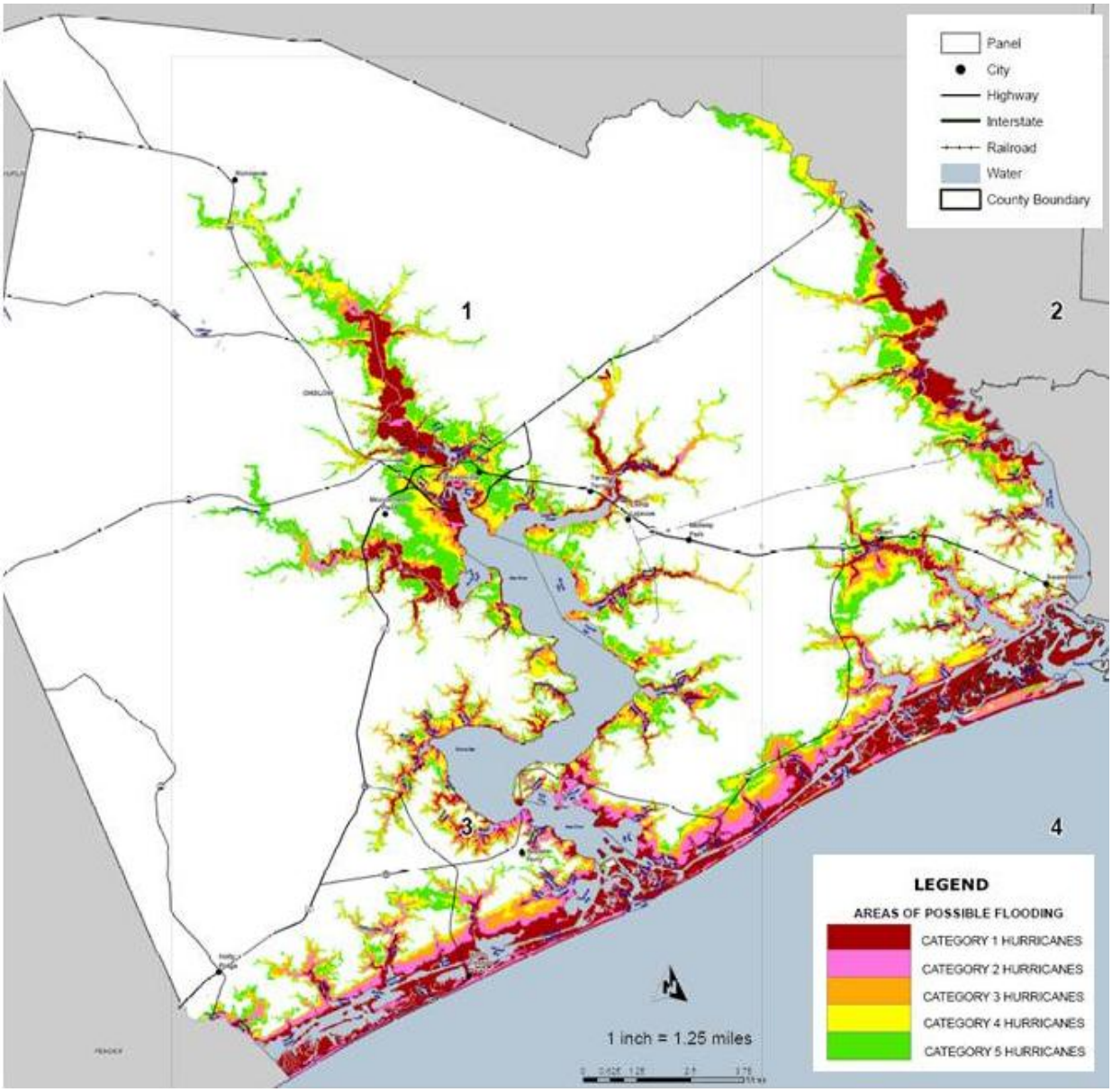
The storm surge arrives ahead of the storm center's actual landfall and the more intense the storm is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas. he surge is always highest in the right-front quadrant of the direction in which the storm is moving. As the storm approaches shore, the greatest storm surge will be to the north of the low-pressure system or hurricane eye. Such a surge of high water topped by driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate shoreline.

4.13.2. Location of Spatial Extent

Storm surges can be extremely dangerous to coastal communtieis in North Carolina, and the coastline of Onslow County. Storm surge can present a greater threat to a community during a hurricane and coastal storm than the winds.

Figure 4.19 shows hurricane inundations expected with each category of hurricane across Onslow County. The map was produced by FEMA in coordination with NOAA and the US Army Corps of Engineers (USACE). The map represents the potential for flooding from hurricanes based on storm surge heights calculated by the National Weather Service's SLOSH (Sea, Lake, and Overland Surge from Hurricanes) Model. SLOSH storm surge elevations represent the worst case combinations of direction, forward speed, landfall, and astronomical tide. The maps do not include wave heights that may accompany storm surge.

Figure 4.19: Storm Surge Inundation in Onslow County



Source: FEMA, NOAA, USACE (HURREVAC)

As Figure 4.19 shows areas closest to coastal areas are at high risk of storm surge inundation in addition most riverine floodplains along most rivers. Areas not located immediately along the coast or major rivers may not be directly impacted except in extreme storm events, they may experience flooding caused by storm surge and extremely high tides.

4.13.3. Historical Occurrences

NOAA and the National Climatic Data Center (NCDC) started recorded storm surge events in 1996. Prior to that storm surge events were not individually categorized apart from hurricane and coastal storm events. According to the NCDC there has been one recorded event of storm surge as shown in Table 4.17.

Table 4.17: Historical Storm Surge Events in Onslow County

Location	Date	Type	Mag	Death /Injury	Property Damage	Description
ONSLOW	08/26/2011	Storm Surge/tide		0/0	8.000M	**Hurricane Irene made landfall as a large category 1 hurricane on the Saffir/Simpson Hurricane Wind Scale during the morning of the 27th. Due to the large size of the hurricane strong damaging winds, major storm surge, and flooding rains were experienced across much of eastern North Carolina. Storm surge damages were estimated at 420 million dollars. Across Onslow county...winds of 50 to 60 mph resulted in numerous trees and power lines down with minor structural damage and extensive power outages. The Highest storm surge was 5.5 feet at North Topsail beach. Other locations receiving a 2 to 3 foot storm surge were Sneads Ferry and Swansboro. Storm total rainfall of 7 to 12 inches resulted in Flooding of streets and other low lying areas. One man died from a Heart attack while boarding up prior to the hurricane.**
Totals:				0/0	8.000M	

Source: National Climatic Data Center

4.13.4. Probability of Future Occurrences

It is likely that Onslow County will continue to experience storm surge associated with large tropical storms, hurricanes, and other coastal storms. As previously discussed, anticipated sea level rise will increase the probability and intensity of future storms. This may cause not only stronger intensity events but may also contribute to the loss of coastal wetlands and erosion of the beaches that serve as natural buffers against the storm surge.

OTHER

4.14. Wildfire

4.14.1. Background

A wildfire is an uncontrolled burning of grasslands, brush, or woodlands. The potential for wildfire depends upon surface fuel characteristics, recent climate conditions, current meteorological conditions and fire behavior. Hot, dry summers and dry vegetation increase susceptibility to fire in the fall, a particularly dangerous time of year for wildfire. Wildfires are part of the natural management of forest ecosystems, but may also be caused by human factors. Nationally, over 75,000 wildfires occur each year. Around 90 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. Fireseason in the southeastern United States runs from March through May.

There are three general patterns of fire spread: 1) Ground Fires – which burn organic matter in the soil beneath surface litter and aree sustained by glowing combustion; 2) Surface Fires – which spread with a flaming front and burn leaf litter, fallen branches and other fuels located at ground level; and 3) Crown Fires – which burn through the top layer of foliage on a tree, known as the canopy or crown fires. Crown fires, the most intense type of fire and often the most difficult to contain, need strong winds, steep slopes and a heavy fuel load to continue burning.

Creeping ground fire at Grand Canyon National Park, Arizona

Surface fire at Grand Canyon National Park, Arizona

Crown fire at Yellowstone National Park, Wyoming

Source: US Department of Interior, National Park Service

The potential for a major fire hazard depends on the characteristics of the fuel, the climate (local weather conditions), outdoor activities, debris burning and construction, and the degree of public cooperation with fire prevention measures. Understanding the fuel characteristic is important because a fuel's composition, including moisture level, chemical makeup and density, determines its degree of flammability. Moisture level is the most important consideration. Live trees usually contain a great deal of moisture while dead logs contain very little. The moisture content and distribution of these fuels define how quickly a fire can spread and how intense or hot a fire may become. High moisture content will slow the burning process since heat from the fire must first eliminate moisture. In addition to moisture, a fuel's chemical makeup determines how readily it will burn. Some plants, shrubs and trees contain oils or resins that promote combustion, causing them to burn more easily, quickly or intensely than those without such oils. Soil types also must be considered because fire affects the environment above and below the surface. Soil moisture content, the amount of organic matter present and the duration of the fire determine to what extent soil will be affected by fire.

Weather conditions such as wind, temperature and humidity also contribute to fire behavior. Wind is one of the most important factors because it can bring a fresh supply of oxygen to the fire as well as push the fire toward a new fuel source. Temperature of fuels is determined by the ambient temperature since fuels attain their heat by absorbing surrounding solar radiation. Humidity, the amount of water vapor in the air, affects the moisture level

of a fuel. At low humidity levels, fuels become dry and, therefore, catch fire more easily and burn more quickly than when humidity levels are high.

The wildland urban interface (WUI) is the area where structures and other human development meet or intermingle with undeveloped wildland, forest or vegetative fuels. North Carolina has more WUI acres than any other state in the country and our growth increases this acreage every year. The interface creates great challenges for fire managers as nearly every fire or its associated smoke may impact homes, roads, farms or other development. Further, the increasing demand for outdoor recreation places more people in wildlands during holidays, weekends and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for wildfire events that can sweep through the brush and timber and destroy property within minutes.

Wildfires can result in economic losses as well. Besides disruptions to business in or near the fire areas, outdoor recreational business, logging and paper product companies, and tourism based companies can all be impacted by wildfires. These impacts, if persistent, can result in economic losses that result in lost jobs. State and local governments can impose fire safety regulations on home sites, new developments, and industry to help with wildfire hazards. Communities can also adopt Firewise principles to help mitigate and reduce their risk. Hazard reduction can include land treatment measures such as fire access roads, water storage, safety zones, buffers, firebreaks, fuel breaks and fuel management. Fuel management, along with prescribed burning programs and cooperative land management planning can all be utilized to help reduce fire hazards.

4.14.2. Location and Spatial Extent

All areas of Onslow County are susceptible to wildfire and the wildland-urban interface is an area of concern with the continued residential growth. Further, drought conditions could exacerbate the risk of wildfire events in Onslow County.

4.14.3. Historical Occurrences

Table 4.18 shows a list of historical fire occurrences in Onslow County from 1993-2013. The list is a total number of occurrences throughout the County by year of incident along with a total number of acres burned. If specific locations are known they are also included. Figure 4.20 shows the fire occurrence areas (FOA) based on data from the Southern Wildfire Risk Assessment. Fire Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. The ignition rate is measured in the number of fires per year per 1,000 acres. Figure 4.21 is the wildland-urban interface risk index which reflects housing density in those specific areas where structures meet or intermix with wildland fuels.

Table 4.18: Historical Wildfire Occurrences in Onslow County (1993-2013)

Date Occured	Locations	# Acres	# Fires
1993	Countywide	405	102
1994	Countywide	743	120
1995	Countywide	430	84
1996	Countywide	312	59
1997	Countywide	379	117
1998	Countywide	172	65
1999	Countywide	430	97
2000	Countywide	308	82

2001	Countywide	322	132
2002	Countywide	239	89
2003	Countywide	144	49
2004	Countywide	210	91
2005	Piney Green / Crown Point	334	92
2006	Sandridge / Crown Pint/ Haw Branch	1275	87
2007	Piney Green / Crown Point/ Haw Branch / Queens Haven	319	116
2008	Catherine Lake /Blue Creek / Angola / Gurganus Rd.	452	77
2009	Countywide	100	77
2010	Countywide	201	91
2011	Countywide	1671	152
06/2011	GSR - 8	30k+	1
06/2011	Holly Shelter	60k+	1
2012	Countywide	72.5	52
2013	Countywide	562.6	42

Source: North Carolina Forest Service

According to the North Carolina Forest Service data this results in an average of approximately 432 acres per year and an average of 89 fires annually in Onslow County.

Figure 4.20: Fire Occurrence Areas in Onslow County

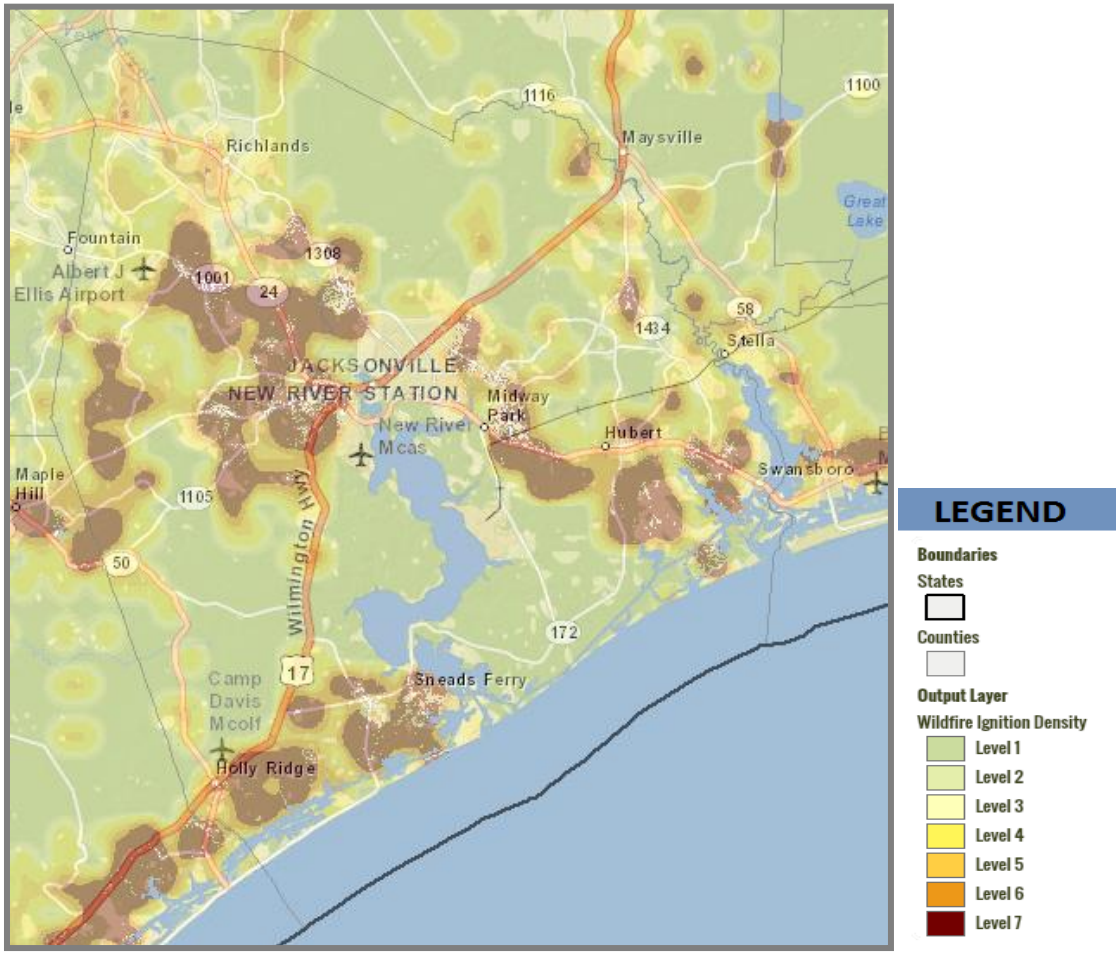
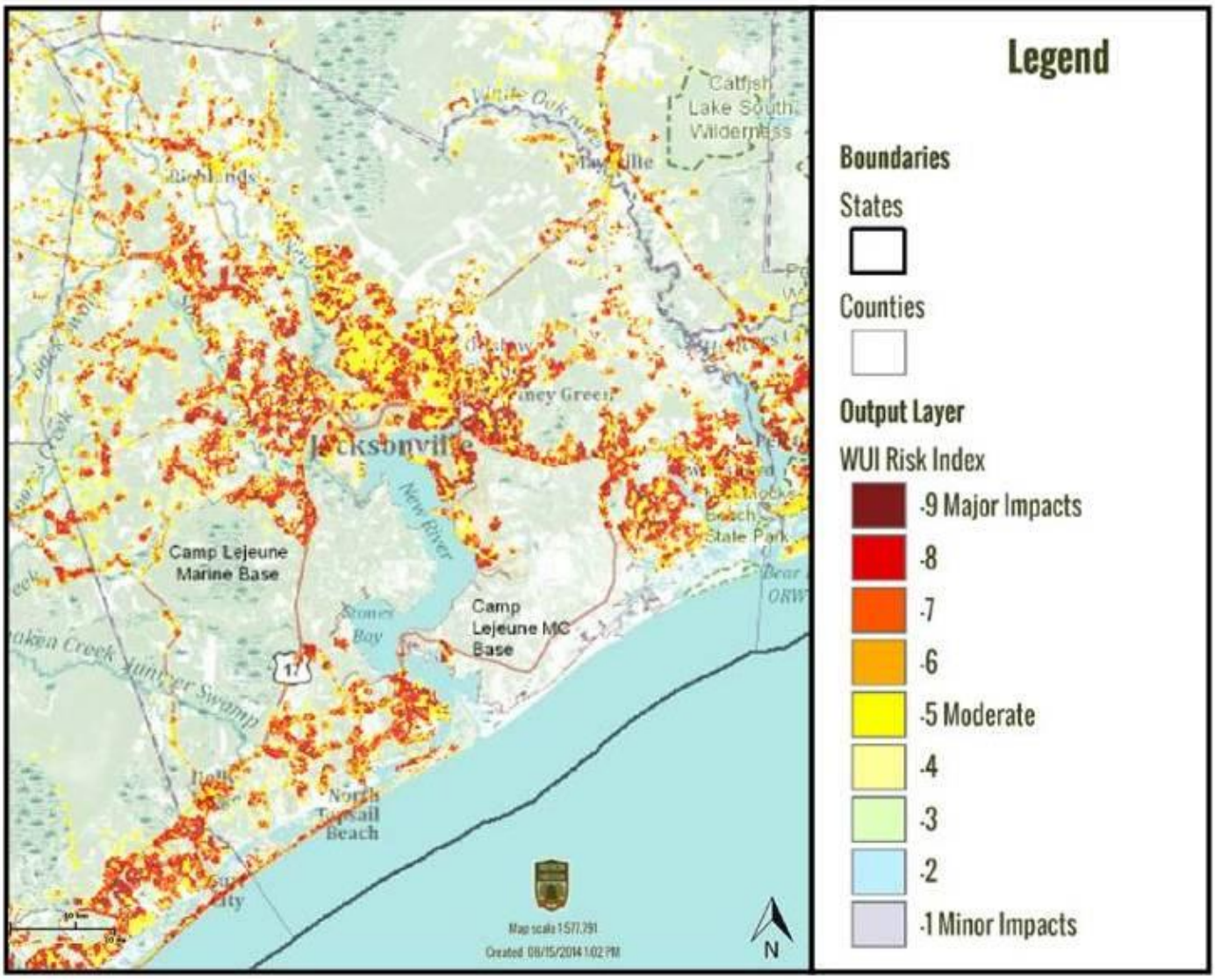


Figure 4.21: Wildland Urban Interface Risk Index in Onslow County



Source: Southern Wildfire Risk Assessment (SWRA)

4.14.4. Probability of Future Occurrences

There is a moderate probability of future wildfire events in Onslow County, this may increase during drought cycles and abnormally dry conditions.

4.15. Conclusions on Hazard Identification and Analysis

The hazard profiles presented in this section were developed using best available data from reputable sources. Government data was predominantly utilized and outside information was only utilized if no government data existed for the specific information. This profile should severe as a qualitative assessment as recommended be FEMA in their "How-to" guidance document titled *Understanding Your Risks: Identifying Hazards and Estimating Losses* (Publication 386-2). This profile relies heavily on historical and anecdotal data, stakeholder input, government research datasets, and professional and experienced judgment regarding observed and/or anticipated hazards. Other relevant plans, studies and technical reports were also consulted.

