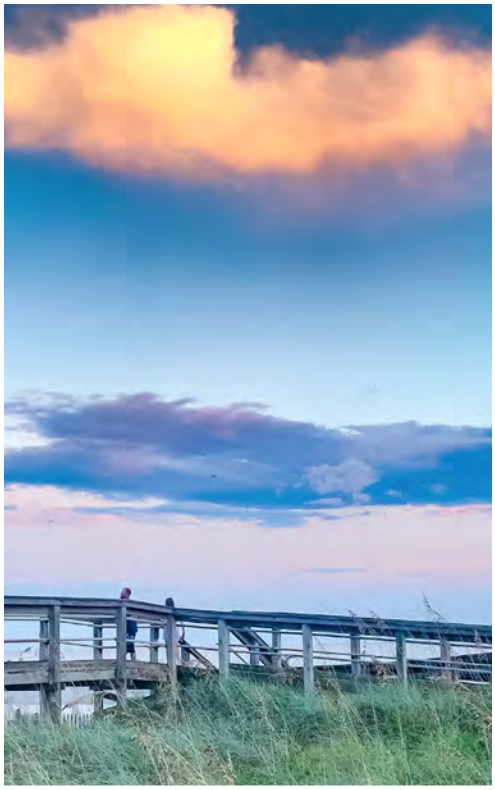

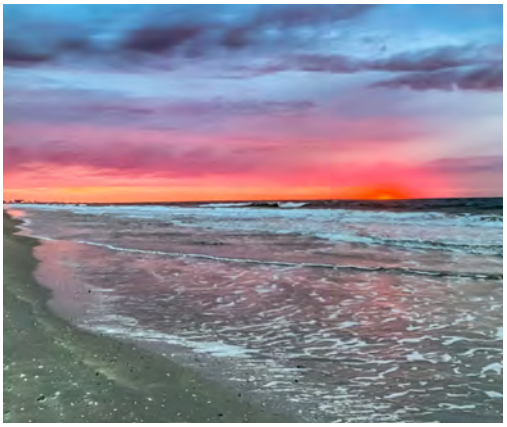

ESP

NORTH MYRTLE BEACH
HAZARD MITIGATION PLAN | 2021 UPDATE

FINAL APRIL 2021

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Chapter 1: Introduction

The City of North Myrtle Beach has experienced and is vulnerable to losses caused by natural and manmade/technological hazards. The City's most recent losses have been caused by hurricanes, floods wildfires and infectious disease; however, the City is also vulnerable to other hazards including coastal erosion, and manmade/technological hazards such as hazardous materials incidents and cyber threats.

To help the City reduce future damages associated with these hazards, the City of North Myrtle Beach City Council established a Hazard Mitigation Planning Committee. Since 2004, the Committee has been charged with undertaking a comprehensive, detailed evaluation of the vulnerabilities of the City to all types of hazards in order to identify ways to make the City more resilient. This document reports the results of the planning process followed by the Committee and includes recommendations for future actions that can be taken to mitigate the impacts of future hazard events that are certain to occur.

The City's first hazard mitigation plan was first developed in 2004 and updated in 2010 and again in 2015. The Disaster Mitigation Act of 2000 requires that local hazard mitigation plans be updated every five years. This 2021 update of the plan represents a comprehensive update of the previous plan.

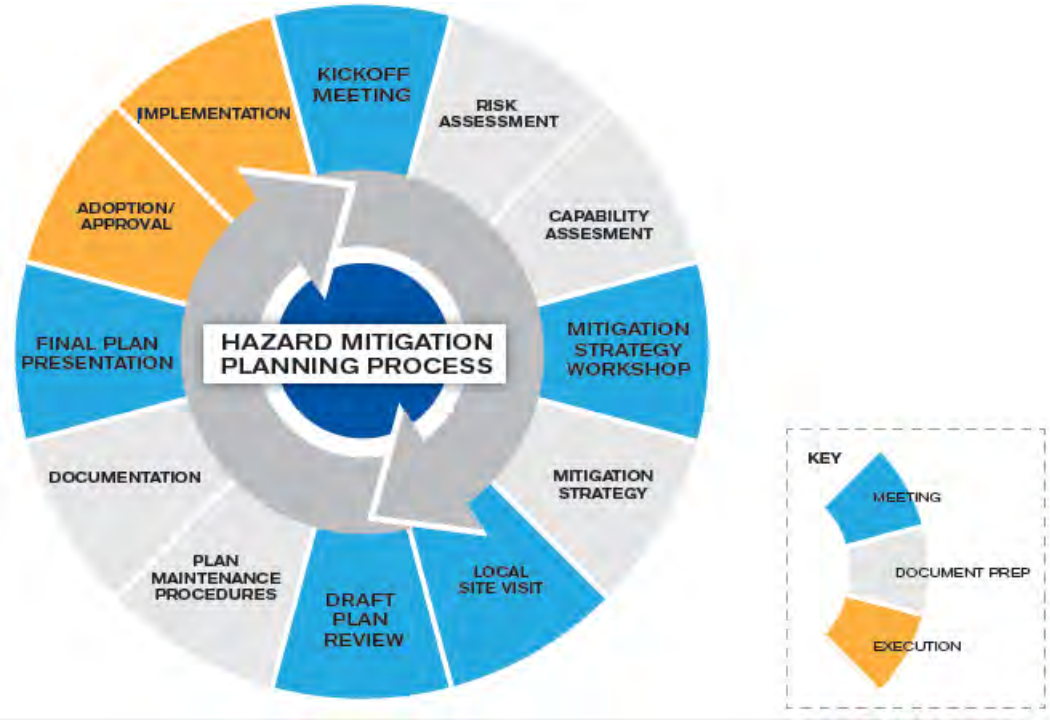
1.1 Plan Purpose

The Mitigation Plan is intended by the Committee to serve many purposes. These include the following:

Provide a Methodical, Substantive Approach to Mitigation Planning

A step-by-step process has been utilized by the Committee to develop this plan. The process relies on soundly based, methodical planning concepts. Each step in the planning process builds upon the previous. By conducting a Risk Assessment (found in Section 3), the hazards that could impact the City are identified and vulnerabilities to these hazards are identified. The Mitigation Action Plan (Section 8) includes the initiatives that are proposed by the Hazard Mitigation Planning Committee that will assist the City in avoiding or minimizing those vulnerabilities. A high level of assurance is developed so that each mitigation initiative proposed by the Committee has a valid basis for both their justification and priority for implementation. One key purpose of this plan is to document the planning process (See Section 2) and to present its results to the community, along with state and federal agencies to justify potential mitigation actions and funding for potential projects.

FIGURE 1.1: HAZARD MITIGATION PLANNING PROCESS



Enhance Public Awareness and Understanding

Public involvement in the mitigation planning process and public feedback on the document itself are critical to the success of hazard mitigation planning efforts. During the previous update of this plan, the Hazard Mitigation Planning Committee expressed an interest in finding ways to make the community aware of hazards and to get their input on the plan. During that update, the Committee first established a public information strategy for the City, called the Program for Public Information (PPI). This plan builds off of those initial efforts and provided supplemental opportunities for the public to be involved in the planning process through online survey instruments and virtual public meetings (held online as a result of the COVID-19 pandemic). Additionally, the City placed draft documents on the City's website, and wrote articles that were published in the local newspaper.

There is a need to inform the community about the impact mitigation planning can have in the City. The plan identifies the hazards threatening the City and provides an assessment of the relative level of risk the hazards pose. Details on specific vulnerabilities of the neighborhoods and business districts are also provided. The plan includes a number of proposals on avoiding or minimizing vulnerabilities. This information is helpful to individuals that wish to understand how the community could become safer from the impacts of hazards.

Create a Decision Tool for Management

The North Myrtle Beach Hazard Mitigation Plan provides information needed by the managers and leaders of the City, citizens and property owners, business and industry, community associations and other key institutions and organizations. This information will allow these stakeholders and entities to take actions to address vulnerabilities to future disasters. It also provides proposals for specific projects and programs that are needed to eliminate or minimize those vulnerabilities.

These proposals, called "mitigation strategies" in the plan, have been justified on the basis of their economic benefits. This approach is intended to serve as a decision tool for management and the community. Local government, business, and citizens can use the plan to learn why the proposed mitigation initiatives should be implemented.

Promote Compliance with State and Federal Program Requirements

There are a number of state and federal grant programs, policies, and regulations that encourage or even mandate that local governments develop and maintain a comprehensive hazard mitigation plan (See Section 1.3). This plan is specifically intended to comply with these requirements. The plan enables the City to quickly respond to state and federal funding opportunities for mitigation-related projects. The plan defines, justifies and prioritizes mitigation initiatives that have been formulated through a technically valid hazard analysis and vulnerability assessment process. Those interested in applying for grants are better prepared, using this plan, to quickly and more easily develop the necessary grant application materials for seeking state and federal funding.

Enhance City Policies for Hazard Mitigation Capability

A component of the hazard mitigation planning process is the analysis of existing policies, programs and regulations that are the basis for the management of growth and development. The experiences, data, and facts of disasters and disaster response are used to look at day-to-day land use planning policy. This allows for a comparison of the expected results from hazards that threaten the City and the policies that are to be used to deal with the impacts that are expected to occur. When the impacts are not adequately addressed by the community's policy or regulatory framework, the impacts of future disasters can be even more severe. This comparison supports and justifies enhancements in City policy to create a more disaster-resistant future for the community.

1.2 Background

Through the application of mitigation policies and practices the City of North Myrtle Beach is working to ensure that fewer citizens and businesses become victims of disasters that may occur in the area.

This mitigation plan provides guidance and recommendations on how the City can mitigate losses from hazard events. The *Plan* uses six categories of mitigation strategies as a "checklist" to ensure that all possible measures are considered. These categories of mitigation strategies include the following:

1. Preventive Measures
2. Property Protection
3. Natural Resource Protection
4. Structural Projects
5. Emergency Management
6. Public Information

Determining the mitigation strategies and measures that are best suited for the City is done through a planning process (described in Section 2). During this process, the various hazards that could impact the City are identified, the full range of possible mitigation measures that could be implemented are reviewed, and the most appropriate and affordable actions are recommended for implementation.

Hazard mitigation is an ongoing effort to reduce the impacts disasters have on people and property. Planning is the key to making mitigation a proactive process. Pre-disaster planning is an essential element in building an effective mitigation program. Preparing a plan to reduce the impacts of disasters before they occur can provide a number of benefits:

- **Saves lives and protects property:** In light of the fact that every community exists in a distinct natural, economic and social environment, hazard mitigation plans must fit within the specific needs of individual communities. A plan must consider the geography, demography, community size, economy, land uses, current community goals, and the hazards that define a community. Mitigation plans are designed to correspond with other community goals in order to provide a plan those best suits the overall needs of the community.
- **Achieves Multiple Objectives:** Mitigation plans can cover numerous hazards. By conducting a concurrent assessment of community vulnerability and capability to deal with various hazards, communities are able to prioritize needs and develop appropriate solutions to current and potential problems. This evaluation provides a comprehensive strategy to contend with the multiple facets of hazard preparation, response and recovery.
- **Saves Money:** The community will experience cost savings by not having to provide emergency services, rescue missions, or recovery operations in areas that are dangerous to people in the event of a disaster. Mitigation actions help communities avoid costly repairs to or replacement of buildings and infrastructure.
- **Facilitates post-disaster funding:** Many disaster assistance agencies and programs, including FEMA, require pre-disaster mitigation plans as a condition for both mitigation funding projects and for disaster relief funding. Programs that require mitigation plans include the Hazard Mitigation Assistance programs (Hazard Mitigation Grant Program – (HMGP), Building Resilient Infrastructure and Communities – (BRIC), and Flood Mitigation Assistance – (FMA) and the Community Rating System (CRS).

1.3 Authority

The North Myrtle Beach Hazard Mitigation Plan has been developed in accordance with current state and federal rules and regulations governing local mitigation plans and has been adopted the City. A copy of the adoption resolution is included in Appendix A. The Plan shall continue to be routinely monitored and revised to maintain compliance with the following provisions, rules, and legislation:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390);
- FEMA's Final Rule published in the Federal Register, at 44 CFR Part 201 (201.6 for local mitigation planning requirements);
- Flood Insurance Reform Act of 2004 (P.L. 108-264) and Biggert-Waters Flood Insurance Reform Act of 2012 (P.L. 112-141) and the Homeowner Flood Insurance Affordability Act of 2014.

1.4 The Community Rating System

This plan was developed to meet the requirements of the Community Rating System (CRS). The CRS provides a flood insurance premium reduction for all policyholders in communities that

implement activities above and beyond the minimum requirements of the National Flood Insurance Program. The CRS provides credits for a variety of community flood protection activities, organized under four general series:

- 300 Public Information
- 400 Mapping and Regulatory Activities
- 500 Flood Damage Reduction
- 600 Flood Preparedness

The objective of the CRS is to reward communities that are doing more than meeting the minimum NFIP requirements to help their citizens prevent or reduce flood losses. The CRS also provides an incentive for communities to initiate new flood protection activities. The goal of the CRS is to encourage, by the use of flood insurance premium adjustments, community and state activities beyond those required by the National Flood Insurance Program to:

- Reduce flood losses, i.e., protect public health and safety,
- Reduce damage to buildings and contents,
- Prevent increases in flood damage from new construction,
- Reduce the risk of erosion damage, and protect natural and beneficial floodplain functions.
- Facilitate accurate insurance rating, and Promote the awareness of flood insurance.