The following sources were among those used to develop the identification and analysis for this section:

- NC Department of Public Safety: Division of Emergency Management: Hazard Mitigation Planning (https://www.nccrimecontrol.org)
- Federal Emergency Management Agency (www.fema.gov)
- National Weather Service (www.weather.gov)
- National Oceanic and Atmospheric Administration: National Climatic Data Center (www.ncdc.noaa.gov)
- Southern Group of State Foresters: Wildfire Risk Assessment Portal (http://www.southernwildfirerisk.com/)
- National Integrated Drought Information Center (www.drought.gov)
- United States Geological Society (www.usgs.gov)
- United States Army Corps of Engineers: National Inventory of Dams (http://geo.usace.army.mil/pgis/f?p=397:1:0)
- North Carolina Department of Environment and Natural Resources (http://portal.ncdenr.org/web/guest)
- National Oceanic and Atmospheric Administration: National Hurricane Center (www.nhc.noaa.gov)
- National Oceanic and Atmospheric Administration: National Severe Storms Laboratory (www.nssl.noaa.gov)

5. VULNERABILITY ASSESMENT

Vulnerability to a natural hazard measures the extent to which people are expected to experience physical harm and the likelihood of property damage. It is important to know where and to what extent the community is susceptible to the impacts of natural hazards. The current level of development and infrastructure generates a set of conditions, resulting in every area having some degree of vulnerability to natural hazards. That degree of vulnerability will change in the future as an area experiences an increase or decrease in development and whether the community implements or ignores hazard mitigation. Therefore, we can speak of both present vulnerability and future vulnerability. Currently most available historic data is only countywide and will be used for both the County's and municipal planning jurisdictions.

The vulnerability section is designed to build upon the information provided in Section 4: Hazard Identification and Analysis by identifying community assets, potentially at-risk populations and development trends in Onslow County and then assesses the potential impact and amount of damages that could be caused by each of the identified hazards previously addressed. The primary objective of a vulnerability assessment is to help better understand the unique risks to identified hazards and better prioritize those risks to develop sound mitigation strategies and policy development. To maintain consistency with previous sections the hazards will be addressed in the following order:

- Atmospheric
  - 5.3 Drought and Heat Wave
  - 5.4 Severe Thunderstorm and Hail
  - 5.5 Hurricane and Coastal Storm (includes Nor'easter)
  - 5.6 Tornado
  - 5.7 Winter Storm
- Geologic
  - 5.8 Earthquake
  - 5.9 Landslide and Sinkhole
  - 5.10 Tsunami
- Hydrologic
  - 5.11 Coastal and Riverrine Erosion
  - 5.12 Dam and Levee Failure
  - 5.13 Flooding
  - 5.14 Storm Surge
- Other
  - 5.15 Wildfire

ELEMENTS B3 & B444 CFR Part 201.6(c)(2)(ii):
The risk assessment shall include a description of the jurisdictions vulnerability to the hazard described in paragraph (c)(2)(i) f this section. The description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008, must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazards;
(B) An estimate of the potential losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;
(C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

To complete the vulnerability assessment multiple sources were consulted for best available data including, federal, state, and local agencies. Additional work will be done on an ongoing basis to continually enhance, expand and improve the accuracy of the initial results. The changes will be incorporated into future plans on an as needed basis. This assessment was conducted utilizing best available data to develop an approximation of risk. Estimates should be used to understand the relative hazard risks and potential losses that may occur. It should be noted that uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific data and knowledge in reference to a specific hazard and their effects on the built environment and form approximations that are necessary to build a comprehensive analysis.

5.1. Methodology

The vulnerability assessment was completed utilizing three distinct methodologies. The first is a geographic information system (GIS) based analysis. The second utilizes statistical risk assessment methodology. The third is a qualitative based approach. Each approach provides estimates for the potential impact of hazards using a common, systematic framework for evaluation, including historical occurrence provided in Section 4. The methodologies are briefly described and introduced here and are further illustrated throughout this section. For each hazard addressed, the vulnerability is summarized in part by an annualized loss estimate specific to that hazard along with a Priority Risk Index (PRI) value described below.

A GIS based analysis was conducted for the following hazard groups:

- Hurricane and Coastal Storm (including Nor'easter)
- Earthquake
- Landslide and Sinkhole
- Coastal and Riverrine Erosion
- Dam and Levee Failure
- Flooding
- Storm Surge
- Wildfire

A statistical risk assessment approach was used to analyze the remaining hazard groups:

- Drought and Heat Wave
- Severe Thunderstorm and Hail
- Tornado
- Winter Storm
- Tsunami

5.1.1. GIS-Based Analysis

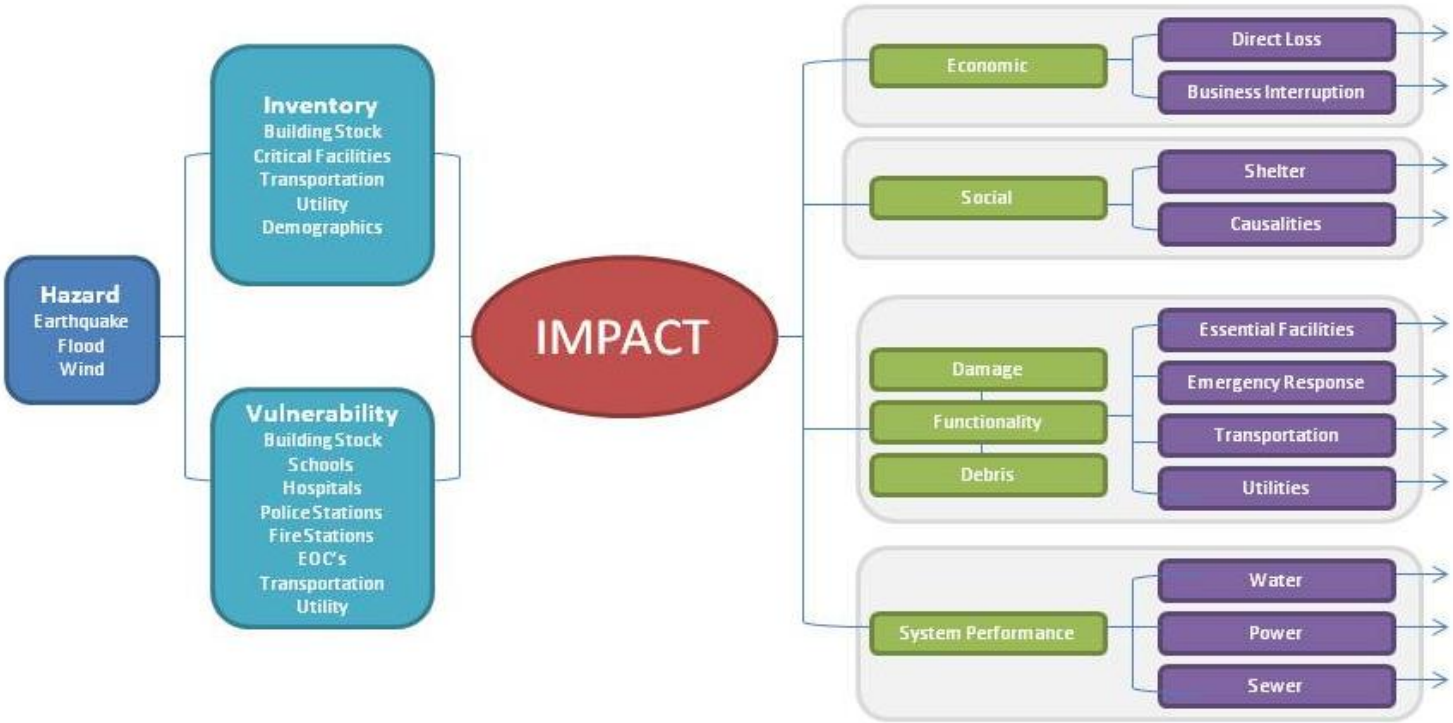
GIS based analysis is based on digital data that is collected from local, regional, state and national sources. The Onslow County Geographical Information System (GIS) Division utilized the latest version of ESRI ArcGIS to help assess hazard vulnerability. Utilizing data layers programmed into the ArcGIS program hazard

vulnerability can be quantified by estimating the assessed building value for parcels and/or buildings determined to be located in identified hazard areas. FEMA's HAZUS-MH software was also utilized to model hurricane winds, riverrine flood, and estimate potential losses for these hazards. The result in this analysis is an estimate of the number of people, buildings and critical facilities, as well as a value of the buildings, determined to be at a potential risk for those hazards with a delineable geographic boundary.

HAZUS-MH

HAZUS-MH is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods and hurricanes. HAZUS-MH uses Geographic Information Systems (GIS) technology to estimate physical, economic and social impacts of disasters. It graphically illustrates the limits of identified high-risk locations due to earthquake, hurricane and floods. Users can then visualize the spatial relationships between populations and other more permanently fixed geographic assets or resources for the specific hazard being modeled, a crucial function in the pre-disaster planning process. HAZUS-MH uses a statistical approach and mathematical modeling of risk to predict a hazards frequency of occurrence and estimated impacts based on recorded historical damage information. The HAZUS-MH risk methodology is described as being parametric, in that distinct hazard and inventory parameters (such as wind speed and building type) were modeled to determine the impact (damages and losses) on the built environment. Figure 5.1 shows a conceptual model of HAZUS-MH methodology.

Figure 5.1: Conceptual Model of HAZUS-MH Methodology



5.1.2. Statistical Risk Assessment Methodology

For those hazards that occur outside the scope of HAZUS and GIS based approaches a statistical risk assessment methodology was utilized. These hazards include drought and heat wave, severe thunderstorm and

hail, tornado, tsunami and winter storm. Because these hazards do not have clearly defined geographical boundaries they cannot be assessed utilizing spatial analysis through GIS systems. This method follows the same principles as HAZUS. First, historical data is compiled for each hazard to relate occurrence patterns (frequency, intensity, damage, etc...) with existing hazard models. When possible, qualitative hazard loss estimates are compared with historical damage data as recorded through reliable sources (local documentation, National Climatic Data Center, etc…) and average annual loss estimates are identified. Hazards that were analyzed utilizing HAZUS were run through a probabilistic "worst case scenario" result to show the maximum potential extent of damages. It should be noted that smaller events would thus create lower losses that are estimated here.

5.1.3. Qualitative Methodology

A qualitative assessment relies less on technology and more on historical and anecdotal data, community input and professional judgment regarding expected hazard impacts. The qualitative method chosen for the Onslow County Hazard Mitigation Plan is the Priority Risk Index (PRI). The purpose of the PRI is to categorize and prioritize all potential hazards as high, moderate or low risk. The PRI is assessed on all hazards but is used to assist with hazards that have no available GIS data or relevant information to perform a quantitative analysis.

The PRI results in numerical values that allow all identified hazards to be ranked against one another on a standard scale, the higher the risk, the higher the PRI value. PRI values are obtained by assigning varying degrees of risk to each hazard across five different categories: probability, impact, spatial extent, warning time and duration. Each category has varying degrees of risk and each degree of risk is assigned a numerical value (1 to 4). Each category is then weighted against the other categories. Table 5.1 lists the categories, degrees of risk, and weighted values. The PRI value is then calculated by multiplying the weighting factor against the category value for each hazard and summing each categories value together. The highest PRI values that can be assigned are 4.0 based on the equation (1 being the lowest risk and 4 being the highest risk). The equation is written:

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

Estimated maximum severity levels (impact) such as magnitude and extent were classified according to scientific scales such as the Saffir-Simpson scale for hurricanes, Enhanced Fujita scale for tornados, Modified Mercalli Intensity for earthquakes and Palmer Drought Severity Index for drought. For those hazards with no scientifically approved scale, only qualitative descriptions of severity are provided based on the hazard identification in Section 4.

Table 5.1: Priority Risk Index Summary

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 100% probability	2	
	Likely	Between 10 and 100% probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50-100% of area affected	4	
Warning Time	More than 24 hrs	Self Explanatory	1	10%
	12-24 hours	Self Explanatory	2	
	6-12 hours	Self Explanatory	3	
	Less than 6 hours	Self Explanatory	4	
Duration	Less than 6 hours	Self Explanatory	1	10%
	Less than 24 hours	Self Explanatory	2	
	Less than 1 week	Self Explanatory	3	
	More than 1 week	Self Explanatory	4	

5.2. Study Area Definition

The study area includes the unincorporated areas of Onslow County and all five municipalities: Holly Ridge, Jacksonville, North Topsail Beach, Richlands, and Swansboro. Onslow County (OC) is in the NC Emergency Management (NCEM) Eastern Branch (EB), and Federal Emergency Management Agency (FEMA) Region IV. Geographically it is located in SE North Carolina approximately 100 miles SE of Raleigh, and 30 miles N of Wilmington. It is bordered on the E by the Atlantic Ocean and Carteret County; on the S by the Atlantic Ocean and Pender County; on the W by Pender and Duplin Counties; and on the N by Jones County.

Onslow County consists of flat, gently rolling terrain, which slopes easterly from an altitude of 63 feet above sea level in the town of Richlands to near sea level at the town of North Topsail Beach. The average elevation is 23 feet. The County includes 27 miles of unspoiled coastline and a total land area of approximately 819 square miles or approximately 524,000 acres. Of this total, 157,000 acres make up US Marine Corps Installations located in the County.The City of Jacksonville is home to the County Seat, and the areas surrounding the City comprise the major population centers and growth area in the County.

5.2.1. Asset Inventory

An inventory of all of Onslow County's assets was compiled in order to help identify and characterize those assets that may be potentially at risk to the identified hazards. By identifying these assets and their geographic location a relative risk and vulnerability for said assets can be determined. Two categories of assets are identified:

- Improved Property – Includes all improved properties in both unincorporated areas of Onslow County and the incorporated jurisdictions according to local parcel data provided by Onslow County Tax Department. The information is listed by number of parcels, number of buildings, and total assessed value of improvements (buildings) that may be exposed to the identified hazards.

- Critical Facilities – Includes all government buildings, medical facilities (both hospitals and EMS stations), fire stations, police stations, schools (with shelters identified), supportive and public infrastructure (airports, highways, bridges, dams, water & sewer facilities), and public and private utilities. Critical facilities are identified as those facilities which must function to protect the health, safety, and viability of the community and those facilities that provide essential services required to maintain or restart the overall function of the community.

The following tables provide detailed listings of the assets have been identified for inclusion in the vulnerability assessment. The list may be expanded in future updates to become more inclusive as better dtat becomes available.

5.2.2. Improved Property

Table 5.2 lists the number of parcels, estimated number of buildings, and total assessed value of improvements in Onslow County.

Table 5.2: Improved Property in Onslow County

Jurisdiction	Number of Parcels	Estimated Number of Buildings	Total Assessed Value of Improvements
Unincorporated	56,764	39,810	$7,094,839,810
Holly Ridge	2,686	1,003	$227,097,210
Jacksonville	15,583	14,677	$3,536,486,684
North Topsail	3,943	2,594	$804,012,460
Richlands	1,074	924	$163,296,910
Swansboro	2,004	1,668	$412,433,041
TOTAL	82,054	60,676	$12,238,166,115

Source: Onslow County Tax Office

5.2.3. Critical Facilities

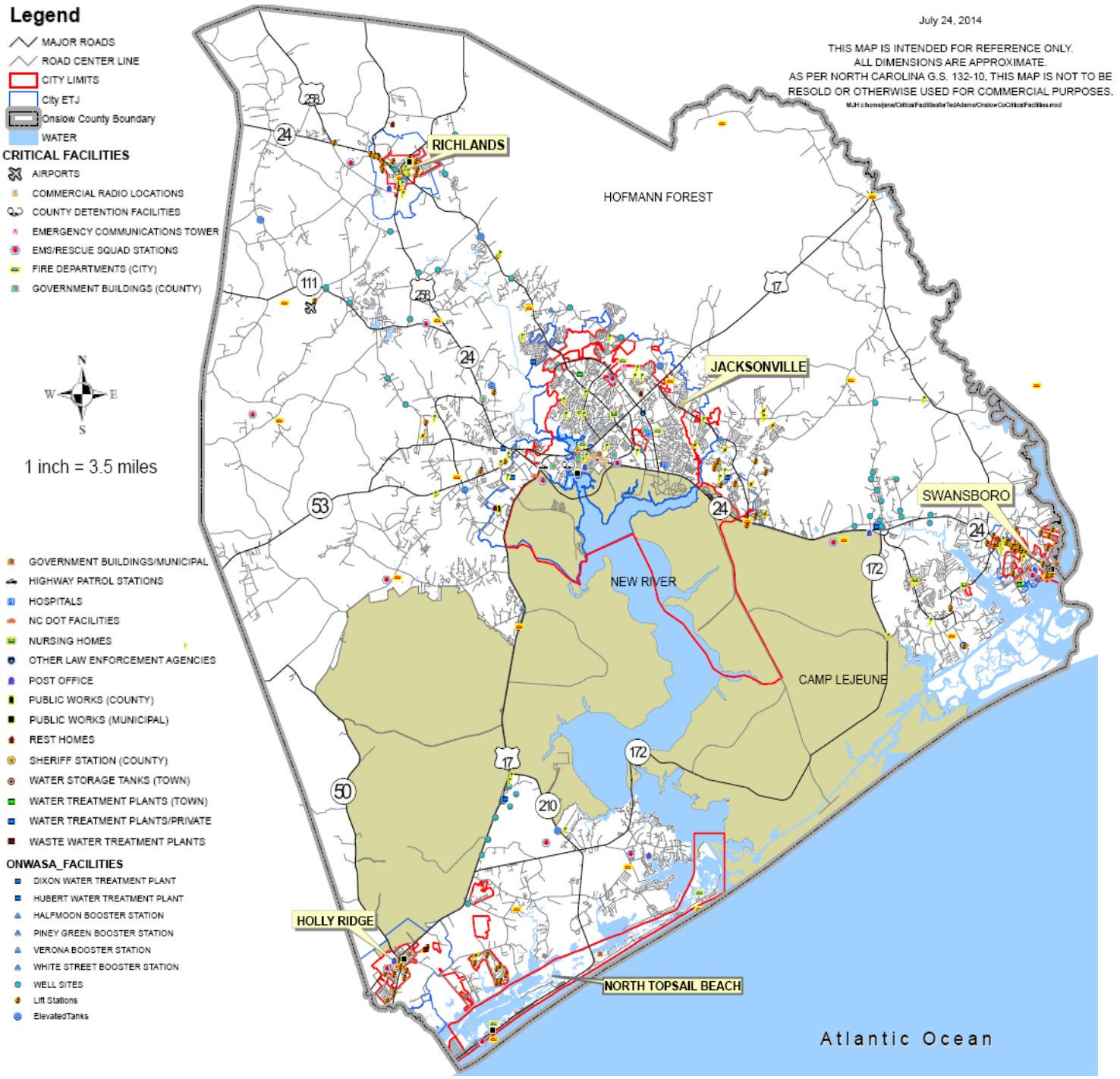
Table 5.3 lists all fire stations, police stations, hospitals, emergency medical facilities (EMS & Rescue), government facilities, emergency shelters, airports, dams and wastewater treatment plants, utilities, public infrastructure and schools in Onslow County. The listings are separated out by the number of each facility within each jurisdiction and the unincorporated areas of the county. Figure 5.2 shows estimated critical facility locations within Onslow County.

Table 5.3: Critical Asset Inventory

Location	Number
Fire Stations	
Holly Ridge	1
Jacksonville	5
North Topsail Beach	2
Richlands	1
Swansboro	1
Unincorporated	16
Police Stations	
Holly Ridge	1
Jacksonville	2
North Topsail Beach	1
Richlands	1
Swansboro	1
Unincorporated	0
Health Care (Hospitals, Urgent Care, Mental Health)	
Jacksonville	7
EMS Stations & Rescue Squads	
Holly Ridge	1
Jacksonville	2
North Topsail Beach	1

Richlands	1
Swansboro	0
Unincorporated	11
Government Buildings	
Holly Ridge	2
Jacksonville	12
North Topsail Beach	2
Richlands	1
Swansboro	2
Unincorporated	2
Emergency Shelters	
Holly Ridge	0
Jacksonville	3
North Topsail Beach	0
Richlands	1
Swansboro	1
Unincorporated	3
Airports	
Holly Ridge	1
Unincorporated	5
Dams & Wastewater Treatment Plants	
Unincorporated	6
Schools	
Holly Ridge	0
Jacksonville	14
North Topsail Beach	0
Richlands	4
Swansboro	4
Unincorporated	18
Utilities	
Holly Ridge	2
Jacksonville	3
North Topsail Beach	1
Richlands	1
Swansboro	2
Unincorporated	16
Emergency Communications Towers	
Holly Ridge	0
Jacksonville	1
North Topsail Beach	0
Richlands	0
Swansboro	0
Unincorporated	4

Figure 5.2: Asset Inventory for Onslow County



Source: Onslow County GIS

5.2.4. Population

The population of the County and the municipalities within the County is 185,220 (*US Census 2013 estimates).* Onslow County is the 11th most populated County in NC and is currently ranked as the fastest growing county (NC Office of State Budget and Management 2013). Onslow County sees a moderate increase in population

during tourist season and according to the Onslow County Tourism board the estimated peak seasonal population is around 200,000+. Table 5.4 provides a summary of population, land areas and densities for the planning areas.