Benefits: It is important to note that reduced flood insurance rates are only one of the rewards a community receives from participating in the CRS. The CRS flood hazard mitigation activities provide enhanced public safety, a reduction in damage to property and public infrastructure, reduced human suffering, and protection of the environment. A community can evaluate the effectiveness of its flood program against a nationally recognized benchmark. Implementing some CRS activities, such as flood hazard mitigation planning, can help a community qualify for certain federal assistance programs.

Plan Credit: This *Hazard Mitigation Plan* is also intended to qualify for CRS credit. It has been prepared in accordance with CRS guidelines. In order to keep the credit, an evaluation report on the City's progress must be submitted to FEMA by October 1 of each year. This requirement acts as additional assurance that this *Hazard Mitigation Plan* will be implemented.

Community Classification Points: There are 10 community classes in the community rating system. Class 1 communities have the largest premium credit; residents of Class 10 communities receive no premium credit. Communities that do not apply for CRS classification are Class 10 communities.

The insurance premium credit is based on whether a property is in or out of the Special Flood Hazard Area (SFHA), i.e., the A and V Zones as shown on the City's Flood Insurance Rate Map (FIRM). The premium credit for properties in the SFHA increases according to the City's CRS class.

The City of North Myrtle Beach has qualified for a Class 6 CRS designation. There are 12,270 flood insurance policies in force in the City. The total flood insurance coverage for City policies is $2,610,564. Flood insurance policy holders saved more than $1,289,000 each year due to

the City's participation in the National Flood Insurance Program's Community Rating System. A City's classification is based on its total points. The qualifying community total points, CRS classes, and flood insurance premium credits are shown below:

TABLE 1.1: CRS CLASSIFICATION POINTS AND INSURANCE DISCOUNTS

Credit Points	CRS Class	SFHA Premium Discount	Non-SFHA Discount
4,500+	1	45%	10%
4,000–4,499	2	40%	10%
3,500–3,999	3	35%	10%
3,000–3,499	4	30%	10%
2,500–2,999	5	25%	10%
2,000–2,499	6	20%	10%
1,500–1,999	7	15%	5%
1,000–1,499	8	10%	5%
500–999	9	5%	5%
0–499	10	0	0

1.5 Plan Organization

The contents of this Plan are designed and organized to be as reader-friendly and functional as possible. It is comprised of nine chapters and five appendices, which are summarized below.

Section 2, ***Planning Process***, provides a complete narrative description of the process used to prepare the Plan. This includes the identification of participants on the planning team and describes how the public and other stakeholders were involved. It also includes a detailed summary for each of the key meetings held, along with any associated outcomes.

The ***Risk Assessment*** is presented Section 3. It is the largest section of the plan and includes the following:

- ***Community Profile*** which provides a general overview of the City, including prevalent geographic, demographic, and economic characteristics. In addition, building characteristics and land use patterns are discussed. This baseline information provides a snapshot of the planning area and helps local officials recognize those social, environmental, and economic factors that ultimately play a role in determining the region's vulnerability to hazards.
- ***Capability Assessment*** provides a comprehensive examination of the City's capacity to

implement meaningful mitigation strategies and identifies opportunities to increase and enhance that capacity. Specific capabilities addressed in this section include planning and regulatory capability, staff and organizational (administrative) capability, technical capability, fiscal capability, and political capability. Information was obtained through the use of a detailed survey questionnaire and an inventory and analysis of existing plans, ordinances, and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses, or conflicts in programs or activities that may hinder mitigation efforts and to identify those activities that should be built upon in establishing a successful and sustainable local hazard mitigation program.

- ***Hazard Identification***; ***Hazard Profiles***; ***Vulnerability Assessment***. Together, these subsections serve to identify, analyze, and assess hazards that pose a threat to the City.

The Risk Assessment begins by identifying hazards that threaten the City. Next, detailed profiles are established for each hazard, building on available historical data from past hazard occurrences, spatial extent, and probability of future occurrence. This section culminates in a hazard risk ranking based on conclusions regarding the frequency of occurrence, spatial extent, and potential impact highlighted in each of the hazard profiles. In the vulnerability assessment, an attempt to quantify the types and numbers of assets that are vulnerable to hazards. Where available, loss estimation methodologies such as FEMA's HAZUS software were used to evaluate known hazard risks by their relative long-term cost in expected damages. In essence, the information generated through the risk assessment serves a critical function as the City seeks to determine the most appropriate mitigation actions to pursue and implement—enabling them to prioritize and focus their efforts on those hazards of greatest concern and those structures or areas facing the greatest risk(s).

The Risk Assessment serves as a basis for determining the goals for the Plan, each contributing to the development, adoption, and implementation of a meaningful and manageable *Mitigation Strategy* that is based on accurate background information.

Section 4 of the plan contains the ***Repetitive Loss Area*** **Analysis (RLAA)** for the City. It provides the detailed mitigation plan for the repetitive loss areas within the City and is a required component of the Community Rating System.

Section 7 of the plan is the City's ***Program for Public Information (PPI).*** This represents the City's ongoing public information effort to design and transmit the messages that the City determines are most important to its flood safety and the protection of its floodplains' natural functions. The PPI was first developed in the previous version of this plan and is updated for the 2021 version.

Collectively, the ***Goals Strategies and Possible Mitigation Actions*** (Section 5), ***Mitigation Measures*** (Section 6) and the ***Mitigation Action Plan*** found in Section 8, provide the blueprint for the City to follow to become more resilient and reduce future damages caused by hazards. Section 5 contains the City's broad hazard mitigation goal statements. Section 6 provides an

analysis of hazard mitigation techniques for the City to consider in reducing hazard vulnerabilities. And finally, Section 8 links specific mitigation actions for the City to locally-assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the Plan both strategic, through the identification of long-term goals, and functional, through the identification of immediate and short-term actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make the City less vulnerable to the damaging forces of hazards while improving the economic, social, and environmental health of the community. The concept of multi-objective planning was emphasized throughout the planning process, particularly in identifying ways to link, where possible, hazard mitigation policies and programs with complimentary community goals related to disaster recovery, housing, economic development, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety.

Plan Maintenance, found in Section 9, includes the measures that the City will take to ensure the Plan's continuous long-term implementation. The procedures also include the manner in which the Plan will be regularly evaluated and updated to remain a current and meaningful planning document.

Section 2: Planning Process

This section of the plan describes the planning process undertaken to develop the 2021 update of the City of North Myrtle Beach Hazard Mitigation Plan. Information about the development of the previous versions of this plan can be found by reviewing those previous documents which can be obtained from the City of North Myrtle Beach.

The Community Rating System prescribes a ten-step process for developing a hazard mitigation plan. The subsections below discuss how the City of North Myrtle Beach addressed each step during the 2021 update of this plan.

Step 1. Organize to Prepare the Plan

Mitigation Planning Committee Appointed

This Mitigation Plan was updated under the guidance of a Mitigation Planning Committee. The Committee is formally recognized by City Council. Half of the committee is comprised of members representing the general public, including residents that live in the floodplain. The membership of the 2021 Mitigation Planning Committee is provided below.

TABLE 2.1: CITY OF NORTH MYRTLE BEACH 2021 MITIGATION PLANNING COMMITTEE

Name	Title	Representing
Dwayne Bates (Citizen)	Designer, Construction Manager	The Bates Group, LLC
Scott Jackson (Citizen)	Owner	Southern Coast Builders
Ray Sessions (Citizen)	Agent	Tilghman Insurance
Wyman Wise (Citizen)	Insurance Agent	Wyman Wise State Farm
Delane Stevens	Building Official	City of North Myrtle Beach Building Department
John Hill, CFM	Assistant Building Official/Floodplain Manager	City of North Myrtle Beach Building Department
Dawn E. Snider	Planner	City of North Myrtle Beach Planning and Development Department
Patrick Dowling	Public Information Officer	City of North Myrtle Beach

Since it was first established in 2015, the Committee has been charged with the following:

a) *Collecting data on hazards and the vulnerability of buildings and critical facilities.*
b) Assessing the impacts hazards could have on the City's people, property, and economy.
c) *Recommending hazard mitigation goals.*
d) *Reviewing potential activities that will accomplish the proposed mitigation goals.*
e) *Preparing a mitigation plan that recommends actions the City should take to achieve the recommended mitigation goals. The plan should meet the planning requirements of the Disaster Mitigation Act of 2000 and the National Flood Insurance Program's*

Community Rating System.

f) *Soliciting public input on hazard problems and solutions during the preparation of the plan and keep the public informed of its deliberations and recommendations.*
g) *Recommending procedures to evaluate the impact of the proposed actions.*

Mitigation Planning Consultant

The Planning Committee set the directions and policies for this planning effort. The City's Building Department provided overall coordination and logistical support for the committee. Other City staff, particularly the Planning and Development Department, the Public Utilities Department and the Public Safety Department provided assistance and information for the plan.

Berry A. Williams, a planning consultant, was responsible for development of the initial plan in 2015. ESP Associates Inc was hired to conduct the 2021 update of the plan. Work completed by the project consultant included data collection, research, and analysis. The consultant also drafted public information materials, handouts, and this Hazard Mitigation Plan.

Documentation of the meetings held during the update of the plan is provided below in brief meeting minutes that summarize the meetings.

Internal Meeting with City of North Myrtle Beach and Project Consultant Staff
February 6, 2020 – City Hall

This meeting served as the official project kickoff meeting between the City and the project consultant, ESP Associates. Project expectations, schedules and roles and responsibilities were discussed. Nathan Slaughter served as the project manager from ESP Associates and helped facilitate the meeting with City staff.

Mitigation Planning Committee Meeting 1
July 29, 2020 – Microsoft Teams Virtual Meeting

This meeting served as the first meeting during the plan update with the Mitigation Planning Committee. Following a welcome and introductions, Mr. Slaughter defined mitigation and talked about the Disaster Mitigation Act of 2000 and how hazard mitigation planning is tied to federal mitigation funding sources of the Hazard Mitigation Assistance (HMA) program. He also discussed the Community Rating System (CRS), specifically CRS activity 510 Floodplain Management Planning and the similarities between FEMA hazard mitigation plans and CRS 510 plans. Mr. Slaughter indicated that the plan would be updated to meet the requirements of both programs.

Mr. Slaughter discussed how hazard mitigation is the mitigation of both existing and future development and the importance of both. The he provided an overview and examples of the six hazard mitigation measures of preventions, property protection, natural resource protection, structural projects, emergency services and public education and awareness.

Mr. Slaughter discussed the key project objectives which were to: perform a complete update of the existing plan to demonstrate progress and reflect current conditions, update the plan before it expires in May of 2021, increase public awareness and education, maintain the City's grant eligibility and compliance with State and Federal regulations, and update the plan in accordance with the CRS.

He then provided an overview of the project tasks. He explained the steps for the planning process, the risk and capability assessments, the mitigation strategy, plan maintenance and documentation. He explained that the Mitigation Planning Committee was being reconvened to lead the plan update process. He also explained how the scope of the plan was being expanded a bit to include all of the hazard that are also found in the State of South Carolina's Hazard Mitigation Plan. In addition to the natural hazards included in the previous versions of the plan, manmade and technological hazards would be addressed.

Mr. Slaughter then began presenting some of the initial findings from the Risk Assessment. He indicated that there have been 181 hazard events recorded on 94 days since the previous plan was completed. The most frequent of those events included thunderstorm winds, flash floods and hail. He stated that this helped prove the importance of having and updating a hazard mitigation plan. He then provided some summary slides to include initial mapping results for flooding, storm surge and wildfires.

Mr. Slaughter then discussed the capability assessment portion of the plan and how the capability assessment captures the capacity of the City to implement a mitigation strategy. He discussed how the capability assessment helps to demonstrate mitigation efforts that have already been successful in the City and also how it helps identify any potential gaps in capability that could be improved through policy and or project completion. He noted that the City has a relatively high capability for implementing hazard mitigation techniques and a strong history of doing so.

Mr. Slaughter then shifted the conversation to the Mitigation Strategy for the City. He indicated that the previous plan included mitigation goals that should be carried over following review by the Committee. He also noted that the previous plan included a number of mitigation objectives that were specific enough to be considered mitigation actions. Mr. Slaughter recommended that the City change the objectives to mitigation actions and the Committee agreed.

He then discussed the need for the Committee to review and update the existing mitigation actions found in the plan. He stated that the Committee should also take the opportunity to identify any new actions that should be included in the plan.

Finally, Mr. Slaughter reviewed the project schedule which he stated had been delayed by the onset of the COVID-19 pandemic. He discussed the makeup of the project team from ESP Associates and defined roles and responsibilities for both the consulting team, the Committee and City Staff. He also indicated that because of the COVID-19 pandemic, initial public outreach activities would be conducted virtually first through an online survey that would be available soon and later through virtual public meetings.

He concluded the meeting by discussing next steps which were to schedule the next Mitigation Planning Committee meeting and to begin public outreach measures once the survey was completed. The meeting was then adjourned.

Mitigation Planning Committee Meeting 2
November 16, 2020 – Mitigation Strategy Meeting
An in-person meeting was held with the project consultant and the Mitigation Planning Committee, adhering to appropriate social distancing and masking regulations. The purpose of the meeting was to present more findings from the risk assessment and to discuss the mitigation strategy in more detail.

Mr. Slaughter began the meeting with brief introductions and an overview of the agenda for the day. He provided a brief refresher on the definition of mitigation and a recap of the Disaster Mitigation Act of 2000 and the key objectives of the project and the project schedule (which remained somewhat delayed because of the COVID-19 pandemic, but still on track for completion of the final plan).

He then began providing more detailed information about the hazards that impact the City. He started by recapping the number of hazard events experienced since the previous plan and discussed the presidential disaster declarations that have been experienced since the previous update. These included Hurricanes Matthew, Irma, Florence and Dorian and the COVID-19 pandemic. He provided summary stats and slides for the following hazards: hurricanes and tropical storms, coastal erosion, severe thunderstorms/lightning, tornadoes/waterspouts, flood, wildfire, drought, severe winter storms, earthquake, nor'easter, excessive heat, rip currents, hazardous materials incident, public health hazards/infectious disease, nuclear power plants, tsunami and terrorism.

Mr. Slaughter provided an overview of the Priority Risk Index. The PRI is a quantitative scoring of hazards which is used to focus in on the hazards of greatest concern for the City Using the PRI, the following hazards were considered the be highest risk for the City: hurricanes and tropical storms and flooding.

Internal Meeting with City of North Myrtle Beach and Project Consultant Staff
March 24, 2021 – Microsoft Teams Virtual Meeting
This meeting was a discussion with consultant and City staff regarding items needed to complete the final draft of the plan.

Step 2. Involve the Public

An important component of the mitigation planning process involved public participation. Individual citizen and community-based input provides the entire planning team with a greater understanding of local concerns and increases the likelihood of successfully implementing mitigation actions by developing community "buy-in" from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of any community's overall mitigation strategy aimed at making a home, neighborhood, school, business or entire city safer from the potential effects of hazards.

Public involvement in the development of the City North Myrtle Beach Hazard Mitigation Plan

was sought using three methods: (1) virtual public meetings; (2) public survey instruments were made available in hard copy and online; and (3) copies of the draft Plan deliverables were made available for public review on county and municipal websites and at government offices. The public was provided three opportunities to be involved in the development of the regional plan at distinct periods during the planning process: (1) during the drafting stage of the Plan; and (2) upon completion of a final draft Plan, but prior to official plan approval and adoption and (3) at the time of official plan adoption by the governing body of each participating jurisdiction. In addition, a public survey (discussed in greater detail below) was made available during the planning process at various locations throughout the City and the City's website. Documentation of these efforts is provided in Appendix D.

Because of the ongoing COVID-19 pandemic, the City held an online public meeting on April 8, 2021 from 6:00 to 7:00 PM. The purpose of the meeting was to present the draft plan and share the key findings and recommendations from the plan. 20 people registered for the meeting and all attended. Feedback received at the meeting was reviewed, considered and used to modify the plan as needed. The meeting was held more than two weeks prior to final adoption of the plan by City Council.

The final opportunity for public input on the plan came at the May 3, 2021 City Council meeting where the plan was presented for formal adoption. Thar meeting was open to the public and therefore provided the public an opportunity to provide any final input or comments on the plan.

Questionnaire

The Hazard Mitigation Committee was successful in getting citizens to provide input to the mitigation planning process through the use of the *Public Participation Survey*. The *Public Participation Survey* was designed to capture data and information from residents of the City and other members of the public that might not be able to attend public meetings or participate through other means in the mitigation planning process.

Copies of the *Hazard Mitigation Public Survey* were distributed to the Hazard Mitigation Committee to be made available for residents to complete at local public offices. Additionally, a link to an electronic version of the survey was also posted on the City's website. A total of 224 survey responses were received, which provided valuable input for the Hazard Mitigation Committee to consider in the development of the plan update. Selected survey results are presented below.

- Approximately 70 percent of survey respondents had been impacted by a disaster, primarily hurricanes.
- Respondents ranked Hurricanes and Tropical Storm as the highest threat to their neighborhood (74.6 percent), followed by Flooding (14.7 percent), and, Wildfire (3 percent).
- Approximately 64 percent of respondents have taken actions to make their homes more resistant to hazards and 87 percent are interested in making their homes more resistant to hazards.
- 73 percent of respondents do not know what office to contact regarding reducing their risks to hazards.
- Emergency Services and Prevention were ranked as the most important activities for communities to pursue in reducing risks.

More detailed results can be found in Appendix D of this plan.

Step 3. Coordination with Other Agencies

During the planning process, many agencies were contacted for information and to determine how their programs affect or could support the City's activities. Table 2.2 below lists the coordination efforts that were made to stakeholders outside of City staff.

TABLE 2.2: SUMMARY OF AGENCY COORDINATION

Agency, Organization or Business	Contact Method	Use of Information in the Plan	Location in the Plan
South Carolina Emergency Management Division – State Hazard Mitigation Officer and Hazard Mitigation Planning Coordinator	Email	Mitigation Coordination, Data Sharing	Entire document
FEMA	Web	NFIP Data for Risk Assessment, Public Information Program and Mitigation Options	Chapters 3, 6, and 7, Appendix 1-4
SC Flood Mitigation Program Coordinator	Email	Map and Risk information	Chapters 3 and 6
U. S. Army Corps of Engineers	Email	Awaiting Response	Appendix D
NOAA Office for Coastal Management, Charleston, SC	Web	SLOSH Maps and Risk Data	Chapters 3 and 6, Appendix D
NOAA Weather Service Office, Wilmington, NC	Email and Web	StormReady and TsunamiReady	Chapter 6, Appendix D
NOAA Centers for Environmental Information	Web	Historic Weather Data for Horry County and NMB	Chapter 3 Risk Assessment
Eastern South Carolina Chapter, American Red Cross	Email	Shelter Locations Critical Facilities	Chapter 6 Appendix 1-4
Department of Health & Environmental Control (DHEC)	Web	Coastal Erosion Maps	Chapter 3 Risk Assessment
Alligator Adventure	Email	Critical Facility and Response Plan	Chapters 3 and 6 Critical Facility, Appendix D

Agency, Organization or Business	Contact Method	Use of Information in the Plan	Location in the Plan
Waccamaw Regional Council of Governments	Email	Awaiting Response	Appendix D
Town of Atlantic Beach	Email	Awaiting Response	Appendix D
Town of Briarcliffe Acres	Email	No Response	Appendix D
City of Myrtle Beach	Email	Awaiting Response	Appendix D
North Myrtle Beach Chamber of Commerce	Email	Economic and Occupancy Data	Chapter 3, Appendix D

Step 4. Assess the Hazards

This step was conducted by gathering data on the hazards that might occur in the City. The 2021 update included the identification of manmade and technological hazards to align with the State Hazard Mitigation Plan. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other media accounts, and from state and local weather records. Mitigation planning meetings were held during this process to review the information on previous hazards. These meetings also provided a forum for discussing the relative importance of the hazards. This information is included in the Risk Assessment in Chapter 3.

Step 5. Assess the Problems Associated with the Hazards

This step was conducted through a review of a local land use map, topographic maps, flood-prone areas map, as well as others. A more detailed analysis was conducted through field surveys, and a review of documents such as the Comprehensive Plan, tax records, the Floodplain Management Plan, the Beach Management Plan, and the Stormwater Master Plan. Mitigation meetings were held to review areas of vulnerability associated with specific hazards. Attendees provided comments and changes were made to the plan. This information is included in the Risk Assessment in Chapter 3.

Step 6. Set Mitigation Goals

Mitigation goals are included in a number of City plans including the Comprehensive Plan, the Floodplain Management Plan, the Beach Management Plan, the City Budget and the Stormwater Master Plan. These documents were reviewed along with the hazard problems identified in Chapter 3, Risk Assessment, to identify a comprehensive set of hazard mitigation goals for the City. These goals and their associated objectives are described in Chapter 5.

Step 7. Review Possible Mitigation Activities

This mitigation plan provides guidance and recommendations on how the City can mitigate losses from natural hazards. The *Plan* uses six strategies as a “checklist” to ensure that all possible measures are considered.

Mitigation Strategies

- Preventive Measures
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Management
- Public Information

A series of brainstorming sessions were used to develop mitigation alternatives and formulate policy statements. The committee analyzed a wide range of possible policies, exploring a combination of different types and scales of projects. Some of the ideas involve new initiatives, programs, and activities. Others involve enhancing or continuing efforts that are already in place and have proven effective in reducing damage losses in previous hazard events. Still other recommendations involve changes to existing policies and practices that were identified during the capability assessment. The mitigation strategies and recommendations are discussed in Chapter 6.

Step 8. Draft a Mitigation Action Plan

In this step the committee identified mitigation policies and activities to carry out the strategies selected for implementation. Each mitigation action is linked to one or more mitigation goals. The Action Plan identifies the office or agency responsible for implementation, identifies a target date for completing the action and the source(s) of funding. The Mitigation Action Plan is found in Chapter 8.

While developing the Action Plan the committee considered the following:

- Will the policy or action solve the problem it is intended to solve?
- Does the policy or activity meet at least one community mitigation goal?
- Will the policy or activity achieve other community objectives?
- Does the policy or activity comply with all federal, state and local regulations?
- Will there be a beneficial or neutral impact on the environment?
- Will the benefits outweigh the costs (for example, the cost of the activity is less than the cost of repetitive repairs that would be necessary if the activity was not implemented)?
- Is funding available or potentially available?
- Does sufficient management capability exist to implement and administer the policy?
- In sum, are the proposed policies and mitigation measures cost effective, environmentally sound, and technically feasible?

Step 9. Adopt the Plan

Because official adoption by the local governing body is so critical to the plan's success, this step asks local governments to document the adoption process, and include an adoption resolution or signature page in the plan itself. On April 9, 2021) the City held a final public meeting to offer citizens an additional opportunity to comment on the plan. The plan was adopted

according to the community's enabling legislation and established legal procedures with at least a two-week public notice of the public hearing.

The City Council's resolution adopting the Hazard Mitigation Plan is included in Appendix A.

Step 10. Implement, Evaluate and Revise the Plan

An effective plan is dynamic and evolving. A community must periodically monitor its implementation, evaluate its effectiveness, and report on the progress of the plan. This step involves a series of tasks that help the City set procedures for ongoing monitoring and evaluation after the plan has been written and put in motion. The tasks include establishing benchmarks or indicators to measure progress, assigning responsibility for updating the vulnerability and capability assessments, and preparing an evaluation report (or plan maintenance report).

During this plan review and evaluation, the following questions will be asked to determine what actions are necessary to update the plan.

- Are the plan's goals still applicable?
- Do the plan's priorities align with State priorities?
- Are there new partners that should be brought to the table?
- Are there new local, regional, state or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community?
- Do existing actions need to be reprioritized for implementation?
- Are the actions still appropriate, given current resources, community needs, and priorities?
- Have there been any changes in development patterns that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Has the community been affected by any disasters?
- Did the plan accurately address the impacts of this event?

FEMA requires an annual evaluation report (or plan maintenance report) to be prepared and for appropriate revisions and updates of the plan to be submitted for approval. Note that FEMA also requires that a formal review occur every five years (when the community must submit the updated plan to SCEMD and FEMA for approval).

To ensure these tasks are completed in a timely manner the City will continue the Hazard Mitigation Committee and assign it new responsibilities for tracking progress on mitigation activities.

Chapter 3. Risk Assessment

This section of the plan identifies all of the natural and manmade/technological hazards that have or could affect the City of North Myrtle Beach and an analysis of the vulnerability to those hazards that the City faces. Upon a review of the full range of natural hazards suggested under FEMA planning guidance, the City of North Myrtle Beach has identified a number of hazards that are to be addressed in its Hazard Mitigation Plan. These hazards were identified through an extensive process that utilized input from the City of North Myrtle Beach Hazard Mitigation Planning Committee members, research of past disaster declarations, and review of the South Carolina State Hazard Mitigation Plan (2018).

During the 2021 update of the plan, in order to maintain consistency with the State Plan, the City of North Myrtle Beach Hazard Mitigation Planning Committee members voted to assess the same hazards that were identified in the most recent update of the South Carolina State Hazard Mitigation Plan which also includes a variety of manmade/technological hazards. Therefore, since the development of the previous version of this plan, the hazard identified and included in the plan have changed. A list of all previous hazards covered in the 2015 City of North Myrtle Beach Hazard Mitigation Plan is viewable in **Table 3.3**, along with a summary of the hazards assessed in this 2021 update. Readily available information from reputable sources (such as federal and state agencies) was also evaluated to supplement information from these key sources.

This section of the plan also provides hazard profiles and attempts to quantify the impacts of hazards on the City (both in qualitative and quantitative terms). This comprehensive assessment of risk is needed in order to formulate the mitigation strategy for the City.

The first subsection of this plan provides a community profile for the City of North Myrtle Beach to provide an overview of the community, its assets and characteristics.

3.1 North Myrtle Beach Community Profile

3.1.1 Geography and the Environment

The City of North Myrtle Beach is located in northeastern South Carolina in Horry County along the Atlantic Ocean. It is part of the Myrtle Beach Metropolitan Statistical Area (MSA) and is located in the Atlantic Coastal Plain geographic land area of the State. The City was established on May 7, 1968, when a new charter was adopted consolidating Ocean Drive Beach, Crescent Beach, Cherry Grove Beach and Windy Hill Beach. Before US Highway 17 was completed access to the area was limited and the population remained small. Of the four original beach communities consolidated to create North Myrtle Beach only Ocean Drive Beach was incorporated before 1950.

The City of North Myrtle Beach enjoys a moderate climate that is characterized by mild winters and hot, humid summers. The average annual precipitation is around 48.2 inches/year.

From March through May, temperatures have an average high in the mid-sixties to the upper seventies and an average low in the mid-fifties. Typically, the weather is milder by

late April and warm in May. In the summer, afternoon highs reach the upper 80s in July and August and afternoon rain showers and thunderstorms are common.