Table 5.4: Population, Areas and Densities

Jurisdiction	Population	Area in Square Miles			Total Housing Units	Density Per Square Mile of Land Area	
		Total Area	Water Area	Land Area		Population	Housing Units
Onslow County	185,220	909	142	767	74,227	242	97
Holly Ridge	1,758	3.8	0.1	3.76	734	468	195
Jacksonville	69,079	50.7	4.2	46.5	22,005	1,486	473
North Topsail Beach	736	10.6	4.2	6.4	2,454	115	383
Richalnds	1,654	1.6	0.0	1.6	709	1,034	443
Swansboro	2,993	2.2	0.1	2.1	1,499	1,425	690

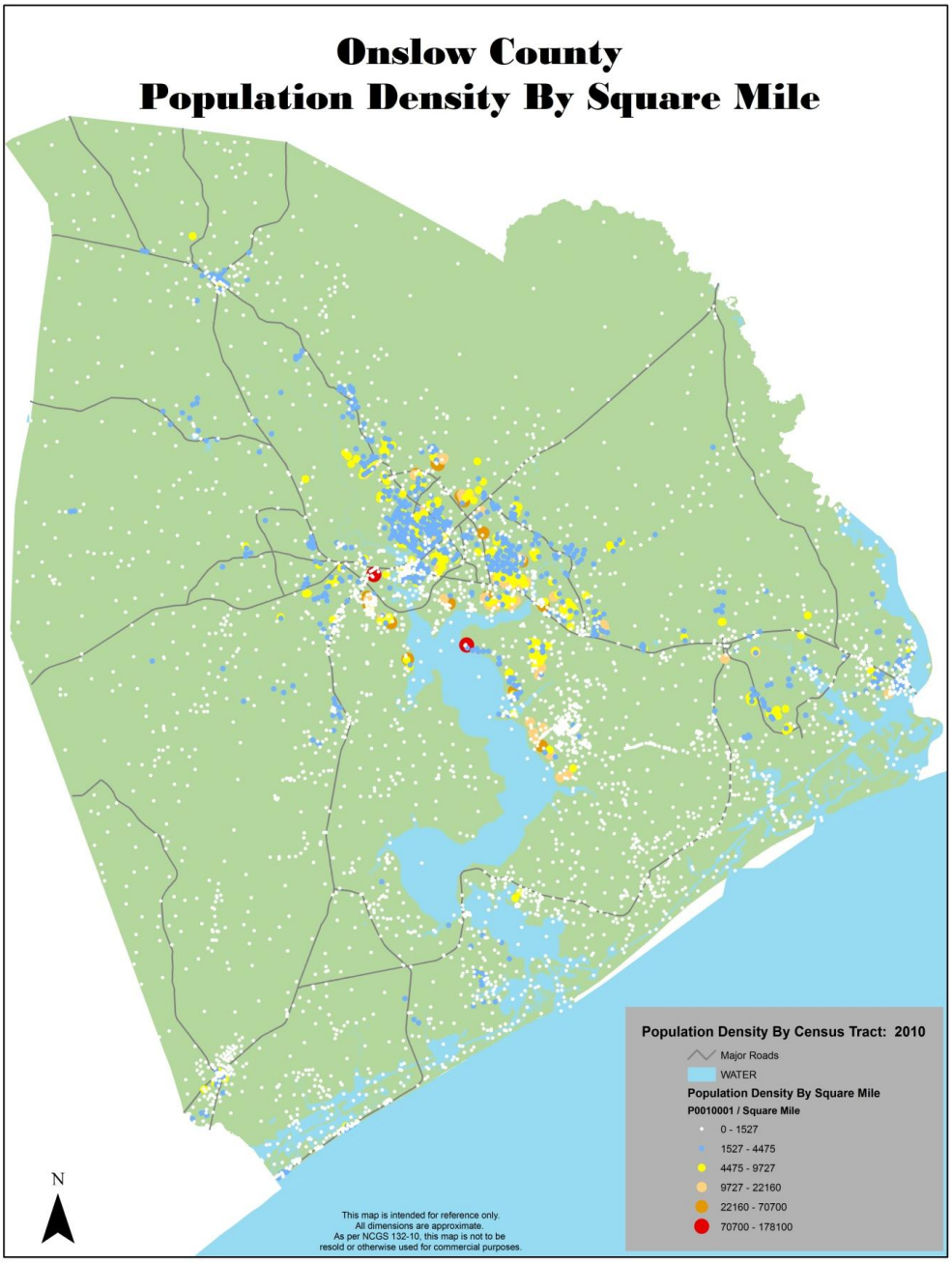
Sources: US Census: Gazetteer

5.2.5. Social Vulnerability

According to the 2010 US Census the median age for Onslow County is 25.8 which is much younger than the North Carolina median age of 37.4 and the average household size in Onslow County is 2.0 persons per household (33.9%). Nearly 18% of the population ranges between 20-24 years old and 9.6% of the population is over the age of 62 (approximately 17,781) and 9.4% are under the age of 5 (approximately 17,410). The median household income level is $45,182 with 21.1% of the population earning between $50,000 and $74,999. Approximately 22.3% of the population earns an income below $25,000 with 6.8% earning less than $10,000. Approximately 11.7% of the residents are listed as veterans. Approximately 7% (13,386) of the population age 16 and older are listed as holding disability status.

Figure 5.3 illustrates the population density by census tract in Onslow County based on the 2010 U.S. Census. Based on the map

Figure 5.3: Population Density by Census Tract



Source: U.S. Census; Onslow County GIS

5.2.6. Development Trends

An important factor in determining mitigation options that will influence future land use decisions is to develop a general analysis of current land uses and development trends. Utilizing this information along with population statistics, projected growth and social vulnerability helps develop a complete picture of vulnerability.

Onslow County and its municipalities have all developed land use ordinances to help regulate land use and guide future development patterns. Onslow County and its municipalities have each develop maps to help better visualize vulnerabilities. Each map can be located throughout the document as identified in Table 5.5.

Table 5.5: Map Reference Locations

Location	Map	Page
Onslow County	Map: Onslow County with Municipalities & ETJ's	Figure 4.1 (pg. 62)
	Map: Flood Hazards	Figure 4.17 (pg. 109)
	Map: Flood Hazard & Repetitive Loss	Figure 5.6
	Map: Flood Hazard & Critical Facilities	Figure 5.4
	Map: Critical Facilities	Figure 5.2 (pg. 128)
Jacksonville	Map 1: City Limits & ETJ	Annex 1-51
	Map 2: CAMA Land Use Map	Annex 1-52
	Map 3: Zoning	Annex 1-53
	Map 4: Flood Zone Map	Annex 1-54
	Map 5: Critical Facilities	Annex 1-55
	Map 6: Repetitive Loss Areas	Annex 1-56
Holly Ridge	Map 1: City Limits & ETJ	Annex 2-26
	Map 2: Flood Hazard	Annex 2-27
	Map 3: Land Use	Annex 2-28
	Map 4: Flood Hazard & Land Use	Annex 2-29
	Map 5: Zoning	Annex 2-30
	Map 6: Flood Hazard & Zoning	Annex 2-31
	Map 7: Repetitive Loss Areas	Annex 2-32
	Map 8: Flood Hazard & Repetitive Loss	Annex 2-33
	Map 9: Flood Hazard & Critical Facilities	Annex 2-34
	Map 10: Town SLOSH Map	Annex 2-35
North Topsail Beach	Map 1: City Limits & ETJ	Annex 3-41
	Map 2: Flood Hazards	Annex 3-42
	Map 3: Land Use	Annex 3-43
	Map 4: Flood Hazard & Land Use	Annex 3-44
	Map 5: Zoning	Annex 3-45
	Map 6: Flood Hazard & Zoning	Annex 3-46
	Map 7: Repetitive Loss Areas	Annex 3-47
	Map 8: Flood Hazard & Repetitive Loss	Annex 3-48
	Map 9: Flood Hazard & Critical Facilities	Annex 3-49
	Map 10: Town SLOSH Map	Annex 3-50
Richlands	Map 1: City Limits & ETJ	Annex 4-34
	Map 2: Flood Hazards	Annex 4-35
	Map 3: Land Use	Annex 4-36
	Map 4: Flood Hazard & Land Use	Annex 4-37
	Map 5: Zoning	Annex 4-38
	Map 6: Flood Hazard & Zoning	Annex 4-39
	Map 7: Repetitive Loss Areas	Annex 4-40
	Map 8: Flood Hazard & Repetitive Loss	Annex 4-41
	Map 9: Flood Hazard & Critical Facilities	Annex 4-42
Swansboro	Map 1: ETJ & Town Limits	Annex 5-43
	Map 2: Flood Hazards	Annex 5-44
	Map 3: Land Use	Annex 5-45
	Map 4: Flood Hazard & Land Use	Annex 5-46
	Map 5: Zoning	Annex 5-47
	Map 6: Flood Hazard & Zoning	Annex 5-48

	Map 7: Repetitive Loss Areas	Annex 5-49
	Map 8: Flood Hazard & Repetitive Loss	Annex 5-50
	Map 9: Flood Hazard & Critical Facilities	Annex 5-51

ATMOSPHERIC HAZARDS

5.3. Drought & Heat wave

PRI Value: 1.8
Annualized Loss Estimate: Negligible

Drought can impact natural systems as well as the ability of cities and towns to function effectively. Effects can include impacts to crops, wildlife, livestock, and the availability of water supplies for residential and commercial use. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.6 and the PRI value is 1.8 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.6: Qualitative Assessment for Drought & Heat wave

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Likely	Minor	Negligible	12-24 hrs	Less than 24 hrs

Due to a lack of available data on historic losses across the sectors caused by drought in Onslow County this estimation is limited to agricultural claims. Agriculture concerns, such as poultry and swine operations are most susceptible to extreme heat. Extreme heat can and does cause extensive poultry deaths. Livestock, while susceptible to extreme heat can be cared for easier than poultry. According to the Natural Resources Defense Council (referred by: National Drought Mitigation Center (NDMC) the annualized crop losses due to drought for North Carolina was $77,754,113 in federal aid with Onslow County receiving $522,157 in Federal Crop Insurance claims, the majority of which were reported as excessive moisture/precipitation/rain.

5.3.1. Asset Vulnerability

All assets across Onslow County are exposed to the effects of drought and heat wave and may exceed total figures listed in Table 5.2. It is unlikely that this hazard will cause structural damages to critical facilities. Onslow County pulls water from aquifers and deep water wells and has felt minimal impact in the recent droughts.

5.4. Severe Thunderstorm & Hail

PRI Value: 2.4
Annualized Loss Estimate: Hail-none (NCDC 1955-2013); Severe Thunderstorm - $4,645 (NCDC 1965-2013)

Historical data shows that Onslow County has a high probability of severe thunderstorm and hail activity on an annual basis. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.7 and the PRI value is 2.4 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.7: Qualitative Assessment for Severe Thunderstorm & Hail

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Highly Likely	Minor	Small	Less than 6 hrs	Less than 6 hrs

Because it cannot be predicted where severe thunderstorm and hail events will occur it is impossible to map geographic boundaries for this hazard and all existing and future buildings, facilities, and populations are considered equally exposed to this hazard and could potentially be impacts.

Given the lack of historical loss data on significant hail damage occurrences in Onslow County, it is assumed that while one major event could potentially result in significant losses due to hail, annualizing structural losses over a long period of time would most likely yield a negligible annualized loss estimates.

5.4.1. Asset Vulnerability

All inventoried assets (Table 5.3) in Onslow County are equally exposed to the effects of Hail. Anticipated damages to this hazard are expected to be minimal to inventoried assets.

5.5. Hurricanes and Coastal Storms (Includes Nor'easters)

PRI Value: 2.9
Annualized Loss Estimate: $51 million (NCDC 1996-2013)

Historical records show that Onslow County, and its jurisdictions, are vulnerable to the damaging effects of hurricane, tropical storms and Nor'easters. According to NOAA records, 104 hurricanes and tropical storms have passed within a 75 mile radius of Onslow County since 1851. Of the 104 passing near Onslow 76 are recorded as having passed through or made landfall in the county. During a Category 3 slow moving hurricane, approximately 18,764 acres could be inundated as compared to 21,377 acres for a fast moving Category 3 hurricane. Onslow County is more vulnerable to fast moving hurricanes (hurricanes that move at a speed that is greater than or equal to 15 mph) than it is to slow moving hurricanes (hurricanes that move at a speed that is less than 15 mph). The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.8 and the PRI value is 2.9 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.8: Qualitative Assessment for Hurricane & Coastal Storm

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Likely	Critical	Large	More Than 24 hrs	Less Than 24 hrs

Hurricanes, tropical storms, and Nor'easters are often large in size and often impact large geographic areas. All existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. Often, other hazards will co-occur during these types of storms. These include flooding, erosion, tornadoes and storm surge. HAZUS-MH was utilized to estimate potential losses from hurricane winds. Currently HAZUS-MH is not capable of developing an estimation model for the cumulative losses incurred from the simultaneous flooding, erosion, storm surge and tornadoes. Storm surge is addressed individually later in this section.

Detailed loss estimates for the hurricane and tropical storm hazards (as related to winds) were developed based on the probabilistic scenarios using HAZUS-MH (Level 1 scenario). Table 5.9 shows estimates of potential losses for hurricane force winds.

Table 5.9: Hurricane Winds Potential Loss Estimates

Level of Event	Estimated Losses
50 Year Storm (95-110 mph Winds)	$229,212
100 Year Storm (110-125 mph Winds)	$1,319,567
500 Year Storm (125-140 mph Winds)	$3,536,760

5.5.1. Asset Vulnerability

All assets in Onslow County and its jurisdictions are exposed to hurricane, tropical storm and Nor'easter hazards. Damages may exceed the estimates given for any particular storm due to varying factors that influence each event. Specific vulnerabilities of each asset will depend greatly on their design and the mitigation measures, if any, that are in place. Continued enforcement of building codes, flood ordinances and other regulatory policies and tools are designed to help mitigate the effects and help minimize future losses.

5.6. Tornado

PRI Value: 2.1
Annualized Loss Estimate: $249,939 (NCDC 1950-2013)

Historical records show that Onslow County is vulnerable to tornado activity. Tornado activity is often associated with other hazards such as Severe Thunderstorm and Hurricane. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.10 and the PRI value is 2.1 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.10: Qualitative Assessment for Tornado

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Likely	Minor	Small	Less Than 6 hrs	Less Than 6 hrs

Because it cannot be predicted where a tornado will strike, it is not possible to map geographic boundaries for this hazard or produce detailed loss estimates. Therefore, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. According to the National Climatic Data Center, over a 59 year time span (1959-2013) Onslow County incurred almost $15 million in losses due to tornado.

5.6.1. Asset Vulnerability

Given the history and likely probability of tornado activity and an inability to predict an affected area, all assets in Onslow County are considered exposed to this hazard. Specific vulnerabilities for each asset will be greatly dependent upon their design and any mitigation measures, if existing, in place. Damages may exceed the average annual losses due to variability of the size and intensity of the storm.

5.7. Winter Storm

PRI Value: 2.1
Annualized Loss Estimates: $8,529 (NCDC 1996-2013)

Historical records indicate that Onslow County is vulnerable to winter storm. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.11 and the PRI value is 2.1 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.11: Qualitative Assessment of Winter Storm

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Possible	Minor	Large	More Than 24 hrs	Less Than 1 Week

Because winter storms often affect large geographic areas, it is not possible to map geographic boundaries for this hazard or produce detailed loss estimates. Therefore, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. According to the National Climatic Data Center, there were 22 occurrences of winter storm, winter weather, sleet, and frost/freeze over a 17 year period.

5.7.1. Asset Vulnerability

Due to the wide geographical scope of winter storms all assets in Onslow County are considered exposed to this hazard. Damages may exceed the average annual losses due to variability of the size and intensity of the storm.

GEOLOGIC HAZARDS

5.8. Earthquake

PRI Value: 1.3
Annualized Loss Estimates: Negligible

Historical records indicate that Onslow County is vulnerable to winter storm. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.12 and the PRI value is 1.3 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.12: Qualitative Assessment of Earthquake

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Unlikely	Minor	Negligible	Less Than 6 hrs	Less Than 6 hrs

As is referenced in the Hazard Identification Section (Section 4) Onslow County's risk to earthquakes is considered limited. HAZUS-MH was utilized to determine estimated losses from earthquakes for the 100, 500 and 1,000 year return periods. Table 5.13 provides a summary of dollar losses and Table 5.14 shows generalized building damage estimates based on percentage of damage (by damage state).

Table 5.13: Earthquake Potential Loss Estimates

Level of Event	Estimated Losses
100 Year Event	Less than $1 million
500 Year Event	$5,780,000
1,000 Year Event	$26,800,000

Table 5.14: Estimates of Potential Building Damage by Damage State

Building Occupancy Type (# of buildings)	Slight		Moderate		Extensive	
	500 yr	1,000 yr	500 yr	1,000 yr	500 yr	1,000 yr
Single Family Residential	373	1,334	58	251	5	23
Other Residential	506	1,343	151	558	5	28
Commercial	34	102	10	37	1	5
Industrial	10	30	3	11	0	1
Agricultural	3	8	1	2	0	0
Education	1	4	0	1	0	0
Government	1	3	0	1	0	0
Religious/Non-Profit	4	11	1	4	0	1
TOTAL	932	2,835	865	865	11	58

5.8.1. Asset Vulnerability

Due to the wide geographical scope of earthquakes all assets in Onslow County are considered exposed to this hazard. Damages from earthquake hazard may vary significantly based on the location of the epicenter, building construction and magnitude of the event.

5.9. Landslide and Sinkhole

PRI Value: 1.6
Annualized Loss Estimate: Negligible

As documented in Section 4, historical records indicate no evidence of landslide events in Onslow County and minor evidence of sinkhole events. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.15 and the PRI value is 1.6 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.15: Qualitative Assessment of Landslide & Sinkhole

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Possible	Minor	Negligible	Less Than 6 hrs	Less Than 6 hrs

There is currently only one recorded event of loss due to sinkhole at an estimated cost of $125,000 (home was condemned and removed). Given the lack of historical data on landslide and sinkhole damages in Onslow County it is assumed that singular events may result in significant damages or losses but long term loss projections would be very low.

5.9.1. Asset Vulnerability

While landslide and sinkhole occurrences are rare, the vast majority of the county overlies a karst formation as is documented in Section 4. Therefore, all identified assets are considered to be vulnerable.

5.10. Tsunami

PRI Value: 2
Annualized Loss Estimates: Negligible

As documented in Section 4, historical records indicate no evidence of tsunami events in Onslow County. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.16 and the PRI value is 2 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.16: Qualitative Assessment of Tsunami

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Unlikely	Limited	Small	6-12 hrs	More Than 1 Week

No standardized models exist for determining loss estimation secondary to tsunami for the East Coast. Currently, The Center for Applied Coastal Research at the University of Delaware, are working to develop tsunami inundation maps for the East Coast however, maps for North Carolina have not yet been created. As a general guideline though, vulnerability to tsunami can be compared to vulnerability to storm surge inundation and flooding.

Given the lack of historical data on tsunami occurrences to affect Onslow County it is assumed that while a single event may cause significant losses, long term projected losses would be very low.

5.10.1. Asset Vulnerability

All current and future assets that are in coastal or riverine areas could potentially be exposed to the tsunami hazard.

HYDROLOGIC HAZARDS

5.11. Coastal & Riverine Erosion

PRI Value: 2.2
Average Annual Loss: Negligible

As documented in the Hazard Identification section Onslow County is vulnerable to the effects of erosion, most significantly coastal erosion. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.17 and the PRI value is 2.2 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.17: Qualitative Assessment of

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Highly Likely	Minor	Negligible	More Than 24 hrs	More Than 1 Week

Coastal Erosion is the primary area of erosion hazard in Onslow County. Unlike most other hazards, coastal erosion is a hazard best described as a slow naturally occurring process that progressively decreases the shoreline over an extended period of time. While significant erosion may be caused in a single event, such as hurricane and tropical storm, most erosion rates are measured on the long-term impact. Shoreline restoration projects and hazard mitigation efforts can complicate the ability to accurately determine hazard areas due to erosion as those areas of highest concern are often areas that receive re-nourishment or stabilization efforts. The areas of highest erosion, according to the North Carolina Division of Coastal Management, are primarily Onslow Beach (Camp Lejeune) and Bear Island (Hammock Beach State Park). For documentation purposed this assessment will focus on improved structures in North Topsail Beach and Bear Island.

The determination of at-risk properties was determined by developing the average erosion rates for several sections of coastline. These average rates were then projected by 20 years of continuous erosion. This developed a potential constant erosion of 60 feet of lost shoreline over the 20 years. It should be noted this factor does not account for storm related loss, restoration or accretion. Applying the 60 foot setback Onslow County GIS ran a spatial analysis to determine a total count and improved values of at-risk properties that fall within the 20 year erosion risk hazard.

The analysis yielded 57 properties totaling over $8,120,890.00 within the 20 year at-risk zone. Table 5.18 identifies properties, by jurisdictions, which were identified. While these properties, for the purpose of this assessment, are identified as being threatened by erosion, it is unlikely that any significant damages will occur on an annual basis.

Table 5.18: Erosion Risk

Location	Number of At Risk Structures	Value of Improvements (Structures) At Risk
North Topsail Beach	57	$8,120,890.00
Surf City	0	$0.00

5.11.1. Asset Vulnerability

Those assets at greatest risk are those closest to the shoreline. This analysis did not indicate any at risk identified assets. Those assets on North Topsail Beach are all located beyond the 60 foot study area.

5.12. Dam & Levee Failure

PRI Value: 2.1
Average Annual Loss: Negligible

Onslow County has no recorded history of dam failure as identified in Section 4. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.19 and the PRI value is 2.1 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.19: Qualitative Assessment of

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Unlikely	Limited	Small	Less Than 6 hrs	More Than 1 Week

Onslow County currently has six dams that are recorded with the National Dam Inventory and North Carolina Dam Inventory, produced by the NCDENR, Division of Energy, Mineral and Land Resources. Of these three are water and wastewater treatment facilities and three are privately owned recreational ponds. For the purposes of this vulnerability study only the three *HIGH* hazard dams were assessed for losses. For each facility a one-mile radius was developed and all properties falling within that radius were counted. None of the three dams assessed are subjected to inundation from a single direction. Table 5.20 identifies dam failure exposure for each facility.

Table 5.20: Dam Failure Exposure

Dam Name	Number of Buildings	Total Assessed Value of Improvements (Buildings)
Jacksonville Wastewater Lagoon	321	$44,128,230
Jacksonville LTS-South Storage Lagoon		
North Topsail Water & Sewer Lagoon (Pluris)	96	$9,524,270

There is no historical record of unintentional dam failre in Onslow County. It should be assumed that a signle failure of one of the three *HIGH* hazard dams could result in significant loss, however, estimated losses over time would be considered negligible.

5.12.1. Asset Vulnerability

The analysis indicated that one critical facility, a school, is just outside the one mile radius and could potentially be vulnerable. Damages could exceed the estimates of the analysis and therefore the asset should be considered.

5.13. Flooding

PRI Value: 3
Annualized Loss Estimate: $485,000 (NCDC 1995-2013)

Approximately 112,245 acres, or 21%, of the County is located within the 100-year floodplain. Approximately 21% of the 100-year floodplain is developed and tax valued at approximately $2.374 billion. There are approximately 6,941 structures located within the 100-year floodplain. The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.21 and the PRI value is 3 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.21: Qualitative Assessment of

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Highly Likely	Limited	Moderate	6-12 hrs	Less Than 1 Week

The assessment for flood hazard includes the qualitative assessment and a GIS based analysis of identified floodplains developed by FEMA in combination with local tax assessment records. At-risk values (exposure) were determined by compiling the values of all assessed improvements (buildings) that were confirmed to be within the following Flood Zones:

- A/AE (1% annual chance of flood)
- Zone VE (1% annual chance coastal flood zone with associated wave action)
- Zone X-shaded (0.2% annual chance of flood)

Table 5.22 lists participating jurisdictions and the number of improved properties located within each of the special flood hazard areas along with the values of the structures identified.

Table 5.22: Onslow County Flood Exposure of Improved Properties

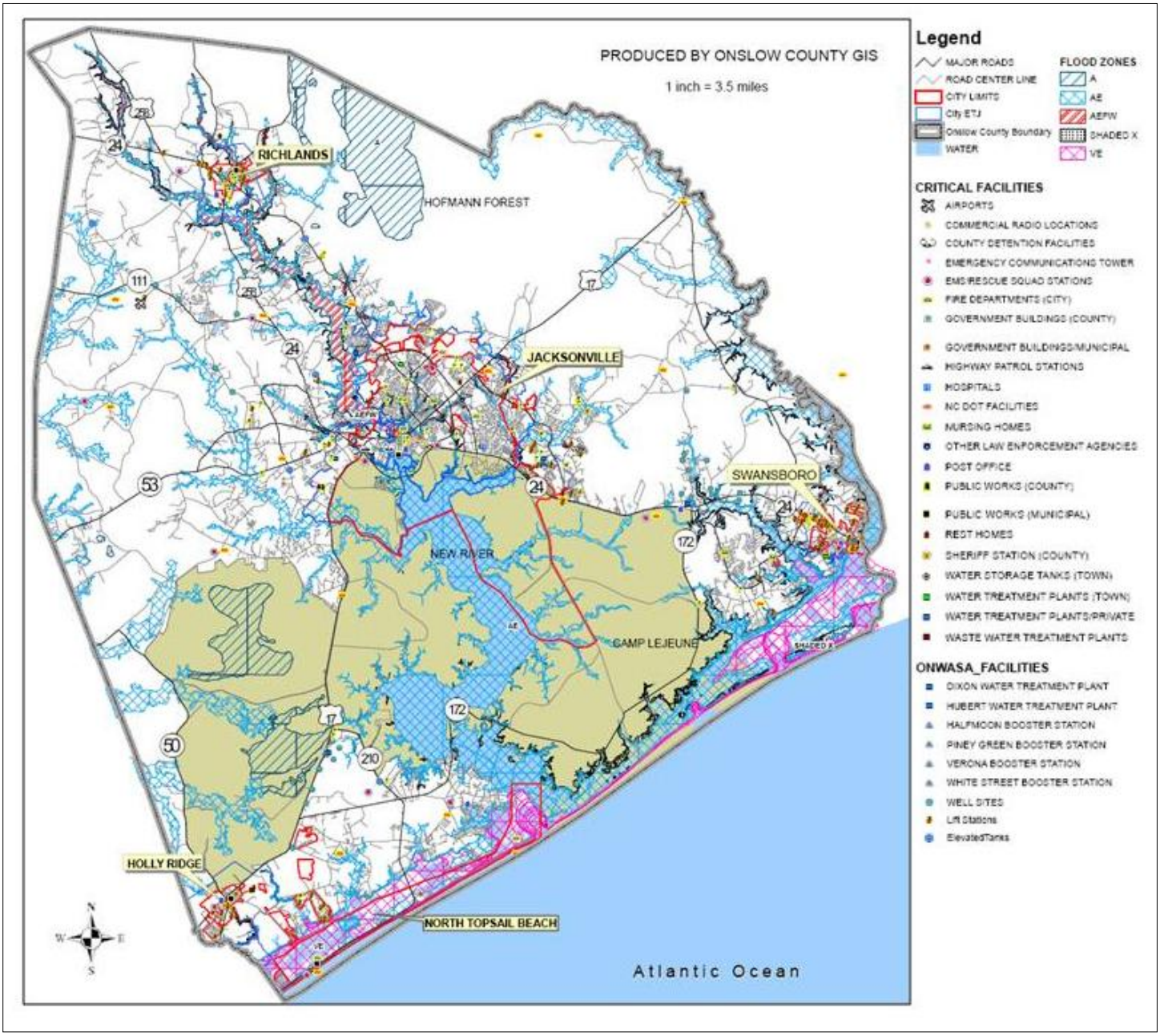
Participating Area	Number of Buildings at Risk	Value of Buildings at Risk
At-Risk (1.0 Percent Annual Chance Flood) (A – 100yr flood)		
Holly Ridge	0	$ -
Jacksonville	163	$ 30,260,000.00
North Topsail	382	$ 55,747,250.00
Richlands	24	$ 3,422,160.00
Swansboro	59	$ 6,146,260.00
Unincorporated	4487	$ 593,186,220.00
TOTAL:	**5115**	**$ 688,761,890.00**
At-Risk (Coastal VE Zone)		
Holly Ridge	0	$ -
Jacksonville	0	$ -
North Topsail	2180	$ 348,942,380.00

Richlands	0	$	-
Swansboro	8	$	1,402,620.00
Unincorporated	215	$	38,698,690.00
TOTAL:	**2403**	**$**	**389,043,690.00**
At-Risk (0.2 Percent Annual Chance Flood) (B or Shaded X – 500yr flood)			
Holly Ridge	0	$	-
Jacksonville	252	$	59,834,610.00
North Topsail	0	$	-
Richlands	16	$	3,531,620.00
Swansboro	36	$	4,200,930.00
Unincorporated	1888	$	246,449,730.00
TOTAL	**2192**	**$**	**314,016,890.00**
Total At-Risk	**9710**	**$**	**1,391,822,470.00**

5.13.1. Asset Vulnerability

There are a total of 21 inventoried assets for Onslow County that are vulnerable to the effects of flood. This includes: 6 lift stations, 3 waste water treatment plants, 1 water treatment facility, 3 fire departments, 1 EMS/Rescue station, 2 public works facilities, 1 law enforcement facility and 1 government building. Figure 5.4 shows inventoried assets in relation to special flood hazard areas (SFHA's) identified by FEMA. It should be noted that the flood hazard may inflict greater damage than what is presented in this assessment as a result of extreme flood events.

Figure 5.4: SFHA's and Critical Assets



Source: Onslow County GIS

5.13.2. NFIP Statistics and Repetitive Loss

Onslow County has identified six generalized flood damage impact areas that are located adjacent to the following water bodies: Stump Sound, Chadwick Bay, Bear Creek, Queens Creek, and Cowford Landing. According to the Federal Emergency Management Agency flood insurance policy records, as of May 2014, there have been more than 3,245 flood losses reported in Onslow County through the National Flood Insurance Program since 1978. These losses have totaled over $40 million in claims payments. These losses include both inland and coastal flood events. It should be noted that these numbers include only those losses to structures that were insured, reported and paid out through NFIP policies. It is highly probable that additional flood losses

have occurred in Onslow County that were uninsured or not reported. Table 5.26 provides details for each jurisdiction with regard to the community's date of entry into the National Flood Insurance Program (NFIP), date of the community's current effective Flood Insurance Rate Map (FIRM), number of flood insurance policies in place, amount of coverage, total losses and dollar amounts of payments. The table also includes the number of repetitive loss properties identified through separate databases for each jurisdiction, as defined by NFIP.

FEMA defines a repetitive loss (RL) property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10 year period since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Severe Repetitive Losses (SRL) are classified as any property that has at least four claims payments, each over $5,000 and a cumulative amount that exceeds $20,000 or any property with at least two separate claims payments in which the cumulative amount of the building portion exceeds the market value of the building.

According to the North Carolina Emergency Management, Onslow County has 446 repetitive loss properties and 29 severe repetitive loss properties. Of the repetitive loss properties, 20 are in the City of Jacksonville, 254 in the Town of North Topsail Beach, 21 in the Town of Swansboro and 151 in the unincorporated areas of the county. Of the severe repetitive loss properties 20 are in North Topsail Beach, 2 are in Swansboro, and 4 are in the unincorporated areas of Onslow County. Total losses paid for all of the RL's and SRL's is approximately $25 million.

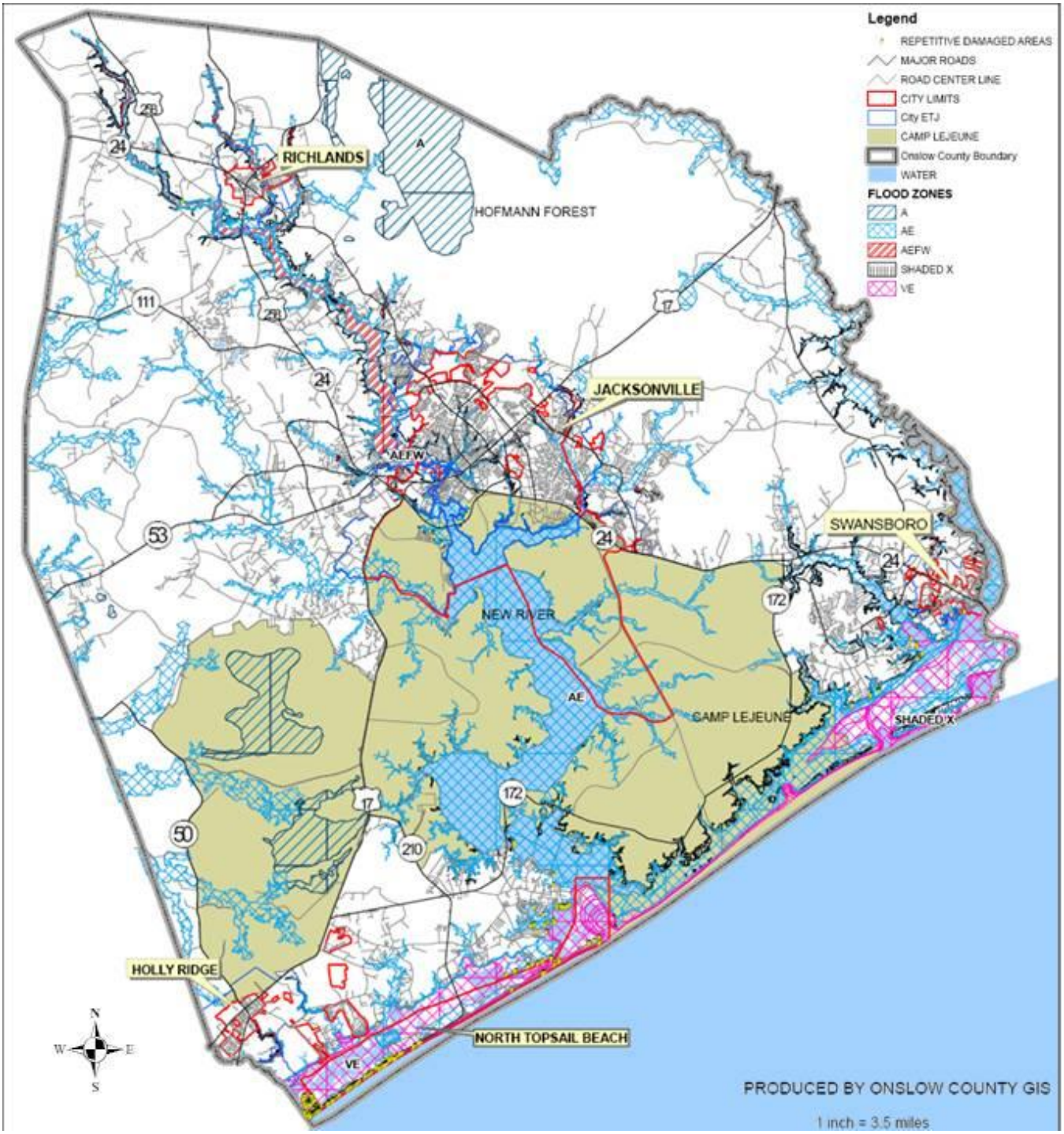
Table 5.26: NFIP Statistics and Repetitive Loss Properties

Community Name	NFIP Entry Date	Current Effective Map	Policies in Force	Amount of Coverage	Total Losses	Total Payments
Holly Ridge	11/03/2005	02/16/2007	45	$ 9,014,000.00	1	$ 7,231.05
Jacksonville	02/15/1985	02/16/2007	733	$ 196,517,400.00	144	$ 1,784,230.08
North Topsail Beach	07/02/1987	02/16/2007	1308	$ 247,487,100.00	1214	$ 14,571,476.53
Richlands	07/02/1987	02/16/2007	25	$ 6,344,000.00	1	$ 6,685.92
Swansboro	10/18/1983	02/16/2007	170	$ 45,623,000.00	98	$ 2,165,835.84
Onslow County	07/02/1987	02/16/2007	2087	$ 528,830,100.00	1787	$ 22,070,474.74
		TOTALS:	4368	$ 1,033,815,600.00	3245	$ 40,605,934.16

Source: FEMA

Figure 5.6 illustrates the general locations of repetitive loss properties in Onslow County and participating jurisdictions. It should be noted that NFIP repetitive loss data is protected under the Federal Privacy Act of 1974 (5.U.S.C. 552a), which prohibits personal identifiers (i.e. owners names, addresses, etc...) from being published in local hazard mitigation plans.

Figure 5.6: Flood Zones and Repetitive Loss Areas



Source: Onslow County GIS

5.14. Storm Surge

PRI Value: 2.4

The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.27 and the PRI value is 2.4 (on a scale of 1 to 4, with 4 being the highest risk level). No annualized loss estimates could be determined for this hazard due to a lack of historical loss documentation.

Table 5.27: Qualitative Assessment of

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Likely	Limited	Moderate	More Than 24 hrs	Less Than 24 hrs

Storm surge is a hazard closely ties with hurricanes and differs from other coastal flood events. Coastal flood and coastal erosion, both independent of hurricane and coastal storm surge, are covered in those respective sections. To determine exposure estimates and potential losses for Onslow County a GIS-based analysis was utilized. This analysis involved running various SLOSH (Sea, Lake, and Overland Surges from Hurricanes) models to estimate storm surges resulting from historical and hypothetical hurricanes. Storm surge inundation areas were then overlaid with parcel data and building footprint data to determine the number and value of at risk properties in Onslow County. Storms were analyzied by both category and fast versus slow moving. Table 5.28 lists the number of properties determined to be in storm surge inundation areas and the improved values for these structures.

Table 5.28: Number and Values of Improved Properties At-Risk to Storm Surge

Storm Surge Inundation Zone	Number of Properties	Total Assessed Value of Improvements (Buildings)	Number of Properties	Total Assessed Value of Improvements (Buildings)
	SLOW MOVING		FAST MOVING	
Category 1 & 2				
Holly Ridge	10	$ 2,130,720.00	10	$ 2,130,720.00
Jacksonville	365	$ 32,380,600.00	365	$ 32,380,600.00
North Topsail	2520	$ 400,484,150.00	2520	$ 400,484,150.00
Richlands	0	$ -	0	$ -
Swansboro	311	$ 45,916,580.00	311	$ 45,916,580.00
Unincorporated	2061	$ 270,746,350.00	2333	$ 325,115,030.00
TOTAL	**5267**	**$ 751,658,400.00**	**5539**	**$ 806,027,080.00**
Category 3				
Holly Ridge	10	$ 2,130,720.00	10	$ 2,130,720.00
Jacksonville	365	$ 32,380,600.00	365	$ 32,380,600.00
North Topsail	2520	$ 400,484,150.00	2520	$ 400,484,150.00
Richlands	0	$ -	0	$ -
Swansboro	311	$ 45,916,580.00	311	$ 45,916,580.00

Unincorporated	2671	$ 358,751,250.00	3198	$ 442,936,640.00
TOTAL	**5877**	**$ 839,663,300.00**	**6404**	**$ 923,848,690.00**
Category 4 & 5				
Holly Ridge	10	$ 2,130,720.00	23	$ 4,161,890.00
Jacksonville	392	$ 36,359,270.00	392	$ 36,359,270.00
North Topsail	2520	$ 400,484,150.00	2520	$ 400,484,150.00
Richlands	0	$ -	0	$ -
Swansboro	311	$ 45,916,580.00	311	$ 45,916,580.00
Unincorporated	3252	$ 447,806,080.00	4948	$ 643,813,720.00
TOTAL	**6485**	**$ 932,696,800.00**	**8194**	**$ 1,130,735,610.00**

5.14.1. Asset Vulnerability

It should be noted that NOAA has separated storm surge inundation from the Saffir-Simpson Hurricane Scale and severe inundation can occur with even Category 1 and 2 storms as is discussed in the Hazard Identification section (Section 4), however for the purposes of this assessment SLOSH models (a category and tide based inundation model) were utilized. The majority of assets are located in areas that would only be inundated in major hurricanes (Category 3 and above).

OTHER HAZARDS

5.15. Wildfire

PRI Value: 2.5
Average Annual Loss: Negligible

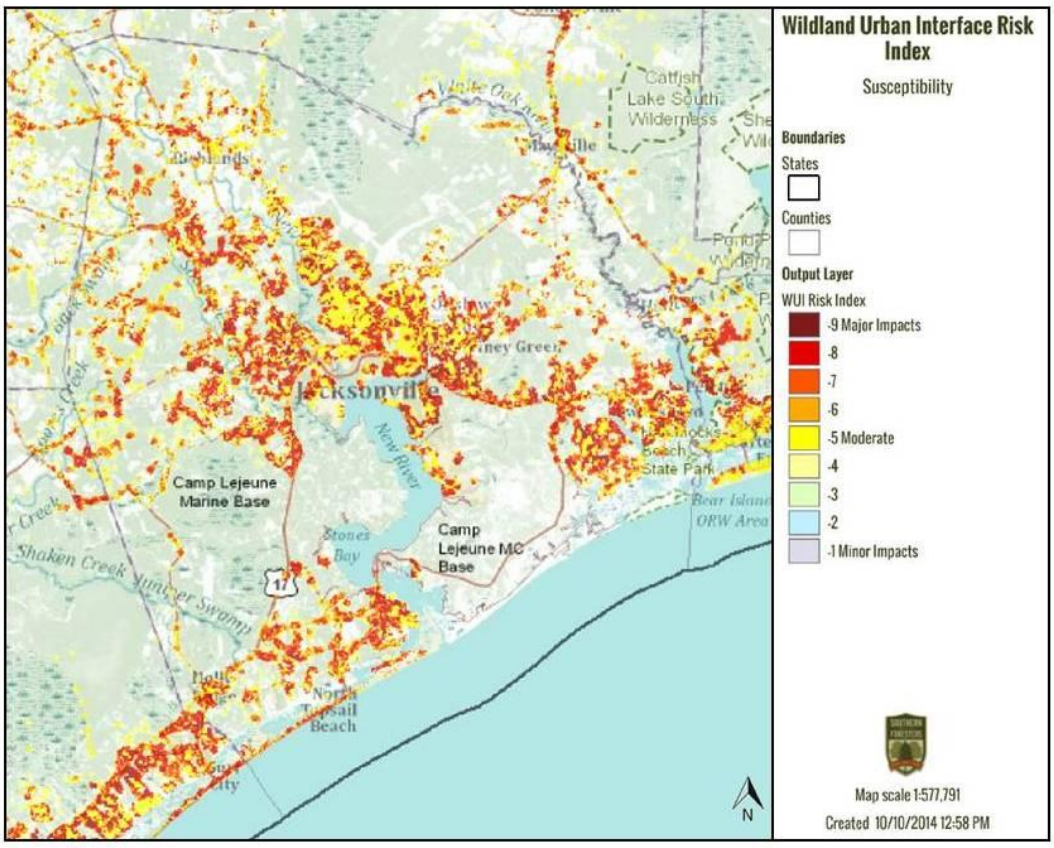
The qualitative assessment performed utilizing the PRI tool is summarized in Table 5.29 and the PRI value is 2.5 (on a scale of 1 to 4, with 4 being the highest risk level).