September tends to be warm and wet though late in the month. October and November tend towards clearer skies and cooler weather. Daytime highs are usually in the eighties during September but fall to the mid-sixties by early November. Lows in the Fall range between mid-sixties in September to mid-forties by November. During these autumn months, there are only occasional rain showers making it the second driest period of the year.

Winter in North Myrtle Beach is generally moderate although temperature extremes can occur. Many days from mid-November through February have high temperatures of 50˚F or more and can even reach the seventies on occasion. Winter lows generally stay above freezing with January being the coldest month in the City. Snowfall is rare with the City averaging less than one inch a year.

3.1.2 Population and Demographics[1]

North Myrtle Beach is comprised of 12 complete census blocks and 3 partial blocks. Geographically, the neighborhoods with the highest permanent residents are located east of US 17 in the Windy Hill and Crescent Beach sections of the City. Cherry Grove has the fewest year-round residents, as does the Little River Neck Road area.

According to the US Census Bureau, the total population in the 2000 Census was 10,974 residents and grew to 13,752 residents in 2010. As of the most recent population estimate provided by the Census Bureau in 2019, the population continued to grow to 16,819. The City grew by almost 45% in population, but by 52% in housing units between 2000 and 2010. The decrease in density during this period is a result of the 2,300-acre Barefoot Resort annexation in 1999. When completed, it is anticipated that the Barefoot Resort will contain 6,500 housing units, many of which will be permanent residences. This annexation marks the beginning of the City's expansion west of the Intracoastal Waterway.

TABLE 3.1 CHANGE IN POPULATION AND HOUSING OVER TIME

Year	Population	Housing Units	Area (sq. mi.)	Density (persons/sq.mi.)
1970	1,957	4,348	9.3	210.4
1980	3,960	7,588	9.3	425.8
1990	8,636	13,336	9.3	928.6
2000	10,974	18,091	13.5	812.9

[1] Much of the information and data found in Section 3.1.2 comes from the US Census and the City's Comprehensive Plan.

Year	Population	Housing Units	Area (sq. mi.)	Density (persons/sq.mi.)
2010	13,752	27,584	20.1	683.4
2019	16,819	28,291	22.35	752.52

Source: Adapted from Comprehensive Plan Update, 2018 and 2019 U S Census Estimates

As of the 2019 Census estimates, the median age of year-round residents in North Myrtle Beach was 58.3 years. Similar to trends in the national population, the City's population median age has increased steadily from 37.8 years in 1980 to 44.2 years in 1990 and 54.7 years in 2010. In 2000, 15% of the population was under 18 years of age; by 2010 this percentage decreased to 12% of the population. As of the 2019 estimate, this percentage was down to 10.7%.

In 2000 the population 65 and older was 22% of the population; by 2010 this percentage increased to 27% of the population and as of the 2019 estimate, that percentage has grown to 35.1%.

Almost 93% of North Myrtle Beach residents over 25 years of age have graduated from high school. Of that, 35.2% hold a bachelors' degree or higher. About 10% of all residents over 3 years old are in school. While almost half of those students being in elementary school.

The average household size has been decreasing at a steady rate over the past 30 years. Currently, the average household size of year-round residents is 2.07 persons per unit. The median income for all households is $60,982 and $41,171 per capita income.

Seasonal Population

The last seasonal population study that was conducted for the City was in 2001. The City recognizes the need for an updated study and hopes to get one completed in the relatively near future. However, for this update, data from the 2001 study is still referenced.

With the completion of Highway 17 access to the "Grand Strand" brought thousands of tourists and tourism became the economic foundation of the area. An accurate seasonal population estimate is needed for provision of police and fire services, and for long range planning of roads, utilities and capital improvements. In addition to determining the number of guests, obtaining visitor demographics assists with planning for resort services, evacuation and other municipal services.

For the 2001 Seasonal Population Study, seasonal components of the population were identified as follows: Hotel, motel, and inn guests Visitors renting from property management agencies Visitors renting from individual property owners Part-time (second home) residents.

By using data collected from rental agencies, individuals and hotels, the study calculated the number of overnight guests daily, weekly and for the summer season. A part-time residence survey was conducted to determine the number of people who stayed part of

the year. Demographics were collected for all categories of guests' ages, size of group visiting, mode of travel, state of origin, activity preferences, education level, employment, and income.

Overnight Guests

Rental guests comprise the largest share of the seasonal tourist population. The 4,957 rental units under property management agencies have an average overnight capacity of 34,222 persons. Hotel guests are the second largest category, with a total of 2,923 rooms and a total overnight capacity of 11,645 persons. Visitors staying in rentals by property owners add another 281 units and roughly 850 persons per day to the seasonal population.

A demographic profile from the 1,200 guest surveys shows that the typical North Myrtle Beach tourist is 30-39 years old, stays six days on average, arrives by car, and most likely comes from North Carolina. He or she arrives for vacation, typically with several relatives and is likely to have visited North Myrtle Beach more than five times previously.

3.1.3 Housing, Infrastructure and Land Use

Housing

The City of North Myrtle Beach has 28,291 dwelling units according to the 2018 Census estimates. Of these, less than one-third, or 5,466 are occupied year-round. The 2013 census estimates reported 59.4% of the housing units are in multi-family structures. According to North Myrtle Beach Building Department housing unit records, as of 2000 there were: 6,227 single-family units, 7,932 multifamily units, 2,815 hotel/motel rooms, 996 other units, including mobile homes. The growth in the number of multi-family units over the past 15 years has been significant.

TABLE 3.2 HOUSING UNITS IN NORTH MYRTLE BEACH

Dwellings	2000	2010
Total Dwelling Units	18,091	27,584
Households	5,458	6,739
Vacant, Seasonal Units	8,110	20,845

Most of the housing units are either single-family detached or multi-family with 20 or more units per structure. 41% of the occupied housing units were built between 1980 –1989. 31% were built between 1990 and 2000. Approximately 1,000 units per year were built in the past six years. The median year for housing units in North Myrtle Beach is 1990 compared to a State median of 1983. Fewer than 100 houses built before 1939 still remain, according to the Census.

The 2010 Census also includes information on the value of 6,739 homes occupied year-round. Seventy percent of the year-round occupied homes are owner-occupied. From

2000 to 2010 the median value of a home increased from $142,600 to $234,253. 62% of the owner-occupied housing units have a mortgage. The median monthly mortgage payment increased from $962 to $1,557 between 2000 and 2010. Renters paid a median monthly rent of $779 compared to a State average of $533. About one-third of the renters paying more than 30% of their household income in rent.

Infrastructure

Highway 17 is the primary arterial roadway through the City with over 40,000 vehicles using the highway on a daily basis. Other primary routes in the City include Ocean Boulevard, Sea Mountain Highway and Main Street.

Grand Strand Airport is located within the City Limits and offers general aviation services serving the North Myrtle Beach Areas. Commercial air travel is available through Myrtle Beach International Airport which is located approximately 20 miles to the south of the City.

Land Use

Land Uses in the City of North Myrtle Beach are typical of those found in resort beach towns. There is a mix of single family residential, multifamily residential, a few high-rise hotels and condominiums and commercial developments. Development remains strong in the City with new construction permits (residential and commercial) for 2020 numbering 404 and 4,230 total permits were issued by the Building Department. The City has invested millions of dollars in community redevelopment projects such as Main Street Revitalization and private investment for rehabilitation of old storefronts has been strong.

There are several vehicles for public improvement funding to spur development or redevelopment of an area. Tax increment financing captures anticipated redevelopment tax dollars and municipal improvement districts allow for financing of certain localized improvements such as public utilities and storm drainage by assessing property within the district. Impact fees are allowed for certain improvements such as stormwater drainage and sewerage disposal. Community development designation can be used to redevelop blighted areas through acquisition, demolition, and resale.

While the market may to continue to fluctuate from year-to-year, it is likely that development in North Myrtle Beach will likely remain strong with most of this development/redevelopment expected to be located along the first and second rows of the oceanfront and in the western portions of the City.

3.1.4 Community Capability Assessment

Because North Myrtle Beach has a long history of coastal storms, City policies have continually evolved to address mitigation. The City has two main policy documents that govern hazard mitigation; the City's Comprehensive Land Use Plan and the Hazard Mitigation Plan, which was prepared as a component of the Community Rating System (CRS).

Additionally, the City's zoning ordinance and the adoption of the International Building Code series are additional regulatory mechanisms currently in place to mitigate hazard impacts. The City is also actively involved with the National Flood Insurance Program and is rated as a Community Rating System Class 6 community.

Various City departments continue to advance their pre- and post-storm mitigation capabilities. The Public Works Department maintains staff and equipment that can remove debris and clean roads and ditches. The City's Public Safety Department is heavily involved with the local emergency management community and participates in numerous emergency preparedness activities. The Planning and Development Department has developed procedures and policies for damage assessment and storm recovery and is familiar with that process. Additionally, City GIS and information technology capabilities continually improve to help provide information before and after a storm both internally and to the public.

The City remains financially, technically, and politically committed to mitigation activities primarily because of the recognized vulnerability to natural hazards.

The City's capability is described more fully in Chapter 6 where current approaches to mitigation are described in detail.

3.2 Hazard Identification and Profiles

This section evaluates the hazards that are identified in the State of South Carolina's Hazard Mitigation Plan (listed in **Table 3.3)** to determine whether or not they are significant enough hazards that impact the City of North Myrtle Beach. If so, these hazards are further evaluated in the risk assessment through hazard profiles and vulnerability assessment, where feasible.

TABLE 3.3: COMPARISON OF HAZARDS INCLUDED IN SOUTH CAROLINA STATE HAZARD MITIGATION PLAN AND NORTH MYRTLE HAZARD MITIGATION PLAN

Hazard	Included in 2021 North Myrtle Beach Risk Assessment (Yes/No)
Hurricane and Tropical Storms (includes Wind, Heavy Rain, and Tornadoes)	Yes
Coastal (Erosion)	Yes
Severe Thunderstorms and Lightning	Yes
Tornadoes (includes Waterspouts)	Yes
Flooding	Yes
Wildfire	Yes
Drought	Yes
Hail	No (discussed under Severe Thunderstorms and Lightning)
Winter Storms	Yes
Earthquake	Yes
Sinkholes	Yes
Landslides (and Mass Wasting)	No

Hazard	Included in 2021 North Myrtle Beach Risk Assessment (Yes/No)
Hazardous Materials*	Yes
Public Health Hazards/Infectious Disease*	Yes
Nuclear Power Plants*	Yes
Sea Level Rise	No
Tsunami	Yes
Terrorism	Yes

** Not included as a hazard in the previous North Myrtle Beach Hazard Mitigation Plan.*

For the previous version of this plan, the Hazard Mitigation Planning Committee identified the following additional hazards that are included were included in the plan, but were not included in the State Plan.

- Nor'easter
- Extreme Heat
- Dam Failure
- Volcanoes

Nor'easters and Extreme Heat remain in the 2021 plan update; however, the committee voted to remove the following hazards because they do not pose a risk to the City.

- Volcanoes
- Dam Failure
- Landslides

And finally, due to an increasing number of occurrences, the planning committee voted to add Rip Currents as a hazard for the 2021 update even though they are not included in the State Plan.

Since the plan was last updated in 2015, there have been 181 hazard events recorded on 72 days, according to the National Centers for Environmental Information Storm Events Database. **Table 3.4** below provides a summary of these events. It is important to take note of those hazard events and consider them in this section of the plan to help ensure that the appropriate hazards are being considered and mitigation actions are being identified in the Mitigation Strategy to reduce the City's vulnerability to these hazards.

TABLE 3.4: SUMMARY OF HAZARD EVENTS SINCE PREVIOUS PLAN

Hazard	Number of Reported Events in Horry County (2015-2020)	Number of Days with Reported Events
Coastal Flood	1	1
Flash Flood	37	11
Flood	12	6
Hail	25	10
Heat	2	1
Heavy Rain	3	3
Hurricane	4	2
Lightning	6	6
Rip Current	10	10
Strong Wind	1	1
Thunderstorm Wind	59	30
Tornado	12	8
Tropical Storm	7	4
Winter Storm	2	1
TOTAL	181	94*

**This number is different than the number of days on which hazard events were recorded (72) because some days had multiple hazards reported on the same day.*

Disaster Declarations in Horry County

Disaster Declarations provide initial insight into the hazards that may impact Horry County and the City of North Myrtle Beach planning area. Since 1989, thirteen presidential disaster declarations have been reported in Horry County, which can be seen in **Table 3.5** below. This includes one event for severe storms and flooding, ten storms related to hurricanes or tropical storms, and two storms related to severe winter weather.

TABLE 3.5: HORRY COUNTY DISASTER DECLARATIONS

Year	Disaster Number	Description
1989	843	Hurricane Hugo
1996	1140	Severe Winds and Flooding Assoc. with Hurricane Fran
1998	1243	Hurricane Bonnie
1999	1299	Hurricane Floyd
2004	1543	Hurricane Charley
2004	1509	Severe Ice Storm
2004	1566	Tropical Storm Frances
2014	4166	Severe Winter Storm
2015	4241	Severe Storms and Flooding
2016	4286	Hurricane Matthew
2017	4346	Hurricane Irma
2018	4394	Hurricane Florence
2019	4464	Hurricane Dorian

Source: Federal Emergency Management Agency

3.2.1 Hurricanes and Tropical Storms

South Carolina is one of the most vulnerable states in the nation to be impacted by hurricanes and tropical storms. North Myrtle Beach borders the Atlantic Ocean with over 9 miles of coastline and inland areas that may be directly affected by these storms.

The City is densely populated, especially during the peak tourist seasons. That density coupled with the generally low coastal elevations, significantly increase the City's vulnerability. The greatest threat to life and property associated with a hurricane and tropical storm is storm surge. Other effects include high winds, tornadoes, and inland flooding associated with heavy rainfall that usually accompanies these storms.

What Is A Hurricane?

A hurricane is a category of tropical cyclone characterized by thunderstorms and defined surface wind circulation. Hurricanes develop over warm waters and are caused by the atmospheric instability created by the collision of warm air with cooler air.

Hurricane winds blow in a large spiral around a calm center called the eye, which can be 20-30 miles wide. When a hurricane nears land, it may bring torrential rains, high winds, storm surges, coastal flooding, inland flooding, and sometimes tornadoes (see "Characteristics of Coastal Storms" below). A single hurricane can last for more than two weeks over water and can extend outward 400 miles. The hurricane season for the Atlantic Coast is June 1 to November 30, with a peak around mid-September.

Characteristics of Coastal Storms:

Storm Surge: The most dangerous and damaging feature of a coastal storm is storm surge. Storm surges are large waves of ocean water that sweep across coastlines where a storm makes landfall. The more intense the storm the greater the height of the water. The higher the storm surge, the greater the damage to the coastline. Storm surges inundate coastal areas, wash out dunes, cause backwater flooding in rivers and streams, and can flood streets and buildings in coastal communities. Storm surge areas can be mapped by the probability of storm surge occurrences using Sea, Lake, and Overland Surges from Hurricanes modeling (SLOSH) (see discussion of SLOSH below).

SLOSH data was used to estimate storm surge heights from historical, hypothetical, and predicted hurricanes in **Figures 3.1- 3.6**. The output of the SLOSH-model provides heights of storm surge for various combinations of hurricane strength, forward speed of storm, and direction of storm. Storm strength is modeled by use of the central pressure and storm eye size using the five categories of storm intensity.