Table 5.29: Qualitative Assessment of

Category / Degree of Risk				
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**
Highly Likely	Minor	Small	Less Than 6 hrs	Less Than 24 hrs

The data used to determine location and spatial extent of wildfire risk in Onslow County was based on data obtained from the Southern Wildfire Risk Assessment (SWRA) provided by the North Carolina Division of Forest Resources.

Figure 5.7: Areas of Wildfire Risk



To estimate wildfire exposure the above referenced map was combined with GIS parcel data to determine the number of improved footprints within the moderate and high risk areas and summing to total assessed values for the properties. Table 5.30 summarizes this information.

Table 5.30: Total Exposure of Improved Properties to Wildfire

Hazard Zone	Number of Properties	Total Assessed Value of Improvements (Buildings) at risk
Moderate Wildfire Risk Area	21,505	$2,467,385,825
High Wildfire Risk Area	31,888	$4,237,159,849

No annualized loss estimates could be determined for this hazard due to a lack of historical data on wildfire occurrences resulting in structural losses. However, based on the data available it is assumed that structural losses over a long period of time would result in negligible annualized losses.

5.15.1. Asset Vulnerability

There are 00 inventoried assets in Onslow County determined to be vulnerable to the effects of wildfire. This includes:

5.16. Conclusions On Hazard Vulnerability

Future vulnerability can be thought of as a measure of the extent to which people and property would be harmed by a hazardous event if a projected scenario of development were to occur. An area's vulnerability changes with time. If current development patterns are projected into the future, it is possible to develop estimates of the population and amount of development that will exist in an area at some future point. Thus, given an increasing population and increasing development, it might appear that an area would have a greater vulnerability to hazards in the future. Vulnerability will increase significantly if development occurs in areas particularly susceptible to natural hazards. A general indicator of Onslow County's future vulnerability lies in its projected population growth. Table 5.31 provides a summary of anticipated population growth through the year 2030 and Table 5.32 provides a summary of current and potential conditions for Onslow County.

Table 5.31: Population Projections for Onslow County

Jurisdiction	2010	2020	2030	Net Gain
Holly Ridge	1,268.00	1,553.55	1,794.51	526.51
Jacksonville	70,145.00	85,941.65	99,271.20	29,126.20
North Topsail Beach	743.00	910.32	1,051.51	308.51
Richlands	1,520.00	1,862.30	2,151.15	631.15
Surf City (part)	1,618.00	1,982.37	2,289.84	671.84
Swansboro	2,663.00	3,262.71	3,768.75	1,105.75
Total Municipalities	77,957.00	95,512.92	110,326.97	32,369.97
Total Unincorporated Areas	99,815.00	122,296.08	141,275.03	41,460.03
Total County	177,772.00	217,809.00	251,602.00	73,830.00
Projected Growth Rates		22.52%	15.51%	
Note: Total County projections are based on North Carolina Office of State Planning data. Municipal estimates were based on the overall projected growth rate for the Total County data. Municipal estimates extrapolated by Onslow County Emergency Services.				

Table 5.32: Current and Potential Conditions for Onslow County

Type of Development	Current Conditions		Potential Future Conditions (2020)	
	Number of Existing Private Buildings	Current Value/ Projected Loss (structure value)	Projected Number of Private Buildings (If developed under existing policies)	Projected Value
Single-Family Residential	30,835	$5,003,821,570	43796	$6,459,774,870
Multi-Family Residential	2075	$444,423,890	3067	$493,232,790
Commercial	1582	$770,842,900	1740	$847,927,190
Industrial	16	$26,897,390	19	$14,468,815
Other (Vacant)	18201	$1,035,178,710	18946	$837,435,810
Subtotal	52,709	$7,281,164,460	67567	$8,652,839,475

As indicated in the above table, Onslow County's population is anticipated to increase approximately 42% between the years 2010 and 2030. As a result, Onslow County's population in the year 2030 may be approximately 251,602. It should be noted, that these projections are based on percent increase of base survival rates. It does not account for net migration or fluctuations in birth or death rates. These numbers should be viewed as gross estimations of predicted growth and actual population statistics may be larger or smaller. While it is impossible to predict exactly how much of the County's new development will occur in the 100-year floodplain, some will certainly occur. Consequently, the County's vulnerability to hurricanes, nor'easters, and flooding will increase due to population growth unless mitigation actions are taken.

This vulnerability assessment provides for significant findings that will allow the Hazard Mitigation Planning Committee to prioritize hazard risk and propose mitigation strategies and actions. This is accomplished by improving our understanding of the complexities and dynamics of risk, how levels of risk can be measured, and the factors that influence risk. The data and findings will help build a baseline for policy development and comparison of mitigation alternatives by creating a method to compare risk changes over time. The data also helps quantify hazard risk relative to other hazards. The ranking will allow for a systematic framework to compare and prioritize the very disparate hazards.

Table 5.33 summarized the qualitative assessments for each hazard as presented throughout this section.

Table 5.33: Summary of Qualitative Assessment

Hazard	Category / Degree of Risk				
	Probability	Impact	Spatial Extent	Warning Time	Duration
Atmospheric Hazards					
Drought and Heat wave	Likely	Minor	Negligible	12-24 hrs	Less than 24 hrs
Severe Thunderstorm / Hail	Highly Likely	Minor	Small	Less than 6 hrs	Less than 6 hrs
Hurricane & Coastal Storm	Likely	Critical	Large	More than 24 hrs	Less than 24 hrs
Tornado	Likely	Minor	Small	Less than 6 hrs	Less than 6 hrs
Winter Storm	Possible	Minor	Large	More than 24 hrs	Less than 1 week
Geological Hazards					
Earthquake	Unlikely	Minor	Negligible	Less than 6 hrs	Less than 6 hrs
Landslide & Sinkhole	Possible	Minor	Negligible	Less than 6 hrs	Less than 6 hrs
Tsunami	Unlikely	Limited	Small	6-12 hrs	More than 1 week
Hydrologic Hazards					
Erosion	Highly Likely	Minor	Negligible	More than 24 hrs	More than 1 week
Dam & Levee Failure	Unlikely	Limited	Small	Less than 6 hrs	More than 1 week
Flood	Highly Likely	Limited	Moderate	6-12 hrs	Less than 1 week
Storm Surge	Likely	Limited	Moderate	More than 24 hrs	Less than 24 hrs
Other Natural Hazards					
Wildfire	Highly Likely	Minor	Small	Less than 6 hrs	Less than 24 hrs

Table 5.34 summarizes annualized loss estimates that were generated for each identified hazard based on the quantitative assessment and compares them with the PRI Values determined based on the qualitative assessment.

Table 5.34: Comparison of Annualized Loss Estimates and Priority Risk Index Values

Quantitative Assessment Findings		Qualitative Assessment Findings	
Hazard	**Annualized Loss Estimates**	**Hazard**	**PRI Score**
Hurricane & Coastal Storm	$51,000,000	Flood	3
Flood	$485,000	Hurricane & Coastal Storm	2.9
Tornado	$249,939	Wildfire	2.5
Winter Storm	$8,529	Severe Thunderstorm / Hail	2.4
Severe Thunderstorm / Hail	$4,645	Storm Surge	2.4
Storm Surge	N/A	Erosion	2.2
Wildfire	Negligible	Tornado	2.1
Erosion	Negligible	Winter Storm	2.1
Dam & Levee Failure	Negligible	Dam & Levee Failure	2.1
Tsunami	Negligible	Tsunami	2
Drought and Heat wave	Negligible	Drought and Heat wave	1.8
Landslide & Sinkhole	Negligible	Landslide & Sinkhole	1.6
Earthquake	Negligible	Earthquake	1.3

The conclusions drawn from the qualitative and quantitative assessments, combined with final determinations from the Hazard Mitigation Planning Committee were grouped into three categories for a final summary of hazard risk for Onslow County based on a High, Moderate, and Low risk designation. It should be noted that rankings are based on best available data and some hazards may be grouped as low risk that due to varying occurrence and magnitude could result in significant risk and loss.

Table 5.35: Conclusions on Hazard Risk

HIGH RISK	Flood Hurricane & Coastal Storm Severe Thunderstorm / Hail Storm Surge Tornado Winter Storm
MODERATE RISK	Wildfire Dam & Levee Failure Landslide & Sinkhole Drought and Heat wave
LOW RISK	Erosion Tsunami Earthquake

6. CAPABILITY ASSESSMENT

In the mitigation planning process, it is not only important to identify what hazards affect a community and what vulnerabilities exist in a community but it is also important to identify the resources the community has available to prepare for, mitigate against, respond to and recover from those hazards. Section 7 of this plan will discuss the capability assessment. This section will include the the following sections:

- 6.1 What is a Capability Assessment
- 6.2 Capability Assessment Findings
- 6.3 Conclusions on Local Capability

ELEMENTS C144 CFR Part 201.6(c)(3):
The Hazard Mitigation Strategy that provides the jurisdictions blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing tools.

6.1. What is a Capability Assessment

A capability assessment is an evaluation of the government structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations and ordinances, and resources available. Each category is evaluated for its strengths and weaknesses in responding to/ preparing for and mitigating the effects of the identified hazards. Integral to any planning process is to establish which goals, objectives and/or actions are feasible based on an understanding of the capacity of the assigned agency to implement them. A capability assessment helps to determine which mitigation actions are practical and most likely to be implemented over time given a local jurisdiction regulatory framework, administrative and technical support, fiscal resources and current political climate.

The capability assessment has two components: 1) an inventory of local jurisdictions relevant plans, ordinances and programs and 2) an analysis of their capacity to execute them. Careful examination of these capabilities will help identify any existing gaps or weaknesses within government activities that could potentially hinder proposed mitigation activities or exacerbate hazard vulnerability.

A capability assessment is an integral part of the hazard mitigation planning process in which the local jurisdictions identify, review, and analyze what they are currently doing to reduce losses, and identify the framework that is in place or should be in place for the implementation of new mitigation actions. The information generated will help the county and municipalities evaluate alternative mitigation actions. Similarly, analyzing what the county and municipalities have the capacity to do, and understanding what needs to be changed or enhanced to facilitate loss reduction, enables all concerned to address shortfalls in the mitigation plan. The capability assessment completed for Onslow County should serve as a planning step and an important part of the foundation for developing effective hazard mitigation strategies.

A basic overall capability assessment is addressed in this section with certain mentions of municipal capabilities. For specific municipal information refer to the respective municipal annex capability assessment.

6.2. Capability Assessment Findings

The findings of the capability assessment are summarized in this plan to provide insight in Onslow County and participating jurisdictions capacity to implement hazard mitigation activities.

6.2.1. Local Government Legal Authority in North Carolina

Onslow County is a local government body with a Board-Manager form of government. The elected Board of Commissioners is the County's decision-making body. The appointed Planning Board serves as an advisory body to the elected Board on planning matters. The County has a number of professional staff departments to serve the citizens of the County and to carry out day-to-day administrative activities.

Local regulations, which are enacted within the bounds of the State's enabling authority, do not automatically meet with judicial acceptance. Any restrictions, which local governments impose on land use or building practices, must follow the procedural requirements of the Fourteenth Amendment, or risk invalidation.

These and other constitutional mandates apply to Federal and State governments and all their political subdivisions. Any mitigation measures that are undertaken by the local government in its regulatory capacity must be worded and enforced carefully within the parameters established by the State and Federal Constitutions, even when such measures are authorized by the General Statutes of North Carolina and even when such measures are enacted in order to protect public health and safety by protecting the community from the impacts of natural hazards.

All local government powers fall into one of four basic groups (although some governmental activities may be classified as more than one type of power): regulation, acquisition, taxation, and spending. Hazard mitigation measures can be carried out under each of the four types of powers.

- ***Regulation***

  Local governments in North Carolina have been granted broad regulatory powers in their jurisdictions. North Carolina General Statutes bestow the general police power on local governments, allowing them to enact and enforce 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). Since hazard mitigation can be included under the police power (as protection of public health, safety, and welfare), towns, cities, and counties may include requirements for hazard mitigation in local ordinances. Local governments may also use their ordinance-making power to abate "nuisances," which could include, by local definition, any activity or condition making people or property more vulnerable to any hazard. Local government enforcement of existing ordinances, building codes, and local plans is critical to effective mitigation.

- ***Acquisition***

  The power of acquisition can be a useful tool for pursuing mitigation goals. Local governments may find the most effective method for completely "hazard-proofing" a particular piece of property or area is to acquire the property (either in fee or a lesser interest, such as an easement), thus removing the property from the private market and eliminating or reducing the possibility of inappropriate development occurring. North Carolina legislation empowers cities, towns, and counties to acquire property for public purpose by gift, grant, devise, bequest, exchange, purchase, lease, or eminent domain.

- ***Taxation***

  Taxation is yet another power granted to local governments by North Carolina law, which can be used as a hazard mitigation tool. However, the power of taxation extends beyond merely the collection of revenue. Many communities set preferential tax rates for areas, which are unsuitable for development (e.g., agricultural land, wetlands) and can be used to discourage development in hazardous areas.

  Local units of government also have the authority to levy special assessments on property owners for all or part of the costs of acquiring, constructing, reconstructing, extending, or otherwise building or improving beach erosion control or flood and hurricane protection works within a designated area. This can serve to increase the cost of building in such areas, thereby discouraging development.

  Because the usual methods of apportionment seem mechanical and arbitrary, and because the tax burden on a particular piece of property is often quite large, the major constraint in using special assessments is political. Special assessments seem to offer little in terms of control over land use in developing areas. They can, however, be used to finance the provision of services a county deems necessary within its boundaries. In addition, they are useful in distributing to the new property owners the costs of the infrastructure required by new development.

- ***Expenditure***

  The fourth major power that has been delegated from the North Carolina State General Assembly to local governments is the power to make expenditures in the public interest. Hazard mitigation principles should be made a routine part of all spending decisions made by the local government, including annual budgets and Capital Improvement Plans.

  A capital program is usually a timetable by which a county indicates the timing and level of municipal services it intends to provide over a specified duration. Capital programming, by itself, can be used as a growth management technique, with a view to hazard mitigation. By tentatively committing itself to a timetable for the provision of capital to extend municipal services, a community can control its growth to some extent especially where the surrounding area is such that the provision of on-site sewage disposal and water supply are unusually expensive. In addition to formulating a timetable for the provision of services, a local community can regulate the extension of and access to municipal services.

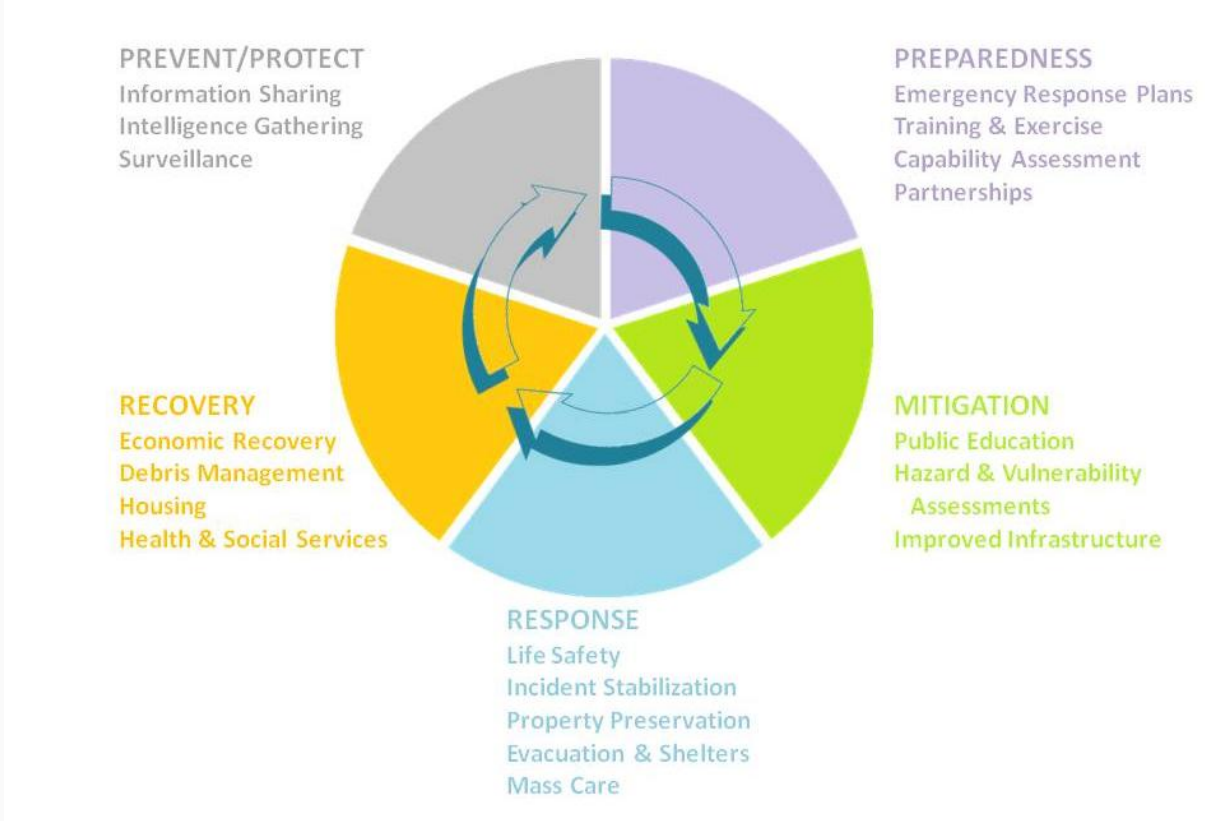
  A Capital Improvement Program (CIP) that is coordinated with extension and access policies can provide a significant degree of control over the location and timing of growth. These tools can also influence the cost of growth. If the CIP is effective in directing growth away from environmentally sensitive or high hazard areas, for example, it can reduce environmental costs.

6.2.2. Emergency Management

A comprehensive emergency management program is based on the framework of the five key mission areas of emergency management: prevention/protection, preparedness, mitigation, response, and recovery. All phases are highly interconnected; that is, each phase influences the other three phases. The cycle as a whole is dynamic and ongoing process. Planning in each phase is a critical part of the emergency management program and a key to the successful implementation of hazard mitigation actions. Opportunities to reduce potential losses through mitigation practices are most often implemented before disaster strikes, such as elevation of flood prone

structures or through the continuous enforcement of policies that prevent or regulate development that is vulnerable to hazards because of its location, design or other characteristics. Mitigation opportunities will also be presented during immediate preparedness or response activities (such as installing storm shutters in advance of a hurricane), and certainly during the long-term recovery and redevelopment process following a hazard event. Figure 6.1 shows the five mission areas of a comprehensive emergency management program.

Figure 6.1: Emergency Management Mission Areas



There are a range of emergency management plans that jurisdictions can utilize to aid in each of the core mission areas. These include:

Hazard Mitigation Plan: The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. Mitigation Plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters.

- Onslow County and the five municipalities of Holly Ridge, Jacksonville, North Topsail Beach, Richlands and Swansboro developed the first version of the multi-jurisdictional plan in 2005 and have maintained and updated the plan on five year FEMA cycle.

Debris Management Plan: Communities with a debris management plan are better prepared to restore public services and ensure the public health and safety in the aftermath of a disaster, and they are better positioned to receive the full level of assistance available to them from FEMA and other participating entities.The core components of a comprehensive debris management plan incorporate best practices in debris removal, reflect FEMA eligibility criteria, and are tailored to the specific needs and unique circumstances of each applicant.

- Onslow County maintains a debris management plan and maintains contracts with a debris monitoring company to assist with management and documentation. The county also maintains a debris hauling contract. Each municipality also maintains debris hauling contracts.

Emergency Operations Plan: An all-hazards plan developed for use by government agencies to ensure a coordinated and effective response to disasters that may occur within its jurisdictional boundaries. The plan is organized to coordinate with the core mission areas of a comprehensive emergency management program.