FIGURE 3.1: STORM SURGE INUNDATION RISK MAP

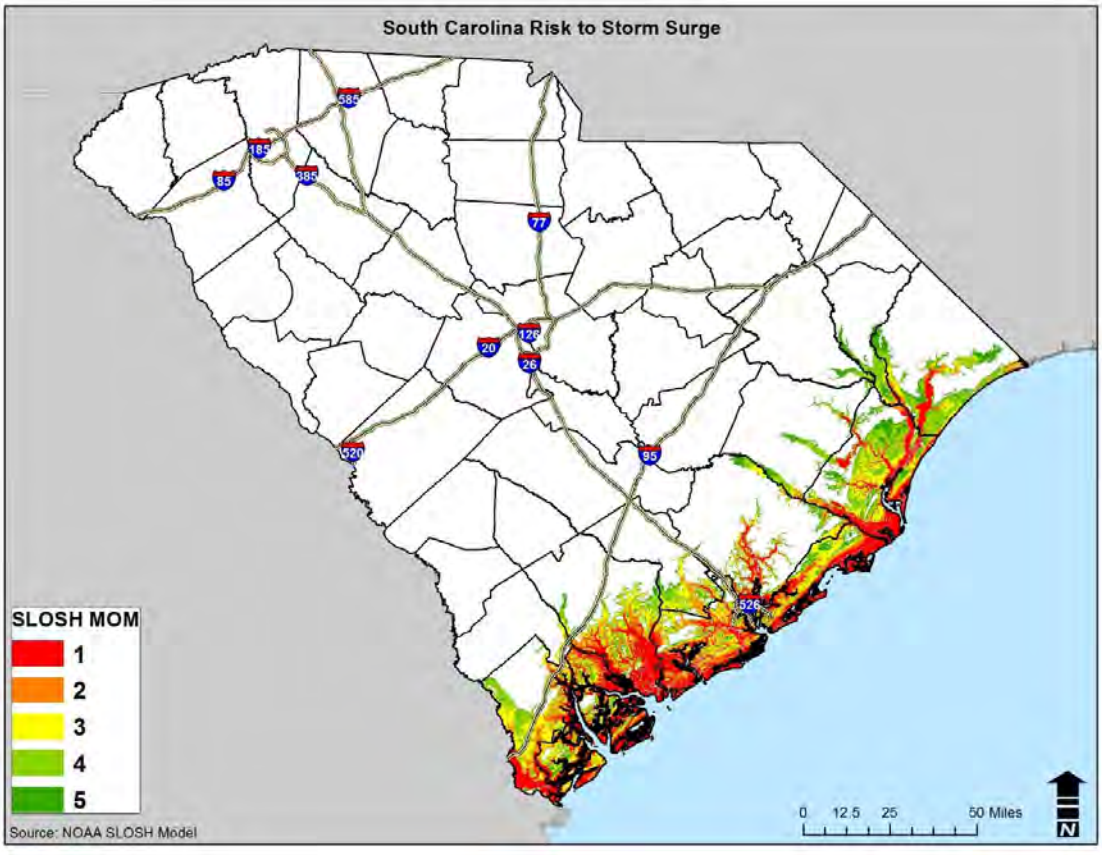


FIGURE 3.2: CATEGORY 1 EXPECTED STORM SURGE INUNDATION MAP

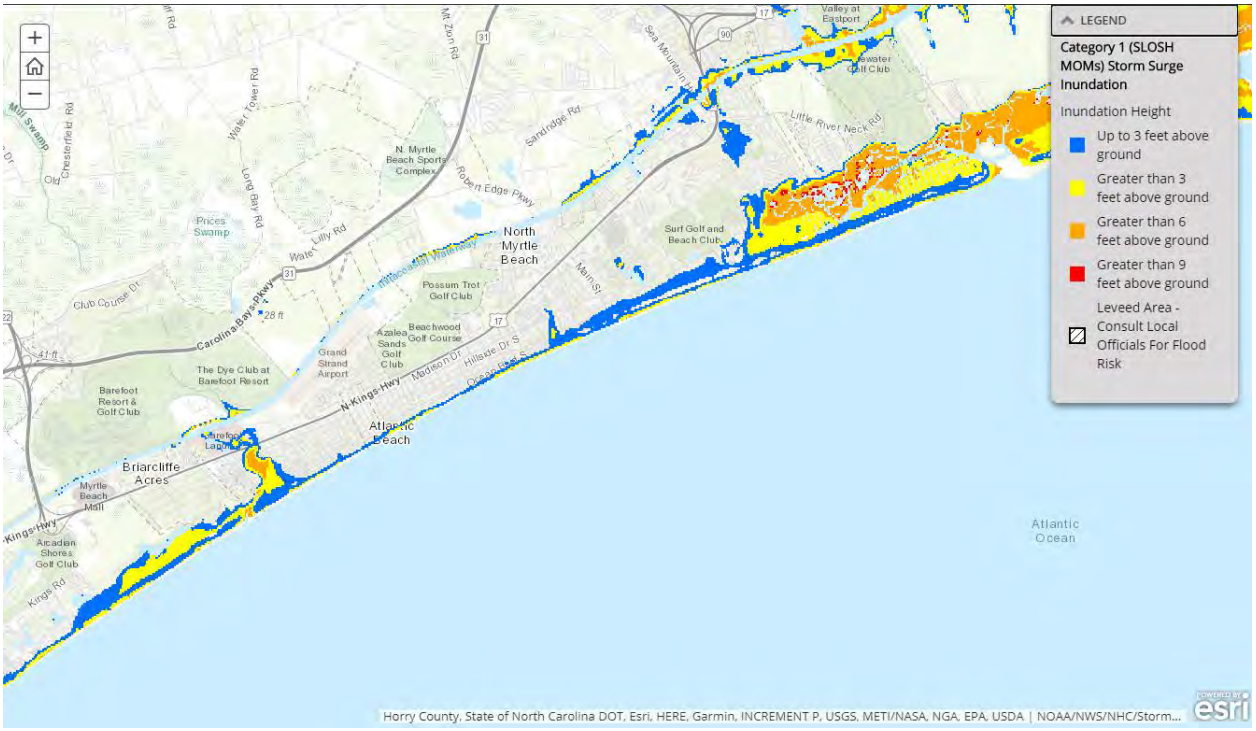


FIGURE 3.3: CATEGORY 2 EXPECTED STORM SURGE INUNDATION MAP

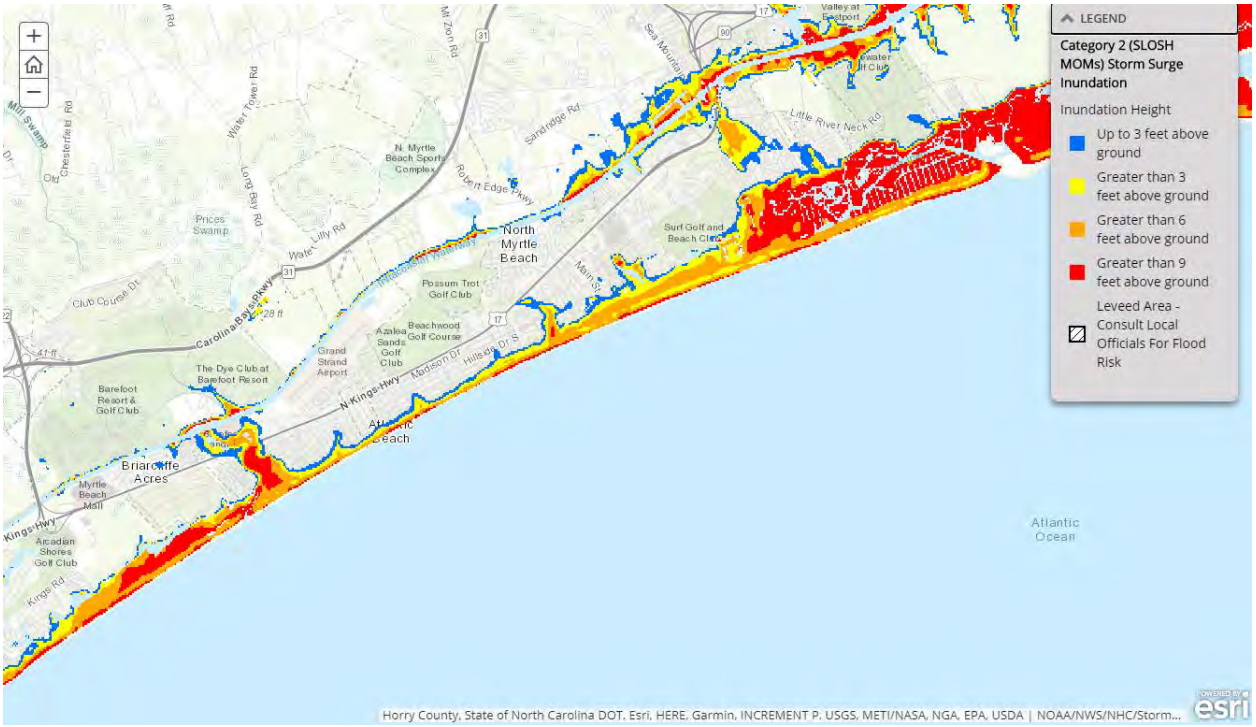


FIGURE 3.4: CATEGORY 3 EXPECTED STORM SURGE INUNDATION MAP

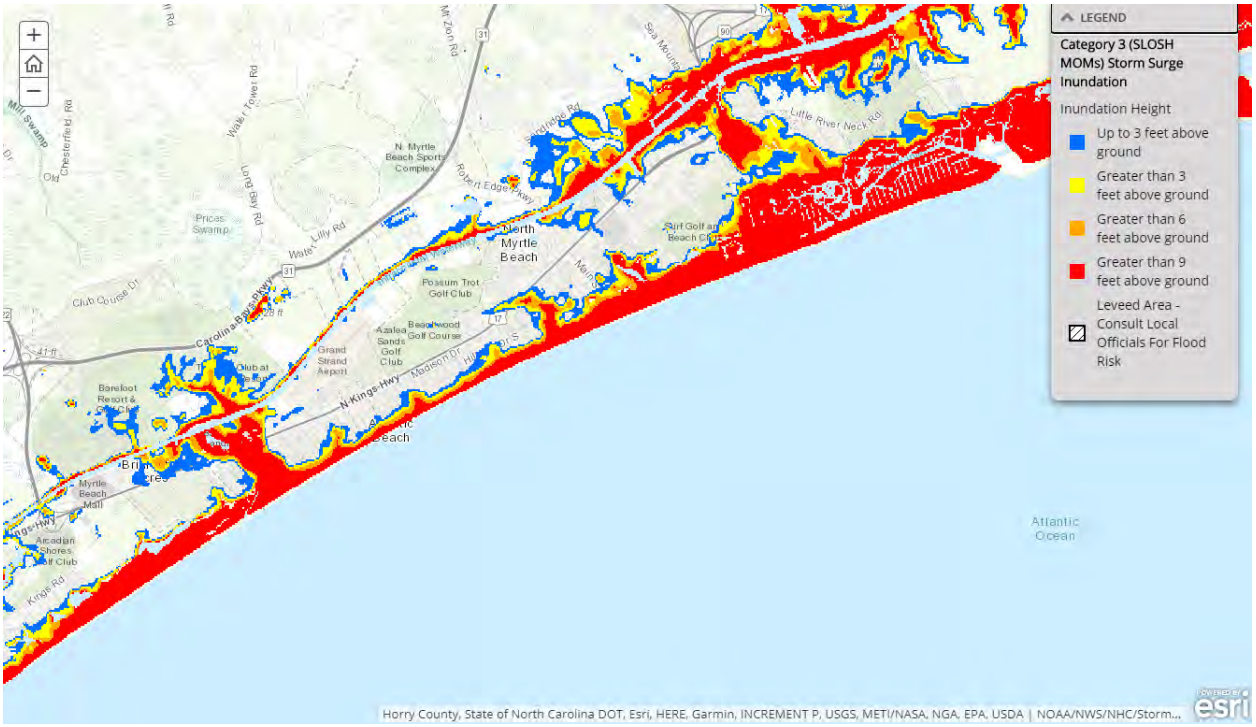


FIGURE 3.5: CATEGORY 4 EXPECTED STORM SURGE INUNDATION MAP

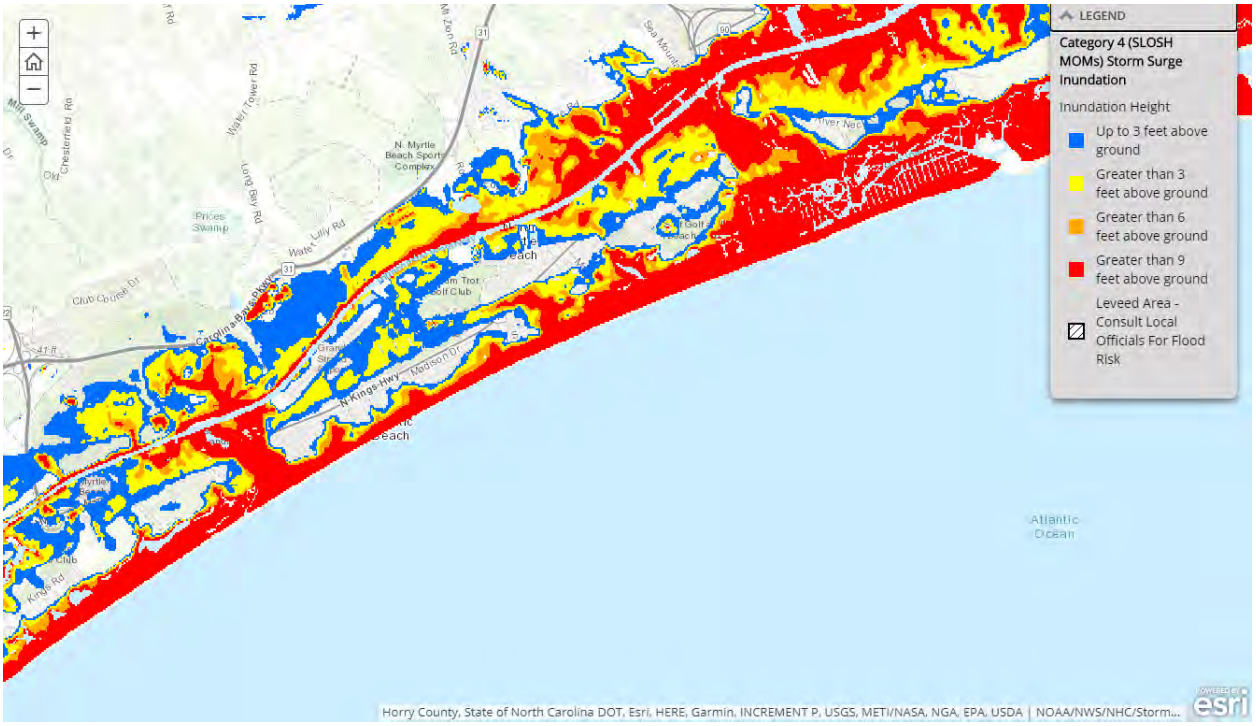
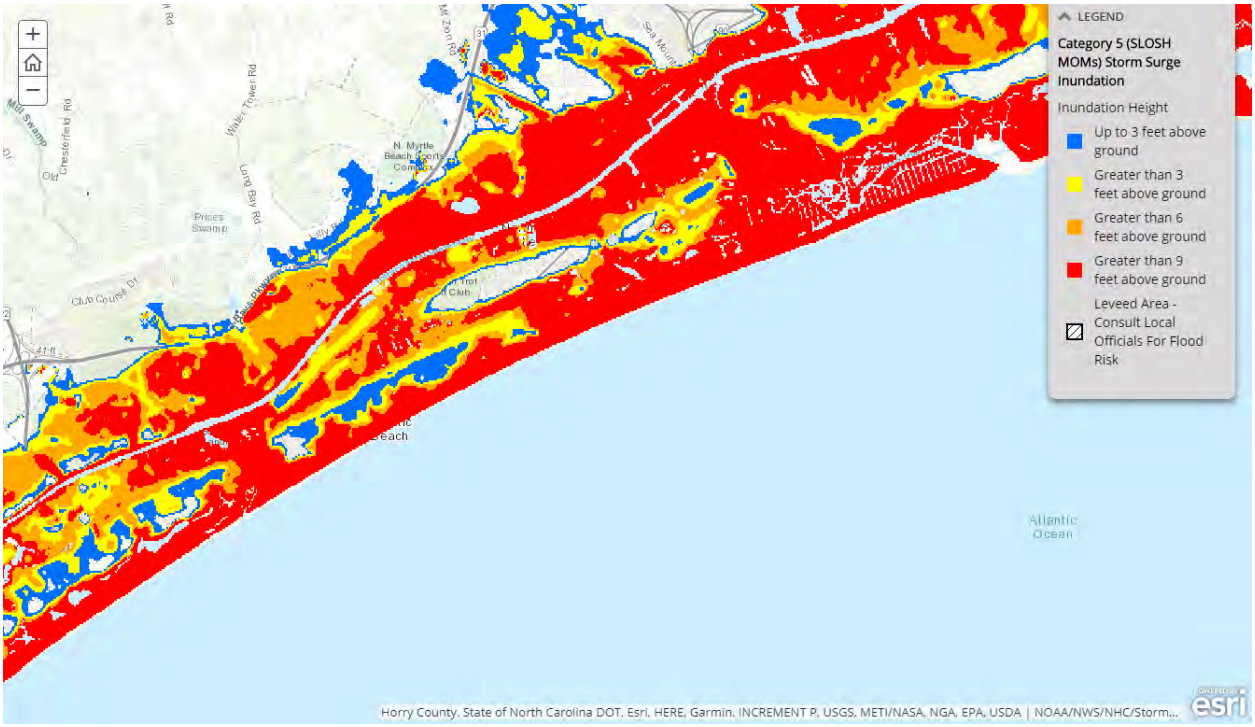


FIGURE 3.6: CATEGORY 5 EXPECTED STORM SURGE INUNDATION MAP



Various storm events can cause abnormally high-water levels along ocean coasts and interior shorelines. These higher-than-expected water levels, known as storm surges, are generally the result of a synoptic scale meteorological disturbance. Storm surges can affect a shoreline over distances of more than 100 miles; however, there may be significant spatial variations in the magnitude of the surge due to local bathymetric and topographic features.

Wind is the primary cause of storm surge. Wind blowing over the surface of the water exerts a horizontal force that induces a surface current in the general direction of the wind. The surface current, in turn, forms currents in subsurface water. In the case of a hurricane, the depth affected by this process of current creation depends upon the intensity and forward motion of the storm. For example, a fast-moving hurricane of moderate intensity may only induce currents to a depth of a hundred feet, whereas a slow-moving hurricane of the same intensity might induce currents to several hundred feet. As the hurricane approaches the coastline, these horizontal currents are impeded by a sloping continental shelf, thereby causing the water level to rise. The amount of rise increases shoreward to a maximum level that is often inland from the usual coastline.

Factors Affecting Surge Height

The elevation reached by the storm surge within a coastal basin depends upon the meteorological parameters of the hurricane and the physical characteristics existing within the basin. The meteorological parameters affecting the height of the storm surge include the intensity of the hurricane; measured by the storm- center sea-level pressure, track (path) of the storm, forward speed, and radius of maximum winds.

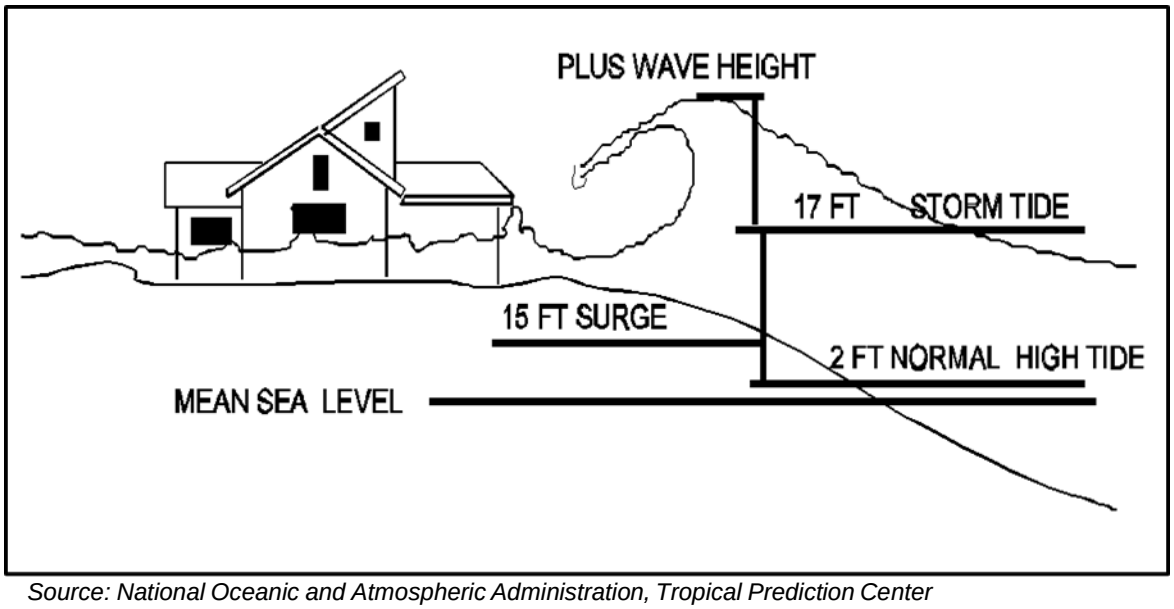
Due to the complementary effects of forward motion and the counterclockwise rotation of

the wind field, highest surges from a hurricane usually occur on the northeast quadrant of the storm's track. This radius of maximum winds, which is measured from the center of the hurricane eye to the location of the highest wind speeds within the storm, can vary from as little as four miles to as much as 50 miles or greater. Peak storm surge may vary drastically within a relatively short distance along the coastline depending on the radius of maximum winds and the point of hurricane eye landfall. The physical characteristics of a basin that influence the surge heights include the basin bathymetry (water depths), roughness of the continental shelf, configuration of the coastline, and natural or man- made barriers. A wide, gentle sloping continental shelf or a large bay may produce particularly large storm surges.

Storm Tide: Other factors that contribute to the total water height are the initial water level within the basin at the time the hurricane strikes and wave effects. If a storm surge occurs at the same time as high tide, the water height will be even greater. Storm tide is the combination of the storm surge and the normal tide. For example, a 15-foot storm surge along with the normal 2-foot high tide creates a storm tide of 17 feet. The timing of the arrival of storm surge is important in that the difference in total flood elevation can be as much as 1 to 2 feet in the study area.

Waves breaking near the shore cause a transport of water shoreward. When there is an increase in wave height water cannot flow back to the sea as rapidly as it came in. This phenomenon, known as "wave setup", increases the water level along the beachfront. Waves will break and dissipate their energy in shallow water. Therefore, a relatively steep offshore beach slope allows large ocean waves to get closer to the shore before breaking and usually promotes larger waves. **Figure 3.7** below shows the flood elevation along shorelines due to storm surge. Due to the presence of barriers such as structures, dunes, or vegetation, the waves break and dissipate a tremendous amount of energy within a few hundred yards of the coastline. Buildings within that zone that are not specifically designed to withstand the forces of wave action are often heavily damaged or destroyed.

FIGURE 3.7: FLOOD ELEVATION INCLUDES STORM TIDE AND WAVE HEIGHT



Source: National Oceanic and Atmospheric Administration, Tropical Prediction Center

Water Force: During hurricanes and other coastal storms, coastal areas will experience flooding with velocity or "wave action," defined as areas subject to receiving waves on top of the rising water from coastal flooding. The velocity and the force of the water make flooding even more destructive. Water weighs approximately 1,700 pounds per cubic yard; extended pounding by frequent waves can demolish any structure not specifically designed to withstand such forces.

The currents created by the tide combine with the action of the waves to severely erode beaches and coastal highways. Many buildings withstand hurricane force winds until their foundations, undermined by erosion, are weakened and fail.

The velocity and wave action knock over buildings, move debris, erode dunes, scour the shoreline, and displace and redeposit sand. Areas subject to coastal flooding with velocity are designated as V or VE zones on FIRMs. Buildings in the coastal AE-Zone experience many of the same problems.

Wind Velocity: The higher the wind speed, the greater the damage. Hurricane force winds can travel hundreds of miles inland, creating substantial damage to buildings, vegetation, and infrastructure.

High winds are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors:

- Wind speed (sustained and gusts) and duration of high winds
- Height of building above ground
- Exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- Strength of the structural frame, connections, and envelope (walls and roof)
- Shape of building and building components
- Number, size, location, and strength of openings (e.g., windows, doors, vents)
- Presence and strength of shutters or opening protection
- Type, quantity, and velocity of windborne debris

Proper design and construction of residential structures, particularly those close to open water or near the coast, demand that every factor mentioned above be investigated and addressed carefully. Failure to do so may ultimately result in building damage or destruction by wind.

High Risk Factors:
The following conditions may exacerbate the effects of coastal storms:

- Coastal shape: Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.
- Storm center velocity: The slower the storm moves, the greater the damage. The worst possible situation is a storm that stalls along a coast, through several high tides.

- Nature of coast: Damage is most severe on low-lying barrier island shorelines because they are easily over washed by storm waves and storm surge.
- Previous storm damage: A coast weakened by even a previous minor storm may be subject to proportionately greater damage in a subsequent storm.
- Human activity: With increased development, property damage increases, multiplying the amount of floating debris available to damage or destroy other structures.
- Hardened sand and flood control structures: Structures such as groins, jetties, or seawalls exacerbate localized scour and erosion and can be undermined, resulting in collapse (particularly seawalls).

Measurement:
Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from 1 (minimal) to 5 (catastrophic). The scale categorizes hurricane intensity linearly based upon maximum sustained winds, minimum barometric pressure and storm surge potential, which are combined to estimate the potential flooding and damage to property given a hurricane's estimated intensity (see Saffir-Simpson Scale and Damage tables below).

TABLE 3.6: SAFFIR-SIMPSON HURRICANE SCALE

Category	Maximum Sustained Wind Speed (MPH)	Minimum Surface Pressure (Millibars)
1	74-95	Greater than 980
2	96-110	979-965
3	111-129	964-945
4	130-156	944-920
5	157 +	Less than 920

Source: National Oceanic and Atmospheric Administration, Tropical Prediction Center

TABLE 3.7: SAFFIR/SIMPSON HURRICANE WIND SCALE

Category	Damage Level	Description of Damages	Photo Example
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.	
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.	
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland.	

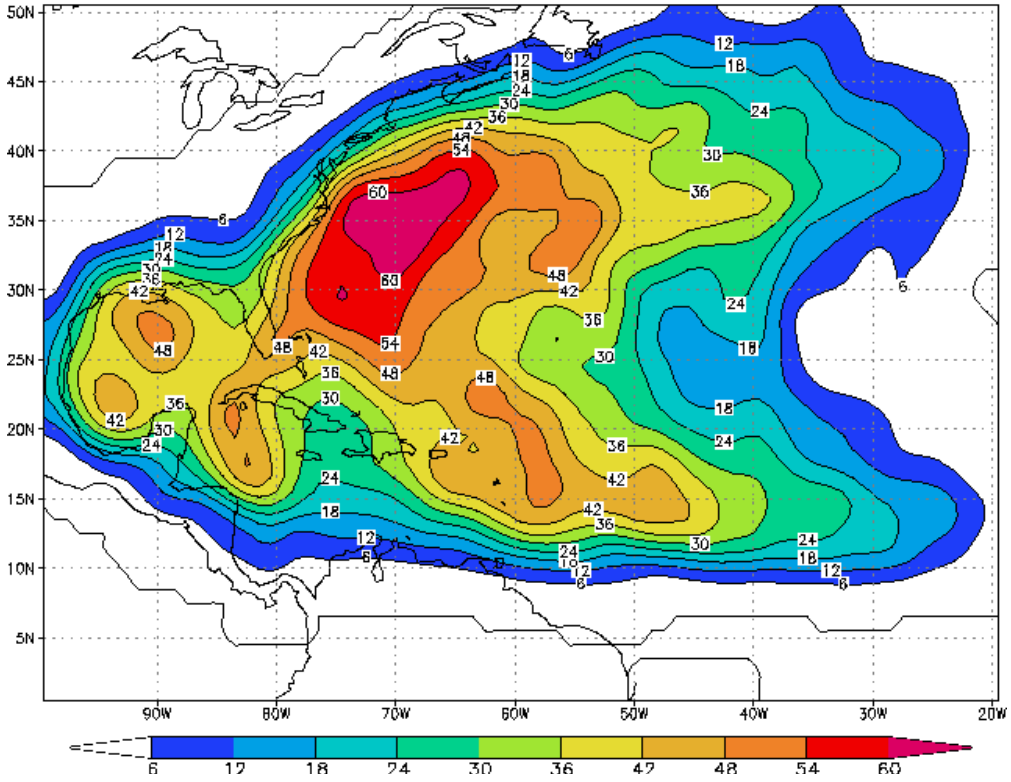
4	EXTREME	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.	
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.	

Source: National Hurricane Center Website

Figure 3.8 shows for any particular location what the chance is that a tropical storm or hurricane will affect the area sometime during the whole June to November hurricane season. The figure was created by Todd Kimberlain of the National Oceanic and Atmospheric Administration's Hurricane Research Division. In creating the graphic, he utilized the years 1944 to 1999 in the analysis and counted hits when a storm or hurricane was within about 100 miles (165 km) of each location.

The figure shows that North Myrtle Beach faces a **36-42% annual chance** that a tropical storm or hurricane will affect the area.

FIGURE 3.8: EMPIRICAL PROBABILITY OF A NAMED STORM



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

Hurricane or tropical storm events have caused ten disaster declarations in Horry County.

Table 3.8 below shows hurricane and tropical storm tracks that have occurred within 75 miles of North Myrtle Beach. **Figure 3.9** below shows a map of tropical storm tracks between 1851 – 2015. **Figure 3.10** shows the tracks of more recent storms.

FIGURE 3.9: SOUTH CAROLINA TROPICAL CYCLONE TRACKS (1851-2015)

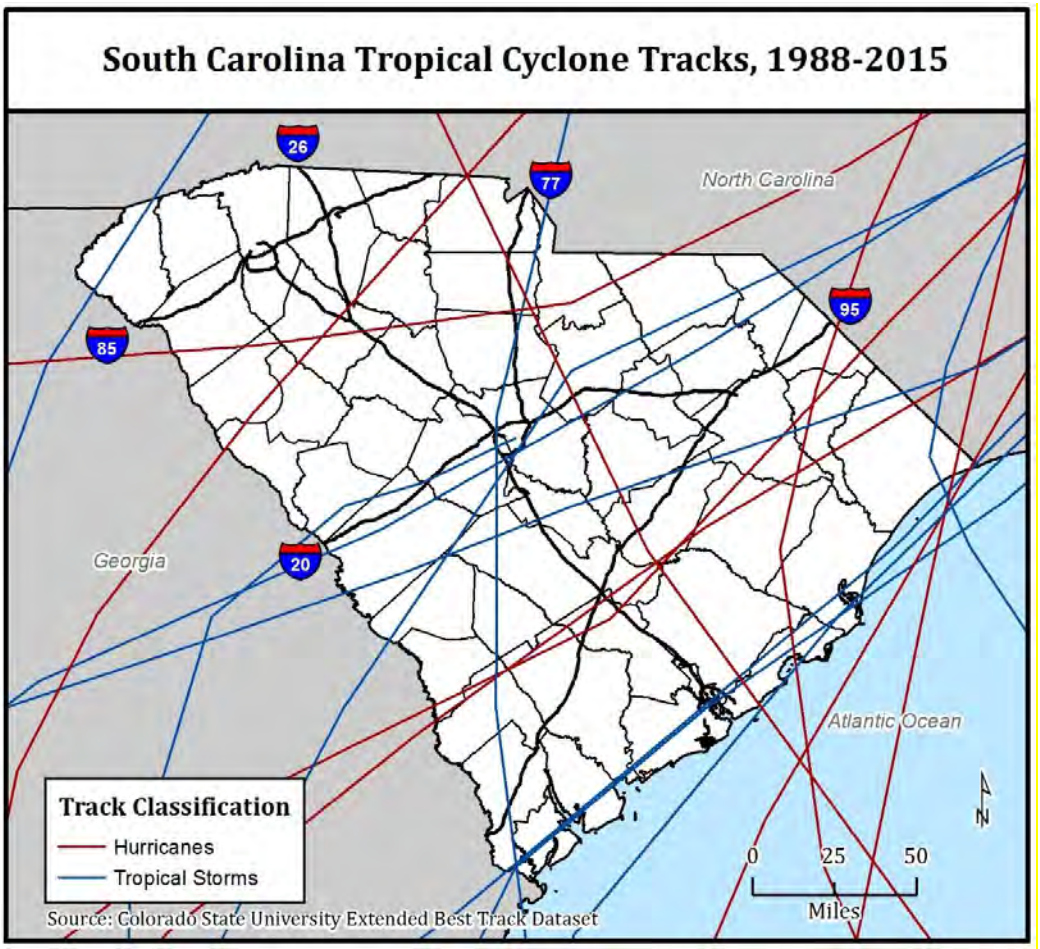
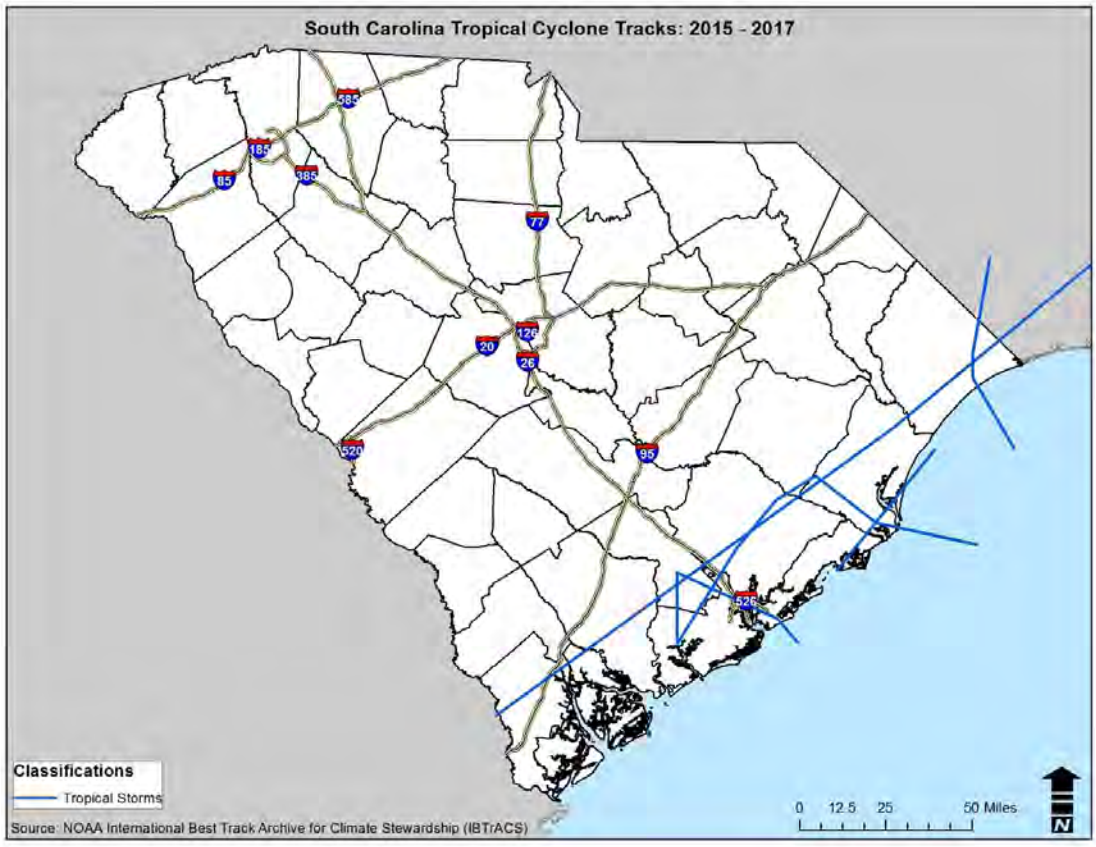


FIGURE 3.10: TROPICAL CYCLONE TRACKS 2015 - 2017



Source: NOAA and South Carolina State Hazard Mitigation Plan

TABLE 3.8: HURRICANE TRACKS WITHIN 75 MILES OF NORTH MYRTLE BEACH

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
8/25/1851	Unnamed	40	Tropical Storm
8/28/1852	Unnamed	40	Tropical Storm
10/10/1852	Unnamed	50	Tropical Storm
9/1/1856	Unnamed	50	Tropical Storm
9/12/1857	Unnamed	90	Category 2
9/27/1861	Unnamed	70	Category 1
9/18/1863	Unnamed	60	Tropical Storm
6/23/1867	Unnamed	60	Tropical Storm
8/15/1867	Unnamed	35	Tropical Storm
10/7/1871	Unnamed	40	Tropical Storm
10/24/1872	Unnamed	70	Category 1
9/20/1873	Unnamed	60	Tropical Storm
9/29/1874	Unnamed	70	Category 1
9/17/1876	Unnamed	70	Category 1

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
9/9/1880	Unnamed	70	Category 1
9/9/1881	Unnamed	90	Category 2
10/12/1882	Unnamed	70	Category 1
9/11/1883	Unnamed	90	Category 2
8/25/1885	Unnamed	80	Category 1
10/11/1888	Unnamed	60	Tropical Storm
6/16/1893	Unnamed	50	Tropical Storm
9/27/1894	Unnamed	65	Category 1
10/31/1899	Unnamed	95	Category 2
7/12/1901	Unnamed	35	Tropical Storm
9/14/1904	Unnamed	70	Category 1
9/17/1906	Unnamed	80	Category 1
6/29/1907	Unnamed	55	Tropical Storm
7/31/1908	Unnamed	70	Category 1
10/20/1910	Unnamed	60	Tropical Storm
10/8/1913	Unnamed	65	Category 1
5/15/1916	Unnamed	35	Tropical Storm
9/22/1920	Unnamed	60	Tropical Storm
9/17/1924	Unnamed	35	Tropical Storm
8/1/1944	Unnamed	70	Category 1
6/27/1945	Unnamed	65	Category 1
7/6/1946	Unnamed	40	Tropical Storm
9/13/1949	Unnamed	40	Tropical Storm
8/28/1952	Unnamed	45	Tropical Storm
8/27/1954	Unnamed	45	Tropical Storm
10/15/1954	Hazel	110	Category 3
8/17/1955	Diane	75	Category 1
10/17/1956	Unnamed	50	Tropical Storm
9/27/1958	Helene	110	Category 3
7/30/1960	Brenda	60	Tropical Storm
9/12/1960	Donna	90	Category 2
9/13/1961	Unnamed	40	Tropical Storm
6/11/1966	Alma	40	Tropical Storm
6/10/1968	Abby	25	Tropical Depression
10/20/1968	Gladys	70	Category 1
8/17/1970	Unnamed	30	Tropical Depression
9/9/1971	Unnamed	25	Tropical Depression
6/21/1972	Agnes	30	Tropical Depression
7/10/1972	Unnamed	25	Tropical Depression
6/28/1975	Amy	30	Tropical Depression