- Onslow County maintains a countywide comprehensive emergency operations plan and manages the central emergency operations center. Each jurisdiction also maintains municipal emergency operations plans to guide specific operations within their jurisdiction and manages municipal emergency operations centers for this purpose. All EOC's maintain contact and coordination throughout any event through multiple methods including the use of the web based program WebEOC.

Continuity of Operations Plan: Continuity of Operations, as defined in the National Security Presidential Directive-51/Homeland Security Presidential Directive-20 (NSPD-51/HSPD-20) as an effort within individual governmental agencies to ensure that Primary Mission Essential Functions (PMEFs) continue to be performed during a wide range of emergencies, including localized acts of nature, accidents and technological or attack-related emergencies.

- Onslow County maintains a continuity of operations plan for all departments.

6.2.3. General Planning

The implementation of hazard mitigation activities often involves individuals other than the emergency management profession. Stakeholders may include local planners, public works officials, economic development specialists and others. Similarly, hazard mitigation planning cuts across multiple disciplines. Some of the most important capabilities that can be utilized for hazard mitigation include comprehensive plans, building codes, floodplain ordinances, subdivision and land development ordinances and zoning ordinances. These tools provide mechanisms for the implementation of adopted mitigation strategies.

Comprehensive or Master Planning: In order to exercise the regulatory powers conferred by the General Statutes, local governments in North Carolina are required to create or designate a planning agency. The planning agency may perform a number of duties, including: make studies of the area; determine objectives; prepare and adopt plans for achieving those objectives; develop and recommend policies, ordinances, and administrative means to implement plans; and perform other related duties. The importance of the planning powers of local governments is emphasized in *NC General Statute 160A-383*, which requires that zoning regulations be made in accordance with a comprehensive plan. While the ordinance itself may provide evidence that zoning is being conducted in accordance with a plan," the existence of a separate planning document ensures that the government is developing regulations and ordinances that are consistent with the overall goals of the community.

Subdivision Regulation: Subdivision regulations control the division of land into parcels for building development or sale. F1ood-related subdivision controls typically require that sub-dividers install adequate drainage facilities, and design water and sewer systems to minimize flood damage and contamination. They prohibit the subdivision of land subject to flooding unless flood hazards are overcome through filling or other measures and prohibit filling of floodway areas. They require that subdivision plans be approved prior to the sale of land. Subdivision regulations are a more limited tool than zoning and only indirectly affect the type of use made of land or minimum specifications for structures.

Broad subdivision control enabling authority for municipalities is granted in *NC General Statute 160-371*. Subdivision is defined as all divisions of a tract or parcel of land into two or more lots and all divisions involving a new street (*NC General Statute 160A-376*).The definition of subdivision does not include the division of land into parcels greater than 10 acres where no street right-of-way dedication is involved.

Building Codes and Building Inspections: Many structural mitigation measures involve constructing and retrofitting homes, businesses, and other structures according to standards designed to make the buildings more resilient to the impacts of natural hazards. Many of these standards are imposed through the building code.

North Carolina has a State compulsory building code, which applies, throughout the State (*NC General Statute143-138*). However, municipalities and counties may adopt codes for the respective areas if approved by the State as providing "adequate minimum standards." However, local regulations cannot be less restrictive than the State code.

Local governments in North Carolina are also empowered to carry out building inspection. *NC General Statute Ch. l60A, Art. 19, Part 5,* and *Ch. 153A, Art. 18, Part 4* empower cities and counties to create an inspection department, and enumerates its duties and responsibilities, which include enforcing State and local laws relating to the construction of buildings; installation of plumbing, electrical, heating systems, etc.; building maintenance; and other matters.

Comprehensive Land Use: Regulatory powers granted by the State to local governments are the most basic manner in which a local government can control the use of land within its jurisdiction. Through various land use regulatory powers, a local government can control the amount, timing, density, quality, and location of new development; all these characteristics of growth can determine the level of vulnerability of the community in the event of a natural hazard. Land use regulatory powers include the power to engage in planning, enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls.

- The North Carolina Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local land use plan in accordance with guidelines established by the Coastal Resources Commission (CRC). Each CAMA land use plan includes local policies that address growth issues such as the protection of productive resources (i.e., farmland, forest resources, fisheries, etc.), desired types of economic development, natural resource protection and the reduction of storm hazards. At the local level, CAMA land use plans provide guidance for both individual projects and a broad range of policy issues, such as the development of regulatory ordinances and public investment programs.

- Onslow County maintains a CAMA plan that includes the Town of Richlands. Holly Ridge, Jacksonville, North Topsail, and Swansboro maintain municipal CAMA Plans.

Zoning: Zoning is the traditional and nearly ubiquitous tool available to local governments to control the use of land. Broad enabling authority for municipalities in North Carolina to engage in zoning is granted in *NC General Statute 160A-381*. The statutory purpose for the grant of power is to promote health, safety, morals, or the general welfare of the community. Land uses controlled by zoning include the type of use (e.g., residential, commercial, industrial) as well as minimum specifications for use such as lot size, building height and setbacks, density of population, and the like. The local government is authorized to divide its territorial jurisdiction into districts, and to regulate and restrict the erection, construction, reconstruction, alteration, repair or use of buildings, structures, or land within those districts. Districts may include general use districts, overlay districts, and special use districts or conditional use districts. Zoning ordinances consist of maps and written text.

Historic Preservation Plan: A historic preservation plan is intended to preserve historic structures or districts within a community. An often overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards, and the identification of ways to reduce future damages. This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet current building standards, or are within a historic district that cannot easily be relocated out of harm's way.

- Onslow County maintains a county-wide inventory of historic properties.

Capital Improvements Plan: A capital improvements plan guides the scheduling of spending on public improvements. A capital improvements plan can serve as an important mechanism for guiding future development away from identified hazard areas. Limiting public spending in hazardous areas is one of the most effective long term mitigation actions available to local governments.

- Onslow County currently maintains a Capital Improvement Plan.

6.2.3.1. Floodplain Management

Flooding represents the greatest natural hazard facing the nation and the Onslow County planning area. At the same time, the tools available to reduce the impacts associated with flooding are among the most advanced when compared to other hazard-specific mitigation techniques. In addition to approaches that cut across hazards, such as education, outreach, and the training of local officials, the National Flood Insurance Program (NFIP) contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards.

In order for a county or municipality to join the NFIP, they must adopt a Local Flood Damage Prevention Ordinance that requires jurisdictions to follow established minimum building standards in the floodplain. Another key service provided by the NFIP is the mapping of identified flood hazard areas. Flood Insurance Rate Maps are used to assess flood hazard risk and set flood insurance rates. The maps also provide an important tool to educate residents, government officials and the business community about the likelihood of flooding in their community. Table 6.1 summarizes NFIP participation in Onslow County.

Table 6.1: NFIP Participation in Onslow County

Community Name	NFIP Entry Date	Current Effective Map	Policies in Force	Amount of Coverage
Holly Ridge	11/03/2005	02/16/2007	45	$ 9,014,000.00
Jacksonville	02/15/1985	02/16/2007	733	$ 196,517,400.00

North Topsail Beach	07/02/1987	02/16/2007	1308	$ 247,487,100.00
Richlands	07/02/1987	02/16/2007	25	$ 6,344,000.00
Swansboro	10/18/1983	02/16/2007	170	$ 45,623,000.00
Onslow County	07/02/1987	02/16/2007	2087	$ 528,830,100.00
		TOTALS:	4368	$ 1,033,815,600.00

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS:

- Reduce flood damage to insurable property;
- Strengthen and support the insurance aspects of the NFIP, and
- Encourage a comprehensive approach to floodplain management.

Table 6.2 Identifies participating CRS communities in Onslow County along with their current class ranking and respective discounts available to homeowners.

Table 6.2: CRS Participating Communities

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
370178	Jacksonville	10/01/1991	10/01/2005	8	10	5	C
370466	North Topsail Beach	10/01/1992	10/01/2002	7	15	5	C

Floodplain Management Plans: A floodplain management plan (or a flood mitigation plan) provides a framework for action regarding the corrective and preventative measures in place to reduce flood-related impacts.

- Onslow County, Holly Ridge, Jacksonville, North Topsail Beach, Richlands and Swansboro maintain floodplain management practices. These may be incorporated as a part of a comprehensive land use plan, floodplain ordinances or designated floodplain management plans.

The North Carolina General Statutes declare that the channel and a portion of the floodplain of all the state's streams will be designated as a floodway, either by the local government or by the State. The legislatively declared purpose of designating these areas as a floodway is to help control floods by preventing obstructions, which inhibit water flow and increase flood height and damage and other losses (both public and private) in flood hazard areas, and to promote the public health, safety, and welfare of citizens of North Carolina in flood hazard areas. To carry out this purpose, local governments are empowered to grant permits for the use of the floodways, including the placement of any artificial obstruction in the floodway. No permit is required for certain uses, including agricultural, wildlife and related uses; ground level uses such as parking areas, rotary aircraft ports; lawns, gardens, golf courses, tennis courts, parks, open space, and similar private and public recreational uses. Existing artificial obstructions in the floodway may not be enlarged or replaced without a permit; local governments are empowered to acquire existing obstructions by purchase, exchange, or condemnation if necessary to avoid flood damages.

The procedures that are laid out for issuing permits for floodway use require the local government to consider the dangerous effects a proposed artificial obstruction may create by causing water to be backed up or diverted; or the danger that the obstruction will be swept downstream to the injury of others; and by the injury or damage that may occur at the site of the obstruction itself. Local governments are to take into account anticipated development in the near future, which may be adversely affected by the obstruction, as well as existing development.

6.2.4. Institutional Capability

Institutional capability is described as an adequacy of departmental and personal resources for the implementation of mitigation related activities. Administrative capability can be evaluated by determining how mitigation-related activities are assigned to local departments and how adequate the personnel resources are for carrying the activities out. The degree of intergovernmental coordination among departments will also affect administrative capability for the implementation and success of proposed mitigation activities.

Onslow County is a chartered county, which is governed by a Board of Commissioner-Manager form of government. In June 2014, there were 1,183 budgeted full-time County employees. Police, Fire, and Rescue departments play critical roles in both natural hazard mitigation and response. The availability and adequacy of hospitals and health care facilities impacts an area's ability to cope with natural hazards. The following provides a brief description of County facilities and departments.

The County's Department of Emergency Services includes the Emergency Medical Services/ Volunteer Rescue Service, the Emergency 911 Communications Center, Emergency Management Office, Hazardous Materials Management, and the Volunteer Fire Service. These agencies work together to provide the County's citizens with complete and unified emergency services during a major incident, natural hazard emergencies, or other unforeseen threats to life and property. The County provides significant financial support for nineteen (19) volunteer fire departments and eight (7) rescue volunteer squads. The County's system of volunteer fire fighting and rescue is both efficient and effective in handling situations in the County's unincorporated areas.

Police protection is provided by the County Sheriff's Department, which presently employs approximately 186 people. The Sheriff's department coordinates and cooperates with local military base military police.

Onslow Memorial Hospital, Camp Lejeune Naval Hospital, and the Brynn Marr Behavioral Health Care provide adequate major health care services for County residents. The County Health Department provides clinical and public health services to County residents. The County Environmental Health, Solid Waste, Mosquito and Animal Control Departments contribute to the County's public health efforts through the control of health hazards, nuisances, and private wastewater disposal systems.

- All jurisdictions currently indicate they have the available personel internally, through coordination with other agencies, or through contracting out to meet the needs of hazard mitigation implementation.

6.2.5. Technical Capability

Technical capability is described as an adequacy of technical expertise of local government employees or the ability to contract outside resources for this expertise in order to effectively execute mitigation activities. Common examples of skill sets and technical personnel needed for hazard mitigation include: planners with knowledge of land development/management practices, engineers or professionals trained in construction practices related to buildings and/or infrastructure, planners or engineers with an understanding of natural

and/or human caused hazards, emergency managers, floodplain managers, land surveyors, scientists familiar with hazards in the community, staff with the education or expertise to assess community vulnerability to hazards, personnel skilled in geographical information systems, resource development staff or grant writers, and fiscal staff.

- ***GIS:*** Onslow County operates a geographic information system (GIS) that provides essential information and technology for hazard response and mitigation. The GIS system provides detailed data on property ownership, land use type, and location. GIS allows this information to be displayed visually to assist in hazard mitigation planning. The GIS provides fast access to and processing of detailed data that can be used to assist in deployment of resources before, during, and after a natural disaster. The system also permits data and visual analysis of the impacts of past storm events thereby assisting in planning for mitigation of future natural disasters. Onslow County provides GIS services to all of the municipalities except the City of Jacksonville who maintains their own GIS capability.

- ***State and Federal Assistance:*** Agencies such as the Federal Emergency Management Association (FEMA) and the North Carolina Division of Emergency Management (NCDEM) have made available numerous implementation manuals and other resource documents. These manuals provide information on mitigation techniques for various hazards, including hurricanes, floods, wildfires, tornadoes and earthquakes. The manuals include information on engineering principles, construction methods, costs and suggestions for how techniques can be financed and implemented. Other Federal agencies such as, the US Army Corps of Engineers and Soil Conservation Service also provide similar services. The North Carolina Division of Emergency Management works in concert with these various Federal agencies to ensure that the State and local governments are prepared to respond to natural disasters. A major effort to improve technical information available to local governments is being undertaken by the State of North Carolina and the Federal Emergency Management Agency.

- ***Emergency Managers:*** All participating jurisdictions indicated that someone within heir current staffing held the role of emergency manager. Currently, only Onslow County has a dedicated emergency management department with an emergency manager and planning officer.

6.2.6. Fiscal Capability

The ability of a local government ot take action is closely related with the amount of money available to implement policies and projects. This capability may be achieved through local budgets, state/federal and private grant resources, and other associated programs designed to assist local capabilities. The costs associated with policy and project implementation can vary widely. In some instances, policies will be tied directly to staff costs associated with the creation and monitoring of a given program. In other instances, funds may be linked to a project, such as repetitive loss home acquisition, which may require a significant commitment from local, state and federal funding sources.

Local Funds: In the State of North Carolina, property taxes provide the primary source of County revenue. Property taxes are primarily and typically used to finance services that must be available and delivered on a daily basis, such as schools, health and social services, planning, solid waste management, and emergency services. This leaves very little funding, if any, for additional services and projects. Fortunately, State and Federal funds are available to local governments for the development and implementation of hazard mitigation programs.

Non-Governmental Funds: Another potential source of revenue for local mitigation efforts, are the contribution of non-governmental organizations, such as churches, charities, community relief funds, the Red Cross, hospitals, for-profit businesses, and nonprofit organizations. A variety of these local organizations can be tapped to help carry out local hazard mitigation initiatives.

State and Federal Funds: There are many sources of Federal and State funding available to local governments for implementing hazard mitigation plans. These programs include Hazard Mitigation Grants, Flood Mitigation Assistance Programs, and the Community Development Block Grants.

- The Hazard Mitigation Grant Program (HMGP) provides funding for mitigation measures following a Presidential disaster declaration. The HMGP is funded in most part by the Federal government and administered by respective State governments. HMGP funds can be used for such projects as acquisition or relocation, retrofitting, development of local mitigation standards and comprehensive mitigation plans, structural hazard control and the purchase of equipment to improve preparedness and response.

- The Flood Mitigation Grant Program (FMAP) is a federally funded program for mitigation assistance to states, communities and individuals for cost-effective measures to reduce or eliminate the long-term risk of flood damage to the built environment and to real property. Unlike the HMGP, FMAP is available to eligible communities on an annual basis. An eligible community must be a participant in the National Flood Insurance Program and must develop a flood mitigation plan. FMAP funds may be used for such projects as elevation and/or dry flood proofing of structures, acquisition of real property, relocation or demolition of structures, and minor structural projects.

- The Community Development Block Grant (CDBG) is another source of funding for hazard mitigation initiatives. The objective of the CDBG program is to assist communities in rehabilitating substandard dwelling structures and to expand economic opportunities, primarily for low-to-moderate-income families. However, because of a Presidential declared disaster, CDBG funds may be used for long-term needs such as acquisition, reconstruction, and redevelopment of disaster-affected areas

- County Economic Tir Designations: North Carolina contains 100 counties. Every year the Department of Commerce ranks each county based on economic well-being and assigns it to one of three tiers. The 40 most distressed counties are designated as Tier 1, the next 40 are Tier 2 and the 20 least distressed are Tier 3. Onslow County was ranked as Tier 2 in the 2014 designation roster.

Local governments may also engage in their own "fund-raising" efforts to pay for mitigation programs that benefit the community at large. In North Carolina, local governments are granted limited powers to raise revenue for public purpose. The General Assembly (*NC General Statute §16A-209)* has conferred upon cities, towns, and counties the power to levy property taxes for various purposes, including:

- ambulance services / rescue squads
- beach erosion and natural disasters (including shoreline protection, beach erosion control, and flood and hurricane protection)
- civil defense
- drainage projects or programs
- fire protection
- hospitals

- joint undertakings with other county, city, or political subdivisions
- planning
- sewage
- solid waste
- water / water resources
- watershed improvement projects

These statutorily enumerated purposes make it clear that local governments are empowered to finance certain emergency management activities, including mitigation activities, with property taxes.

6.2.7. Political Capability

One of the most difficult and sensitive capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects. However, having the support of local governing bodies and officials is imperative to the success of any mitigation effort. Political capability in the municipalities in the county varies. Hazard mitigation may not be a local priority, or may conflict with or be seen as an impediment to other goals of the community, such as growth and economic development. Therefore the local political climate must be considered in designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing their adoption and implementation.

- Onslow County is working to establish hazard mitigation in its daily operations. In doing this, the County works in close cooperation with the municipalities to prioritize many of the issues surrounding mitigation efforts. In the long run public education and awareness campaigns about the economic efficiency and social utility of mitigation measures helps foster its general acceptance by citizens, and in turn elected officials. Disaster prevention and recovery takes close intra and inter governmental coordination and cooperation between all agencies – local, State, and Federal. This coordination and cooperation is essential in creating a viable and workable local mitigation strategy. Onslow County is politically capable of carrying out this plan and its hazard mitigation goals and objectives.

6.3. Conclusions on Local Capability

After gathering the preceding capability information, the data must be analyzed and evaluated. Since the capability assessment will provide the framework for developing recommendations for specific mitigation actions in the hazard mitigation plan, it is essential that the assessment both identify shortfalls in a jurisdiction's capability, as well as draw attention to special opportunities that should be capitalized upon while they remain viable. Specific Jurisdictional conclusions can be referenced in the respective municipal annex. Overall each jurisdiction participating in this plan has shown a willingness and commitment to hazard mitigation.

The development of the Hazard Mitigation Plan entails reviewing and updating existing land use policies and regulatory ordinances while considering new policies and ordinances that improve and extend protection of the public health, safety, and welfare. The hazard mitigation planning process has provided the opportunity to ensure that all planning efforts work cohesively in order to achieve mitigation goals for existing and future development. Integration into the existing regulatory framework will ensure that the Hazard Mitigation Plan will be utilized to its full potential.

Table 6.3 provides a summary of the County's existing policies and programs and their effectiveness at mitigating natural hazards. Generally, this assessment shows that Onslow County has been committed to

mitigating the effects of natural hazards but in response to recent storm events, additional action may need to be taken. An acceptability assessment is a useful analytical step, which can help Onslow County prioritize and focus limited resources on the most critical of its mitigation needs. Having reviewed which natural hazards pose the greatest threats, the capability of Onslow County to respond, and the particular areas of the County's planning jurisdiction that are most vulnerable, Onslow County can then decide whether this level of risk is acceptable. Local officials and planners can use these conclusions to focus local mitigation efforts on those areas where they are most critically needed, thus making the most of limited financial personnel, and material resources. Conclusions can also help determine whether it is necessary to increase the area's capability in certain areas to reduce its vulnerability.

Table 6.3: Policy and Program Assessment

Policies / Programs					
	Policy / Program Status[1]	**Document/ Reference[2]**	**Effectiveness for Mitigation**	**Rationale for Effectiveness[3]**	**Recommendations for Incorporating into Hazard Mitigation Strategy**
1.	**Comprehensive Plan**				
1.1	Onslow County supports State standards for shoreline stabilization in which the preferred methods are stated as follows: (1) marsh grass or other natural protective features (2) sloped riprap and (3) vertical bulkheads (only as last resort).	Comprehensive Plan (pg. 25)	High	High, because the County maintains standards equivocal to the State.	Continue to support State standards
1.2	Onslow County encourages the State of North Carolina, as well as all area local governments to diligently pursue the acquisition and development of waterfront properties for public use, particularly regarding boating access	Comprehensive Plan (pg. 26)	High	High, because it limits the amount of structures in the floodplain or storm surge location	Continue to encourage the acquisition and development of waterfront property for public use
1.3	Onslow County will work, whenever possible, to require the retention and management of natural vegetation in buffer areas along its creeks and rivers	Comprehensive Plan (pg. 46)	High	High, because it allows an area for flood waters without causing damage to property	Continue to require the retention and management of natural buffers along creeks and rivers
1.4	Onslow County supports NC Division of Water Quality regulations regarding storm water runoff resulting from development activity. Intensive growth and development will not be allowed where poor drainage exists unless appropriate corrective improvements are to be completed as part of the project.	Comprehensive Plan (pg. 46)	High	High, because it requires necessary drainage to reduce the likelihood of water damage to structures	Continue to require appropriate corrective improvements
1.5	Onslow County shall give priority consideration to corrective measures to prevent the flooding of roads, houses, and businesses caused by intense rain events	Comprehensive Plan (pg. 46)	Medium	Medium, because it does not address specific mitigation activities to accomplish this goal	Address specific goals to prevent flooding by intense rain events

1.6	Development activities in the 100-year floodplain or near water bodies shall be carefully controlled. If development must occur, low intensity uses such as recreation and agriculturally related activities (adequately buffered) shall be preferred	Comprehensive Plan (pg. 47)	Medium	Medium, because it prefers low intensity uses in the 100-year floodplain	Continue to prefer low intensity uses in the 100-year floodplain
1.7	Onslow County shall discourage the placement of septic systems within the 100-year floodplain	Comprehensive Plan (pg. 47)	High	Medium, because it discourages the placement of septic systems in the floodplain that could lead to groundwater contamination	Continue to discourage the placement of septic systems in the 100-year floodplain
1.8	Onslow County supports coordinated efforts to preserve and protect the ecological and flood hazard benefits of freshwater wetlands, as protected under Section 404 of the Clean Water Act of 1972	Comprehensive Plan (pg. 64)	High	High, because it supports coordinated efforts to protect the flood hazard benefits of freshwater wetlands	Continue to support efforts to protect the flood hazard benefits of freshwater wetlands
2. **Flood Damage Prevention Ordinance**					
2.1	All new construction and substantial improvements shall be anchored to prevent floatation, collapse, or lateral movement of the structure	Flood Damage Prevention Ordinance (pg. 400)	High	High, because it supports improvements made to prevent flotation, collapse, or lateral movement of structures	Continue to support efforts to protect the flood hazard areas through construction and improvement mitigation
2.2	All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage	Flood Damage Prevention Ordinance (pg. 400)	High	High, because it supports materials and utility equipment that is resistant to flood damage	Continue to support construction and improvements made with equipment resistant to flood damage
2.3	Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities shall be designed and located as to prevent water from entering or accumulating within the components during conditions of flooding	Flood Damage Prevention Ordinance (pg. 400)	Medium	Medium, because it prevents water from entering or accumulating within service facilities during conditions of flooding	Continue to support the location and design of service facilities as to prevent water entering or accumulating within the components during conditions of flooding

2.4	All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems and discharges from the systems into floodwaters	Flood Damage Prevention Ordinance (pg. 400)	High	High, because it helps to prevent floodwater from entering the system and discharges from entering floodwater	Continue to support new and replacement water supply systems that help maintain a high quality of water for citizens of Onslow County
2.5	New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems and discharges from the systems into floodwater	Flood Damage Prevention Ordinance (pg. 400)	High	High, because it minimizes or eliminates infiltration of floodwaters into the sewage systems and discharges from entering the floodwater	Continue to support new and replacement sewage systems that will help minimize or eliminate infiltration of floodwaters into sewage systems
2.6	On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding	Flood Damage Prevention Ordinance (pg. 400)	Medium	Medium, because disposal systems will make all possible efforts to eliminate impairment or contamination from flooding	Continue to support disposal systems that are located and constructed to prevent impairment or contamination from flooding
2.7	New construction or substantial improvement of any residential structure shall have the lowest floor elevated no lower than two feet above the base flood elevation	Flood Damage Prevention Ordinance (pg. 401)	Medium	Medium, because requiring the base flood elevation to be two feet may assist in the mitigation of flood damage at lower levels of structures	Continue to support new construction and improvements that have the lowest floor two feet above the base flood elevation
2.8	Elevated buildings that include fully enclosed areas used for the sole purpose of parking vehicles, building access, or storage which is subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters	Flood Damage Prevention Ordinance (pg. 402)	High	High, because exterior walls will allow for the entry and exit of floodwaters, thus reducing flooding in enclosed areas.	Continue to require elevated buildings to have exterior walls that automatically equalize flood forces
2.9	All applicants wishing to purchase a permit for temporary structures must submit, in writing to the local administrator, a plan for the removal of the structure in the event of a hurricane or flash flood notification	Flood Damage Prevention Ordinance (pg. 402)	Medium	Medium, because upon notification, it is the applicant's responsibility to move the temporary structure	Continue to require a plan for the removal of temporary structures

2.10	Areas designated as floodways will have no encroachments; all new construction and improvements shall comply with applicable flood reduction provisions; and no manufactured homes shall be permitted, except in an existing manufactured home park or subdivision	Flood Damage Prevention Ordinance (pg. 403)	High	High, because the floodway is an extremely hazardous area due to the velocity of waters which carry debris, potential projectiles, and has erosion potential	Continue to restrict encroachments, make construction and improvements comply with provisions, and allow manufactured homes only in pre-existing mobile home parks

[1] Potential or Existing Policy/ Program
[2] Plan and Page Number
[3] Low, because allows for development in the floodplain

7. MITIGATION STRATEGY

This section of the plan will provide a blueprint for Onslow County to follow to help address and become less vulnerable to the identified hazards. It is based on the findings and conclusions of the *Hazard Identification*, *Risk Assessment* and *Capability Assessment*. This section contains the following subsections:

- 7.1 Introduction
- 7.2 Community Goals & Mitigation Objectives
- 7.3 Identification and Analysis of Mitigation Techniques

7.1. Introduction

A mitigation strategy helps provide Onslow County with a basis for action. Based on the County's hazard identification, its vulnerability assessment, and its capability assessment the Onslow County Hazard Mitigation Plan Advisory Committee endeavored to develop appropriate and cost effective Hazard Mitigation strategies consistent with the achievement of the stated FEMA and NC State overall Goal: "To substantially reduce loss of life and damage to property" stemming from these events. Onslow County's Hazard Mitigation Plan was designed to be both comprehensive and strategic in nature. That is, the plan was created to provide a comprehensive review of hazards and identify policies and projects intended to not only reduce the future impacts of hazards, but also assist the county, and participating jurisdictions, to achieve compatible economic, environmental and social goals. The plan is strategic in that all policies are linked to departments or individuals responsible for their implementation. When possible, funding sources that may be used to assist have been identified.

Planning Approach

In order to guide the actions of those charged with implementation the plan follows a traditional planning approach beginning with identification of mitigation goals. The goals are broad statements that set community priorities for reducing susceptibility to natural hazards. They serve as the basis for development of the more specific plan objectives and hazard mitigation activities. They are achieved through more action oriented objectives. The objectives address problems and situations identified through analysis of the hazard profile, vulnerability assessment, and local government capability assessment and are specific to each jurisdiction. Objectives are more tangible and specific than goals. When an objective is accomplished, it may be checked off and progress directed toward accomplishing another objective. Whereas goals are general statements that may never be fully realized, objectives should be capable of being accomplished. Onslow County hazard mitigation objectives provide intermediate steps toward reaching the goals that have been provided in this plan. The objectives include both hazard mitigation policies (such as land use regulations) and hazard mitigation projects that seek to address specifically targeted hazard risks (such as repetitive loss property acquisition).

The second step involves identification, consideration and analysis of available mitigation measures to help achieve the identified goals. This process is long term and continuous and is sustained through the review, development and maintenance of this Plan. Through this process alternative measures will continue to be considered when future opportunities are identified, data and technology improve, or funding becomes available.

The third step is the selection and prioritization of specific mitigation actions for Onslow County and the participating jurisdictions. The mitigation action plans represent unambiguous and functional plans for action and are considered essential for the mitigation planning process. Actions may include policies or projects designed to reduce the impacts of future hazard events. Mitigation Action Plans will be specific to each jurisdiction in this plan. The jurisdictional mitigation actions and policies can be found in the respective Jurisdictional Annex. The components of the planning framework are explained in greater detail below:

Goals:	Goals represent broad statements that are achieved through the implementation of more specific actions. Goals provide the framework for achieving the intent of the plan.
Hazard Mitigation Policies:	Policies are defined as a course of action agreed to by members of the team. Funding sources are listed, if applicable.
Hazard Mitigation Projects:	Projects are defined as specific actions taken to address defined vulnerabilities to existing buildings are systems.
Mitigation Action Plan:	Prioritized listing of actions (policies and projects, including a categorization of technique, individual or organization responsible for completion, and potential funding sources if applicable.

7.2.Community Goals and Mitigation Objectives

Every five-year cycle the Plan Advisory Committee reviews the goals that were identified for the plan. Goals and objectives are addressed at a countywide level and then also addressed individually at a municipal level. To achieve the broad community goals listed above an analysis of those goals was conducted resulting in the specific goals listed in. These goals are intentionally broad in scope and written to assist in setting our community priorities, and provide the basis for the County's hazard mitigation objectives and implementation strategies included in this plan.

ELEMENTS C344 CFR Part 201.6(c)(3)(i):
The Hazard Mitigation Strategy shall include a description of the mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

- Decrease the community's vulnerability to future hazard events.
- Increase the community's resiliency so that recovery can be quicker and less costly.
- Decrease the likelihood that a future natural hazard becomes a natural disaster.
- Ensure that future development contributes to the community's sustainability over time.

- To enhance local government capability to lessen the impacts of all natural hazards
- Restore and protect the natural capacity of floodplains to prevent future disasters, improve public health, restore degraded ecosystems, and make communities livable
- To identify and protect critical services, buildings, facilities and infrastructure that are at risk of damage due to natural hazards and to undertake cost-effective mitigation measures to minimize losses
- To develop an effective public awareness/ education/ outreach program for natural hazards the County and municipalities are most likely to experience.
- To protect persons and property, as well as reduce damage and loss to existing community assets.
- To ensure disaster resistant future development.
- Minimize the damage to public infrastructure resulting from natural hazards;
- Manage future development so that vulnerability of private property to natural hazards is reduced;
- Expedite post disaster reconstruction;
- Protect the fragile natural and scenic areas located along the New River and its tributaries.

The objectives address problems and situations identified through analysis of the hazard profile, vulnerability assessment, and local government capability assessment and are specific to each jurisdiction. Onslow County hazard mitigation objectives provide intermediate steps toward reaching the goals that have been provided in this plan.

- Preserve open space in floodplain areas.
- Improve education and outreach to the community regarding natural hazards.
- Provide regulations that effectively mitigate natural hazards and encourage development in suitable areas.
- Support activities that will make structures less susceptible to damage during natural hazard events.
- Improve upon the protection of the general population from all natural and man-made hazards.
- Reduce the potential impact of natural and man-made disasters on OC and local municipalities' response resources.
- Reduce the potential impact of natural and man-made disasters on OC and municipal Critical Facilities.
- Reduce the potential impact of natural and fabricated disasters on the County's' and municipalities' infrastructure.
- Improve Emergency Preparedness.

- Improve the County's and municipalities' Disaster Response and Recovery Capability.
- Reduce the potential impact of natural and man-made disasters on the County's and municipalities' economy.
- Reduce the County's and municipalities' liability with respect to natural and man-made hazards generally.
- Reduce the potential impact of natural and man-made disasters on the County's and municipalities' historic places and interests as well as other tangible and intangible characteristics, which add to the quality of life of the County's and municipalities citizens.

7.3.Identification and Analysis of Mitigation Techniques

ELEMENTS C444 CFR Part 201.6(c)(3)(ii):
The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effect of each hazard, with particular emphasis on new and existing buildings and infrastructure.

The County's Hazard Mitigation Plan Advisory Committee used the following to develop and prioritize the hazard mitigation strategies: Cost-benefit review, Results of Hazard Identification and Analysis, Results of Vulnerability Assessment, Results of Community Capability Assessment; and Effectiveness in meeting hazard mitigation goals and comprehensive plan goals. In order to ensure that a broad range of mitigation actions were considered a comprehensive range of specific mitigation actions for each hazard were analyzed. These fall into the following six broad categories of mitigation techniques:

7.3.1. Prevention

Preventative activities are intended to keepall hazards problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Hazard mapping
- Open space preservation
- Floodplain regulations
- Stormwater management
- Drainage system maintenance
- Capital improvements programming
- Shoreline / riverine / fault zone setbacks

7.3.2. Property Protection

Property protective measures enable structures to better withstand hazard events, remove structures from hazardous locations, or provide insurance to cover potential losses. Examples include:

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Retrofitting (i.e., wind proofing, flood proofing, seismic design standards, etc)
- Insurance
- Safe room construction

7.3.3. Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of natural systems. Examples of natural systems that can be classified as high hazard areas include floodplains, wetlands and barrier islands. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

- Floodplain protection
- Beach and dune preservation
- Riparian buffers
- Fire resistant landscaping
- Erosion and sediment control
- Wetland restoration
- Habitat preservation
- Slope stabilization

7.3.4. Structural Projects

Structural mitigation projects are intended to lessen the impact of hazards by modifying the environment or hardening structures. Structural projects are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Levees, dikes, floodwalls, or seawalls
- Detention and retention basins
- Channel modification
- Beach nourishment
- Storm sewer construction

7.3.5. Emergency Services

Although not typically considered a mitigation technique, emergency services minimize the impact of a hazard on people and property. Actions taken prior to, during, or in response to a hazard event include:

- Warning systems

- Search and rescue
- Evacuation planning and management
- Flood fighting techniques

7.3.6. Public Education and Awareness

Public Information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards and mitigation techniques they can use to protect themselves and their property. Examples of measures used to educate and inform the public include:

- Outreach and education
- Training
- Speaker series, demonstration events
- Real estate disclosure
- Hazard expositions

8. MITIGATION ACTION PLAN

The mitigation actions proposed by Onslow County's local governing body are listed below. The municipal Mitigation Strategies and Actions can be found in the respective Annexes that include:

- Annex 1: City of Jacksonville
- Annex 2: Town of Holly Ridge
- Annex 3: Town of North Topsail Beach
- Annex 4: Town of Richlands
- Annex 5: Town of Swansboro

ELEMENTS C544 CFR Part 201.6(c)(3)(iii):
The mitigation strategy shall include an action plan describing how the actions identified in paragraph (c)(2)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction.

ELEMENTS C544 CFR Part 201.6(c)(3)(iv):
For multi-jurisdictional plans, there must be identifiable ction items specific to the jurisdiction requesting FEMA approval or credit for the plan.

The Onslow County Mitigation Action Plan lists the action, the results of the capability assessment, as well as the cost-benefit review were given special emphasis, in light of their possible use in environmental reviews for HMGP, FMA and other Federal hazard mitigation projects. As a result, each hazard mitigation strategy includes a responsible party for carrying out the implementation, a period by which they should complete the implementation, whether it is new or existing, an implementation status, estimated cost, and other items to demonstrate that each action has been thoroughly assessed for feasibility.

It should be stressed that this plan is a policy document and intended to serve as a planning tool. This plan is not a regulatory document nor does the adoption of the plan require Onslow County to implement all of the objectives included in the plan. However, Onslow County will periodically review their hazard mitigation goa1s; and objectives and make a concerted effort towards implementation.

Action #	Action	Hazard	Funding	Responsible Party	Target Completion Date	Priority	Benchmarks / Indicators of Progress
PREVENTION							
P1	GIS staff will maintain a map and listing of streets that will be used for evacuation in the event of a hurricane.	Flooding	Local	GIS Police Fire	On-going	High	GIS will review the evacuation routes with the Emergency Services Department Director during annual hurricane response training.
P2	Onslow County's flood plain map will be modified prior to the new FEMA flood maps being approved.	Flooding Hurricanes Nor'easter	Local	GIS PD	On-going	Medium	Progress will depend on the collaboration between the State and FEMA
P3	Control water pollution by regulating point sources that discharge pollutants into waters in Onslow County.	Flooding or Discharge	Local	PD State	On-going	Low	Monitoring of development sites to ensure storm water controls are in place and are maintained.
P4	Onslow County will rely on its existing ordinances and land use controls to regulate development within the floodplain.	Flooding	Local	PD	On-going	Medium	Ensure codes and ordinances are enforced during the permitting and construction processes. Monitor sensitive areas for unpermitted construction activities.
P5	Continue to actively pursue State and Federal grant funds to assist in the implementation of the recommendations included in this plan.	All	Grants	EM PD	On-going	Medium	
P5	Apply for Community Rating System (CRS) classification and pursue CRS credit points for having this multi-hazard plan in place.	Flooding	Local	PD	On-going	High	FEMA and local regulations are reviewed and applied during the building permit and inspection processes. Additionally, progress reports must be submitted to FEMA to remain in the program
P7	Adopt a policy prohibiting the development of critical public facilities in the l00-year floodplain in cases where viable alternatives exist. Such a policy could be enforced through the County's floodplain and subdivision ordinances and permit issuance process.	Flooding	Local	AD PD	On-going	Medium	

PROPERTY PROTECTION							
PP1	The Onslow County Geographic Information System's staff will use flood plain, parcel, and aerial data to map specific flood plain areas. This will allow for future hazard mitigation community outreach by educating all citizens on the dangers of living in the flood plain.	Flooding	Grants Local	GIS PD	On-going	High	Continual software upgrading of GIS is already in place. Planning will coordinate on an annual basis to review the floodplain information and notify citizens on an as need basis.
PP2	Onslow County will continue to support the flood damage prevention codes by enforcing the rules and regulations of new construction and maintenance.	Flooding Hurricanes Nor'easter	Local	PD	On-going	Medium	Ensure codes and ordinances are enforced during the permitting and construction processes. Monitor sensitive areas for unpermitted construction activities.
PP3	Onslow County will continue to support its storm hazard mitigation policies provided in the *1997* Onslow *County Coastal Area Management Act (CAMA) Land Use Plan*.	Flooding Hurricanes Nor'easter	Local	PD	On-going	Medium	Ensure land use recommendations and decisions are consistent with the goals and policies outlined in the CAMA Land Use Plan.
PP4	Encourage surveyors, engineers, and land planners to become familiar with the NFIP land use and building standards by distributing copies of the NFIP land use and building standards from the County's inspections department when applicants apply for permits	Flooding	Local	PD	On-going		Provide classes/informational sessions and utilize various media platforms to distribute information on NFIP and Building Code Standards.
NATURAL RESOURCE ACTION							
NR1	Onslow County shall encourage the long-term management and wise use of its natural resources including, particularly, ocean and estuarine area resources, surface wetland and floodplain ecosystems, and other important natural areas.	Flooding Storm Surge Erosion	Local	PD	On-going		Ensure land use recommendations and decisions are consistent with the goals and policies outlined in the CAMA Land Use Plan.

NR2	Onslow County encourages the prevention of premature conversion of large areas of productive agricultural land to development and to protect valuable environmental areas from destruction	All	Local	PD	On-going		Maintain Voluntary Ag Districts and overlay districts that protect working lands within Onslow County.
EMERGENCY SERVICES							
ES1	Onslow County will continue to educate its staff on the HAZUS software endorsed by FEMA.	Wind Flooding	FEMA Local	EM GIS	On-going	Medium	Staff will complete training and educational seminars offered by FEMA.
ES2	Emergency Management will try to identify repetitive loss and severe repetitive loss properties and the Planning Department will try to obtain funds from grants to remove these properties.	Flooding	FEMA Grants Local	EM PD	On-going	High	An assessment will be conducted at a specified time to evaluate the ability to identify repetitive loss properties and to discuss the funds available to remove the property.
ES3	Onslow County Volunteer Fire Departments will provide additional services during the times of emergency/ disasters.	Wind Flooding Nor'easter Hurricanes	Local	VFD	On-going PRN	Low	The Onslow County Fire Commission will monitor progress. Volunteer Fire Departments currently provide these services.
ES4	Onslow County will continue to support its *Emergency Operations Plan (EOP)*.	All	Local Grants	EM BoC	On-going	High	The Emergency Operations Plan will be reviewed on an annual basis. Documentation will be provided to NCEM to support these reviews.
ES5	Sustain radio communications system through maintenance.	All	Local Grants	EM	New	High	Build out of new county wide interoperable P25 800MHz radio system that will include all agencies. System will provide for full interoperability between all agencies during disaster and emergency response.
STRUCTURAL							
S2	Onslow County should pursue the acquisition of properties in at risk areas when they are substantially damaged, meet the criteria for acquisition, and there is a planned public re-use for the property. Deed restrictions should be placed on properties that are acquired to prevent	All	FEMA Local Grants	PD	On-Going	Medium	Maintain Voluntary Ag Districts and overlay districts that protect working lands within Onslow County.

	development.						
S3	Onslow County should support the elevation of structures above flood level as an alternative when acquisition is not possible. Emphasis should be placed on structures located within the County's Repetitive Loss Areas. All elevations should meet State specifications and prioritization should be based on benefit/ cost rather than flood height.	Flood	Local Grants	PD	On-Going	Medium	
S4	The County will continue to maintain a computer database of all structures acquired or elevated through county-sponsored projects	Flooding Hurricanes Nor'easter Storm Surge Erosion	Local	PD	On-going	Medium	Updates to database as projects occur.
PUBLIC INFORMATION							
PI1	Onslow County will continue to educate its citizens on the importance of conserving water.	Drought	FEMA Grants Local	ONWASA	On-Going	Medium	Monitoring of the dated educational material will be handled by Planning to ensure that the information being taught is accurate.
PI2	Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.	All	Local Grants	EM	On-Going	Medium	
PI3	Ensure that the Onslow County website maintains updated documents about flood insurance, flood protection, floodplain management, and natural and beneficial functions of floodplains.	All	Local	EM PD	On-going	Low	

PI5	Educate local real estate agents about the Onslow County website's NFIP and flood hazard information that will advise potential buyers to investigate the flood hazard for the property they are considering purchasing.	Flood	Local	PD EM	On-Going	Low	
PI6	Send a flood protection flyer to all properties in the County through a document that that is distributed to all residences. The flyer should include the following information: a general identification of the local flood hazard, flood safety, flood insurance, property protection, floodplain development permit requirements, and drainage system maintenance. In addition, the flyer should specifically state that although a particular house may not require flood insurance that does not mean that a garage or outbuilding on the property is not subject to flooding.	Flooding	Local Grants	EM PD	On-going	Medum	
PI7	Provide information on the Onslow County website that explains what you can do to protect your property from wildfires. This should include ways for individuals to stay safe in addition to ways to prevent property loss.	Wildfire	Local	EM	On-going	Low	
PI8	Provide material on the Onslow County website regarding the hazards of thunderstorms, lightning, and hailstorms. This should include danger signs, what kind of disaster supplies would be needed, and ways to help prevent loss of life and/or property.	Severe Thunderstorm	Local	EM	On-going	Low	
PI9	Provide brochures on the Onslow County website explaining to residents what to do if they find a sinkhole on agricultural land, on commercial or industrial sites, or at their residential property	Sinkhole	Local	EM	On-going	Low	

P20	Establish and maintain a 5 year schedule for review and updates of the Countywide multi-jurisdictional Hazard Mitigation Plan.	All	Local	EM	New	Medium	Maintain a 5 year schedule to ensure FEMA approval status is maintained.

Abbreviations:
GIS – Geographical Information Systems
PD – Planning Department
EM – Emergency Management
AD – Administration
VFD – Volunteer Fire Department
BoC – Board of Commissioners,

9. PLAN MAINTENANCE

This section discusses how the Mitigation Strategy and Mitigation Action Plan will be implemented and how the Hazard Mitigation Plan will be evaluated and enhanced over time. This section also discusses how the public will continue to be involved in a sustained hazard mitigation planning process. It consists of the following three subsections:

- 9.1. – Implementation
- 9.2 – Monitoring, Evaluating and Updating the Plan
- 9.3 – Incorporation into Other Planning Mechanisms
- 9.4 – Continued Public Involvement
- 9.5 – Plan Adoptions

9.1. Implementation

Each jurisdiction participating in the Plan was responsible for implementing specific mitigation actions as prescribed in their locally adopted Mitigation Action Plan. Each action has been assigned to a specific person or local government office in order to increase accountability and the likelihood of implementation. This approach enabled individual jurisdictions to update their mitigation strategy as needed, without altering the broader focus of the County Plan. The separate adoption of locally-specific actions was required so that each jurisdiction was not held responsible for the action(s) of every other jurisdiction involved in the planning process. Whenever possible, a funding source has been identified that may be considered when attempting to implement the action. In addition, an implementation time period, or a specific implementation date, has been assigned in order to assess whether actions are being implemented in a timely fashion. Strategies that will be incorporated into existing programs or activities are identified. Plan implementation will start from the time that it each plan is adopted.

9.2.Monitoring, Evaluating and Updating the Plan

9.2.1. Monitoring

ELEMENTS A644 CFR Part 201.6(c)(4)(i):
The plan shall include a plan maintenance process that includes a section describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle.

After a local hazard mitigation plan has been developed and adopted, it is important to continually track the progress of mitigation actions and evaluate how the implementation strategies contained in the plan work in practice. Planners and other local officials involved in hazard mitigation must monitor the implementation of the plan and evaluate its effectiveness, in order to recommend additional mitigation actions and make periodic revisions to the plan.

Monitoring and evaluation are the ongoing processes of compiling information on the outcomes resulting from implementation of the hazard mitigation

plan. This process measures progress in achieving goals, objectives, and implementation strategies. Through the monitoring and evaluation process, revisions required to respond to changes in regional and local conditions may be identified. Local conditions are constantly changing. Changes in land use and development affect a variety of infrastructure issues such as potable water, sewer, roads, storm water facilities, and ecological considerations such as water quality. Storms and other natural processes, like coastal and riverine erosion, continually alter a community's hazardous areas. In addition, strong policies and programs should help achieve some of a community's mitigation objectives. Because so many factors will affect the success of mitigation efforts, a planned evaluation of the local mitigation strategy is essential. Evaluation gives an opportunity to enhance the balance between effective mitigation and future growth and economic development.

9.2.2. Evaluating

Periodic evaluations of the Hazard Mitigation Plan will take place as deemed necessary by the Hazard Mitigation Advisory Committee during the annual meeting(s). Evaluations will not only include an investigation of wether mitigation actions were completed, but also an assessment of how effective those actions were in mitigating losses. A review of the qualitative and quantative benefits (or avoided losses) of mitigation activities will support this assessment. Results of the evaluation will then be compared to the goals and objectives established in the plan and decisions will be maderegarding whether sctions should be discontinued or modified in any way in light of new developments. Progress will be documented by the Hazard Mitigation Advisory Committee for use in the next Hazard Mitigation Plan Update.

The evaluation report will include the following:

- A review of the goals and objectives– do they address current and expected conditions?
- A review of any disasters or hazards that occurred during the year.
- A review of each element or objective of the original plan, including what was accomplished in the previous year.
- A discussion of why any objectives were not reached or why implementation is behind schedule.
- Recommendations for new projects or revised objectives.
- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing the plan?
- Are there implementation problems, such as technical, political, legal or coordination issues with other agencies?
- Have the outcomes occurred as expected?
- Did the agencies and other partners participate in the plan and planning process as proposed?

9.2.3. Revisions and Updates

Periodic evaluation and revision of the plan helps to ensure that local mitigation efforts include the latest and most effective mitigation techniques. Periodic revisions help keep the County and municipal plans in compliance with Federal and State statutes and regulations. Additional development, implementation of mitigation efforts, development of new mitigation processes, and changes in Federal and State statutes and regulations may all affect the local hazard mitigation plan. In the context of a Federal disaster declaration, State and local governments are allowed to update or expand an existing plan to reflect circumstances arising out of the disaster. An updated plan in this circumstance might include a re-evaluation of the hazards and the jurisdiction's exposure to them, a re-assessment of existing mitigation capabilities, and new or additional mitigation recommendations.

Updates to the *OC MJ-HMP* will be considered on a 5-year cycle. Each Five Year update will be lead by a representative from Onslow County Emergency Services. The plan review should include recommendations and information gathered by the evaluation process described above and any changes or amendments as determined by the process of annual review described below. Although the comprehensive review and revision is scheduled, some amendments to the Plan may be prompted by a number of circumstances, including identification of specific new mitigation projects, completion of several proposed mitigation actions, or if required to qualify for specific funding.

The review process shall be the responsibility of the OC Hazard Mitigation Plan Advisory Committee and shall consist of the convening of appropriate Plan contributors and/ or meetings with contributors individually as practical or necessary following a disaster or other instances warranting re-examination of the mitigation policies. Meetings will be recorded, should be made public, and such recommendations as may be forthcoming shall be evaluated and forwarded to the overall OC Hazard Mitigation Plan Advisory Committee for consideration and comment.

Each jurisdiction will produce a progress report with recommendations for updates and revision and bring it before their Commissioners or Councils. These reports should reflect updates on progress of mitigation actions, completion of mitigation actions, possible changes in or new areas of funding, and any legislative changes having direct effect on the plan. Progress reports may contain information provided by other reports including, but not limited to, Community Assistance Visits (CAV). As updates occur, the date, reason and responsible party should be noted. Updates or revisions, which affect the plan as a whole or impact any other jurisdiction(s), will require a presentation of findings and recommendations be submitted to those jurisdictions' council members for adoption.

9.2.4. Procedure for Amending the Hazard Mitigation Plan

A. Initiation of Amendments

Any person or organization, including the Planning Department, may petition the Board of Commissioners to amend this plan. The petition shall be filed with the Planning Department and shall include a description of the proposed text or map amendment, along with an explanation of the changing circumstances that necessitate consideration of the amendment.

Upon initiation of a text or map amendment, the Planning Department shall forward the proposed amendment to all interested parties, including, but not limited to, all affected County departments, and other interested agencies such as the NC Division of Emergency Management, the US Army Corps of Engineers, and the US Department of Agriculture Natural Resource Conservation Service (USDA NRCS) for a 30-day review and comment period. At the end of the comment period, the proposed amendment shall be forwarded along with all review comments to the Planning Board for its consideration. If no comments are received from the reviewing department or agency within the specified review period, such shall be noted in the Planning Department's recommendation to the Planning Board.

B. Planning Board Review and Recommendation

The Planning Board shall review the proposed amendment, along with the Planning Department's recommendation and any comments received from other departments and agencies. The Planning Board shall submit its recommendation on the proposed amendment to the Board of Commissioners within forty-five (45) days. Failure of the Planning Board to submit its recommendation within this period shall constitute a favorable recommendation.

C. Public Hearing Requirements

No amendment to the plan may be adopted until a public hearing has been held. Upon receipt of a recommendation from the Planning Board, the Planning Department shall, after consultation with the Clerk to the Board, schedule a public hearing before the Board of Commissioners on the petition.

The public notice shall be published one (1) time in a newspaper having general circulation within the County at least ten days prior to the scheduled public hearing date. In computing this period, the date of publication shall not be counted but the date of the public hearing shall be.

With respect to map amendments, the Planning Department shall provide first-class mail notice of the public hearing to: Owners, according to County tax records, of all properties whose use of land may be affected by the proposed amendment; and Owners, according to County tax records, of all properties within 100 feet of the properties affected by the proposed amendment.

The Planning Department may also post notices of the public hearing in the vicinity of the properties affected by the proposed amendment and take any other action deemed by the Planning Department to be useful or appropriate to give notice of the public hearing. The notice required or authorized by this section shall:

1. State the date, time, and place of the public hearing;

2. Summarize the nature and character of the proposed change;

3. If the proposed amendment involves a change in potential use of the land, reasonably identify the property whose potential land use would be affected by the amendment;

4. State that the full text of the amendment can be obtained from the County Planning Department; and

5. State that substantial change in the proposed amendment may be made following the public hearing.

D. Board of Commissioners Review and Adoption

Upon receipt of a recommendation from the Planning Board, the Planning Department shall schedule a public hearing before the Board of Commissioners on the petition according to the procedure outlined in Section "Public Hearing Requirements."

9.3.Incorporation into Other Planning Mechanisms

The municipal governments have created and incorporated the requirements of the OC MJ-HMP into other County and local plans. The County and municipal planners will incorporate the requirements of this HMP in updates to local planning documents, such as the comprehensive EOP, CAMA land-use plan, capital improvement plans, and other plans as necessary and applicable, and those ordinances such as floodplain, sub-division, and zoning. The County and municipal planners will provide copies of this plan to each planning advisory member as needed. The local planner will recommend to 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 vulnerability to the impacts of natural hazards in the jurisdiction.

ELEMENTS A444 CFR Part 201.6(b)(3):
The plan maintenance process shall include a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Onslow County is experiencing a great deal of residential growth throughout the county and considerable commercial growth in the Sneads Ferry area. The county has completed countywide zoning. The Subdivision and Zoning Ordinances address the suitability of land for development, protect property values and natural resources, and minimize hazards. The Flood Damage Prevention Ordinance establishes a two-foot freeboard and also limits development within flood hazard areas. The County enforces the North Carolina Building Code which includes provisions for high wind zone areas. The Joint Land Use Study (JLUS) is complete and we anticipate working with Marine Corps Base Camp Lejeune on the implementation of this study over the next several months.

9.4.Continued Public Involvement

In developing the plan, the County sought to educate the public by soliciting public participation in the planning process and to integrate any proposed new policies and ordinances into the County's existing regulatory environment. Public meetings were scheduled throughout the planning process to gain valuable citizen input and to broaden public

ELEMENTS A544 CFR Part 201.6(c)(4)(iii):
The plan maintenance process shall include a discussion on how the community will continue public participation in the plan maintenance process.

understanding and support for development and implementation of the Plan. The Plan was used as an educational tool to convey to County citizens the danger of natural hazards and to outline strategies for mitigating potential damage to lives and property within the County.

A major goal of the hazard mitigation process is to continue to offer support and information to County residents. After adoption of the Plan, the Hazard Mitigation Plan Advisory Committee will play the lead role in seeking to educate citizens on the findings and strategies of the Plan.

Public participation in the *OC MJ-HMP* is critical to developing a viable HMP. The public is welcomed and encouraged to become actively involved in providing input to the OC Hazard Mitigation Plan Advisory Committee. To facilitate continued public involvement in the planning process:

- The public will be invited to participate in the annual review of the plan.
- Public notice of plan reviews will be issued via area newspapers, television, pubic notices, and the County's website.
- Copies of the plan will be kept on hand at all public libraries and at appropriate agencies through the County, Cities, and Towns. The plan will have a contact address, email address, and phone number of the person responsible for keeping track of public comments on the plan.
- The plan will be available on the Onslow County Website and will contain an email address and phone number the public can use for submitting comments and concerns about the plan.

9.5.Plan Adoptions

At the completion of the planning process, the OC Hazard Mitigation Plan Update Advisory Committee produced a *OC Multi-Jurisdiction Hazard Mitigation Plan* for submission to the appropriate County and Municipal leaderships for adoption, promulgation, and execution. The County and municipal annexes were adopted and predicated upon final approval by the appropriate State and Federal approving agencies.

Adoption of the *OC MJ-HMP* follows in accordance with those legal guidelines and statutes, to include The Disaster Mitigation Act 2000; 44 CFR 201.6 (c)(5), that are the process for official adoption.

JURISDICTION	ADOPTION DATE
Town of Holly Ridge	Pending FEMA Approval
City of Jacksonville	Pending FEMA Approval
Town of North Topsail Beach	Pending FEMA Approval
Town of Richlands	Pending FEMA Approval
Town of Swansboro	Pending FEMA Approval
Onslow County	Pending FEMA Approval

9.5.1. Adoption Resolutions

APPENDIX A: PLANNING DOCUMENTATION

MEDIA RELEASE

Contact: Todd W. Lyman
Public Information Officer
Todd_lyman@onslowcountync.gov
(910) 347-4717
Or
Norman Bryson, Emergency Services
(910) 347-4270
Norman_bryson@onslowcountync.gov

FOR IMMEDIATE RELEASE
August 29, 2014

Public Invited to Assist With County Hazard Mitigation Plan Update

Onslow County, NC – Onslow County citizens are invited to attend a public meeting at the Onslow County Emergency Operations Center, 1180 Commons Drive North Sept. 5 from 6-7 p.m. to learn about and contribute to changes to the Onslow County Multi-Jurisdiction Hazard Mitigation Plan.

Onslow County Emergency Services plans for weather and environmental hazards resident in our county. This year officials will conduct a mandated five-year update to the hazard mitigation plan. Topics include flood plains, dam and sinkhole risk mitigation, which can impact homeowners and builders here.

In 2000, the Federal Disaster Mitigation Act, an amendment of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, was passed and required state and local governments to develop hazard mitigation plans. The plan, at its core, is a living document aimed at reducing the risk and vulnerability of community life and property. The plan also helps increase public awareness of what hazards may affect them and what reduction measures are used in the community. The Onslow County Multi-Jurisdiction Plan identifies all hazards that may affect our area and outlines strategies and policies to reduce vulnerability. FEMA mandates that the hazard mitigation plans be reviewed and updated to ensure that it remains an active and open document.

Onslow County has been working with local towns and cities for more than eight months to update their annexes to the multi-jurisdiction plan as part of a scheduled five year review. The document is a draft pending approval by the Onslow County Board of Commissioners prior to state and federal approval. The draft document will be available for review at the meeting. Citizens are encouraged to attend this meeting, which also fulfills one of the FEMA planning requirements. For more information please call 910-347-4270. The plan can be viewed at http://onslowcountync.gov/Departments/Emergency_Services/Hazard_Mitigation/

ONLINE NOTIFICATION

Norman Bryson, Emergency Services
(910) 347-4270
Norman_bryson@onslowcountync.gov

Posted at: http://onslowcountync.gov/Departments/Emergency_Services/Hazard_Mitigation/

Onslow County Multi-Jurisdictional Hazard Mitigation Plan Update Information

Mitigation planning is most effective when it is based on a comprehensive, long-term plan that is developed before a disaster occurs. The purpose of mitigation planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. Local hazard mitigation planning should be community oriented in assessing risk and vulnerability and practices to best minimize or manage those risks. The plan should also establish a maintenance schedule to will ensure it remains current and dynamic and can be incorporated into routine local decision making. Onslow County adheres to the FEMA 5 year review cycle. The next FEMA review is scheduled for 2015.

*** Hazard Mitigation Plan Update Community Meeting***

There will be a public meeting to review and discuss the 2015 proposed Onslow County Multi-Jurisdictional Hazard Mitigation Plan. The plan addresses natural hazards that could potentially affect Onslow County and the municipalities of Holly Ridge, Jacksonville, North Topsail Beach, Richlands, and Swansboro. Citizens are invited to come and review and provide feedback on the plan.

September 5, 2014
6-7pm
1180 Commons Dr. N
Jacksonville, NC

For more information please contact Onslow County Emergency Services at 910-347-4270

1st MEETING ATTENDANCE

1 of 2

ONSLOW COUNTY
EMERGENCY SERVICES DEPARTMENT
REGISTRATION RECORD

Meeting/Course Program/Title: HAZARD MITIGATION PLANNING

Date: 13 FEB 14 Time: 10:00 AM Location: ONSLOW COUNTY EOC

NAME (please print)	POSITION/ ORGANIZATION	MAILING ADDRESS (w/zip code)	PHONE NO. (w/area code)	E-MAIL ADDRESS
STACIE MILES	OCES DEPUTY DIRECTOR			stacie-miles@onslowcountync.gov
ANDREW JASPERS	OCES Planning officer			andrew.jaspers@onslowcountync.gov
Bob Ritchie	SWANSBORO			britchie@ci.swansboro.nc.us
ARTHUR TAYLOR	SWANSBORO FD			ataylor@ci.swansboro.nc.us
Jennifer Holland	SWANSBORO			jholland@ci.swansboro.nc.us
Patricia Pike	ONSLOW GIS			patricia.pike@onslowcountync.gov
DEBORAH J. HILL	NTB PLANNING DIR			dhill@north-topsail-beach.org
SPENCER LEE	DEPUTY CHIEF JACKSONVILLE FIRE & EMERG. SVS.			slee@jacksonvillenc.gov
ALAN FERNANDEZ	DEPUTY PLANNING DIRECTOR			alan.fernandez@onslowcountync.gov
BEN WARREN	O.C. PLANNING DIRECTOR			benjamin.warren@onslowcountync.gov
RON Lindig	RPD			Townerch13@embarqmail.com

272

ONSLOW COUNTY
EMERGENCY SERVICES DEPARTMENT
REGISTRATION RECORD

Meeting/Course Program/Title: HAZARD MITIGATION PLANNING

Date: 13 FEB 14 Time: 10:00 AM Location: ONSLOW COUNTY EOC

NAME (please print)	POSITION/ ORGANIZATION	MAILING ADDRESS (w/zip code)	PHONE NO. (w/area code)	E-MAIL ADDRESS
Gregg Whitehead	Town of Richlands			richlandsnc@embarqmail.com
DAVID COTTON	DEPUTY COUNTY MANAGER ONSLOW COUNTY			DAVID_COTTON@ONSLOWCOUNTYNC.GOV

3rd MEETING ATTENDANCE

ONSLOW COUNTY
EMERGENCY SERVICES DEPARTMENT
REGISTRATION RECORD

Meeting/Course Program/Title: **Hazard Mitigation Planning Meeting #3**

Date: 14 Aug 2014 Time: 10:00am Location: 1180 Commons Dr. N

NAME (please print)	POSITION/ ORGANIZATION	MAILING ADDRESS (w/zip code)	PHONE NO. (w/area code)	E-MAIL ADDRESS
Stacie Miles	OCES			Stacie_Miles@onslowcountync.gov
Jane Holland	GIS Tech			jane_holland@onslowcountync.gov
ANDREW P. JASPERS	OCES			Andrew_Jaspers@onslowcounty nc.gov
DEB HILL	NTB			dhill@northtopsail-beach
Jennifer Holland	SWANSBORO			jholland@ci.swansboro.nc.us
Bob Ritchie	SWANSBORO			britchie@ci.swansboro.nc.us

APPENDIX B: FEMA LOCAL MITIGATION PLAN REVIEW