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
10/26/1975	Hallie	45	Tropical Storm
9/5/1977	Clara	20	Tropical Depression
8/20/1981	Dennis	60	Tropical Storm
9/11/1984	Diana	110	Category 3
9/13/1984	Diana	85	Category 2
11/22/1985	Kate	50	Tropical Storm
9/8/1987	Unnamed	30	Tropical Depression
7/20/1994	Unnamed	30	Tropical Depression
9/1989	Hugo	121	Category 4
6/19/1996	Arthur	40	Tropical Storm
7/12/1996	Bertha	85	Category 2
9/6/1996	Fran	100	Category 3
8/26/1998	Bonnie	100	Category 3
9/16/1999	Floyd	90	Category 2
6/13/2001	Allison	25	Tropical Depression
10/11/2002	Kyle	30	Tropical Depression
8/13/2004	Bonnie	30	Tropical Depression
8/14/2004	Charley	65	Category 1
8/29/2004	Gaston	45	Tropical Storm
9/6/2004	Frances	52	Tropical Storm
9/15/2005	Ophelia	75	Category 1
9/1/2006	Ernesto	60	Tropical Storm
7/20/2008	Cristobal	45	Tropical Storm
9/6/2008	Hanna	60	Tropical Storm
5/30/2012	Beryl	40	Tropical Storm
6/7/2013	Andrea	40	Tropical Storm
7/3/2014	Arthur	80	Category 1
5/10/2015	Ana	40	Tropical Storm
5/31/2016	Bonnie	25	Tropical Depression
9/3/2016	Hermine	55	Tropical Storm
10/8/2016	Matthew	75	Category 1
8/29/2017	Unnamed	35	Tropical Storm
9/11/2017	Irma	43	Category 1
9/4/2018	Florence	65	Category 1
9/5/2019	Dorian	90	Category 2
7/8/2020	Fay	25	Tropical Depression
8/4/2020	Isaias	75	Category 1

Source: National Oceanic and Atmospheric Administration

Descriptions of some of the more significant hurricanes and tropical storms to impact North Myrtle Beach are provided below.

October 1954: (Category 4) Hurricane Hazel – made landfall in the vicinity of the North Carolina/South Carolina line. Near Little River, S.C., wind speeds were reported at 106-mph and tides up to 16.9 feet. In South Carolina one person was killed and damage was estimated at $27 million. **Figure 3.11** shows the storm damage from Hurricane Hazel along the coast of Horry County in 1954.

FIGURE 3.11: HURRICANE HAZEL COAST DAMAGE

August 1955: (Category 1) Hurricane Diane – passed off the coast of North Myrtle Beach before moving into North Carolina. Fortunately, there was no storm surge associated with this storm but it did cause tides to come in higher than normal. Damages in South Carolina were reported by the National Weather Service to be about $100,000.

September 1958: (Category 3) Hurricane Helene – Approached North Myrtle Beach but curved Northeast and only caused minor damages from the fringe effects of the storm.

September 1984: (Category 2) Hurricane Diana – hit the North Carolina Coast twice near Wilmington with winds in excess of 110 mph and dropping more than 11 inches of rain. Heavy rains and high winds were felt in South Carolina but few damages were reported.

September 1989: (Category 4) Hurricane Hugo –made landfall as a Category 4 Hurricane near Sullivan's Island and immediately was downgraded to Category 3. It continued on a northwest track at 25-30 mph and maintained hurricane force winds as far inland as Sumter. Hugo exited the State southwest of Charlotte, N.C., before sunrise on September 22. The hurricane caused 13 directly related deaths and 22 indirectly related deaths, and it injured several hundred people in South Carolina. Damage in the State was estimated to exceed $7 billion, including $2 billion in crop damage. Though Hugo came ashore more than 75 miles from North Myrtle Beach; it still had a profound impact on the beach. The storm produced a 10-foot storm surge that caused major damage to hundreds of first and second row, oceanfront homes.

July 1996: (Category 2) Hurricane Bertha – hit the North Carolina coast between Wrightsville Beach and Topsail Island. The storm approached close to the coastal counties of S.C., but did not cause any significant damage. The maximum sustained winds (36 kts) and peak gusts (50 kts) both occurred at the Charleston City office. Bertha's most significant impact was on tourism.

September 1996: (Category 3) Hurricane Fran – hit the North Carolina coast near Bald Head Island. Because North Myrtle Beach was on the weaker side of the storm the damage was not severe. The storm surge caused minor beach erosion.

August 1998: (Category 2) Hurricane Bonnie – made landfall near Bald Head Island, NC. The Center came within 70 miles of the Horry County coast. As the storm tracked northward during the afternoon and early evening, highest wind reports were from the NNW, ranging as high 82 mph at the Cherry Grove pier, while at the Myrtle Beach Pavilion the highest gust was 76 mph. Rainfall ranged from 2 to 4 inches. Ocean levels rose 2 to 3 feet above normal with no overwash. Rainfall of about 7 inches caused extensive ponding of water.

September 1999: (Category 4 in Bahamas, Category 2 when made landfall in North Carolina) Hurricane Floyd – The center moved northeast about 60 miles off the coast of Georgetown, S.C., where wind gusts were recorded at 50 to 60 mph. Rainfall was heavy along coastal counties, a foot of rain fell in Georgetown County; 18 inches feel in eastern Horry County. The heavy rains caused flooding to many roads, and buildings. Waves were reported to be 15 feet at Cherry Grove Pier where damage was the largest.

August 9-15, 2004 – Hurricane Charley**:** Hurricane Charley struck near Cape Romain, South Carolina as an 80-mph hurricane, moved offshore briefly, and made its final landfall near North Myrtle Beach as a minimal hurricane with winds of 75 mph. With the landfalling system, five tornadoes were reported in the state. However, only two were confirmed; one moved through the Francis Marion National Forest, downing trees along its path. Storm surge ranged from 4 ft-6 ft, although only minor beach erosion occurred. Widespread rainfall peaking at over 7 in fell into the west of the storm's track. In downtown Charleston, 2.09 in of rainfall was reported, while in Hampton 1.53 in of rain fell. However, a bulk of the rainfall remained offshore. With the soil still saturated from Tropical Storm Bonnie, some flooding in low lying areas of Charleston County occurred. Up to 1 ft of water accumulated on South Carolina Route 17 and on local streets. Flash floods were also observed in Mount Pleasant. A bridge in Union County washed out following rainfall from Charley and Tropical Storm Bonnie. 135,000 customers were without power, and storm damage totaled $20 million (2004 USD).

Tropical Storm Frances (September 6-7, 2004): Frances formed as a tropical storm on August 25 and reached hurricane force on the 26th, and eventually as high as a Category 4 hurricane on the 28th25. While crossing the Bahamas it weakened to a Category 2 and eventually was a tropical depression as it moved through Georgia and up the Southern Appalachians25. Significant for South Carolina were the tornado outbreaks from the remnants of Frances. Approximately 41 tornadoes were reported for South Carolina on the 7th, breaking the previous one-day record of 23 tornadoes on August 16, 1994 from Tropical Storm Beryl. Sumter County had the worst damage26. An F2 destroyed 9 homes, damaged 55 homes, injured 3 people, and caused over $1.7 million in damage. Kershaw County had an F3 tornado that destroyed several stables and picked up a horse

trailer and dropped it onto the roof of another stable. Total loss estimates for the state were estimated at over $93 million dollars.

Hurricane Matthew (October 8, 2016): Hurricane Matthew moved up the southeast coast and slowly weakened to a category 1 storm as it moved up along the South Carolina coast and then eastward near the North Carolina coast. The hurricane brought 6 to 12 inches of rain and up to 15 inches to some areas of northeast South Carolina, with the bulk of the rainfall occurring within a 12 hour period. This rain fell on wet to in some cases saturated soil due to much above normal rainfall in September. The result was historic flooding; widespread flash flooding, and an extended period of river flooding. Matthew's flooding rains, surge, and wind brought loss of life, displaced tens of thousands of people, and caused hundreds of millions of dollars in structural damage as homes and businesses were devastated or totally destroyed. Major infrastructure will have to be repaired or rebuilt. Property Damage was estimated at $67,000,000.

Hurricane Irma (September 11, 2017): Hurricane Irma tracked well to the west of the southeast Georgia and southeast South Carolina region but caused significant impacts due to heavy rainfall, strong winds, tornadoes, and storm surge. The peak storm total rainfall of 9.07 inches was recorded by a CoCoRaHS observer near Beaufort, SC. This widespread heavy rain resulted in several reports of flash flooding with water entering homes and businesses. Wind damage produced numerous power outages across the region with some damage to structures and numerous downed trees. The strongest winds were confined to coastal locations, but frequent gusts into the 40-50 mph range occurred well inland. One fatality and 1 injury occurred from trees falling on homes and across roadways in southeast South Carolina. The entire southeast Georgia and southeast South Carolina coast was impacted by storm surge generally ranging from 3 to 6 feet. Significant beach erosion occurred at area beaches with widespread damage to docks and piers all along the coast, as well as numerous reports of inundated roadways. Property damage was estimated at over $575,000.

Hurricane Florence (September 4-5, 2018): Hurricane Florence was a powerful hurricane that caused severe damage in the Carolinas in September 2018, primarily as a result of freshwater flooding. The sixth named storm, third hurricane, and the first major hurricane of the 2018 Atlantic hurricane season, the system became a tropical storm on September 1. Florence rapidly intensified on September 4-5, becoming a Category Four major hurricane on the Saffir–Simpson scale. Florence broke the South Carolina record for most rainfall from a tropical system. The highest recorded rainfall total in South Carolina was 23.63 inches in Loris, S.C. Rainfall amounts in excess of 15 inches were recorded in Georgetown, Horry, Marlboro, Dillon, Marion, and Chesterfield counties. Wind gusts as high as 60 mph were recorded in Horry, Florence and Marion counties.

Hurricane Dorian (September 5, 2019): Tropical Storm force winds arrived on September 5. Dorian also produced some flooding, especially in Charleston. Over 160,000 buildings lost power. Two confirmed tornadoes were spawned in South Carolina by Dorian, including a tornado that was reported in Little River that damaged trees, roofing, and lifted a car. At the same day, another tornado was reported in Myrtle Beach. Hurricane force winds extended outward up to 60 miles from the center and tropical-storm-force-winds extended outward up to 220 miles.

The following chart (**Table 3.9**) shows the category and number of hurricanes that have

had a direct hit to South Carolina since 1900. Only 1 of the sixteen hurricanes, has passed within 20 miles of the City North Myrtle Beach. The two maps following this section provide insight to tropical systems that have affected Horry County. The first map illustrates all tropical systems that have affected Horry County, while the second shows only hurricanes that have had a direct hit to Horry County.

TABLE 3.9: CATEGORY AND NUMBER OF HURRICANES WITH DIRECT HIT TO SOUTH CAROLINA SINCE 1900

Area	Category Number					AI	Major
	1	2	3	4	5	(1-5)	(3-5)
South Carolina	8	4	2	2	0	16	4
Horry County	2	1	1	0	0	4	1
20 Miles of N Myrtle Beach	0	0	1	0	0	1	1

Source: NOAA Climatic Data Center (1900-2015).

3.2.2 Floods

What Is A Flood?

A flood is a natural event for rivers, streams and coastal areas. Excess water from rainfall or storm surge accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers, lakes and oceans that are subject to recurring floods. Flooding is the most common hazard in South Carolina, and thousands of households are located within floodplains.

Floods can occur at any time of the year, and at any time of day or night. Most injuries and deaths occur when people are swept away by flood currents, often when attempting to traverse floodwaters in a vehicle.

Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by hurricanes during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push seawater up coastal rivers and inlets, blocking the downstream flow of inland runoff. The surge associated with tropical storms and hurricanes propagates the Intracoastal Waterway and causes overbank flooding in North Myrtle Beach.

Urban flooding occurs where there has been development within stream floodplains. 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 sanitary sewer systems.

High Risk Factors:

The following conditions may exacerbate the effects of floods: impermeable surfaces, steeply sloped watersheds, constrictions, obstructions, debris, contamination, soil saturation, and velocity.

Impermeable surfaces: Excessive amounts of paved areas or other surfaces upstream or in the community can increase the amount and rate of water runoff. Development affects the runoff of stormwater when buildings and parking lots replace the natural vegetation, which normally would absorb water. When rain falls in an undeveloped area, as much as 90 percent of it will infiltrate the ground; in a highly developed area, as much as 90 percent of rainfall will run off.

Constrictions: Re-grading or filling within or on the edge of floodplains obstructs flood flows, backing up floodwaters onto upstream and adjacent properties. It also reduces the floodplain's ability to store excess water, sending more water downstream and causing floods to rise to higher levels. This also increases floodwater's velocity downstream of the constriction.

Obstructions: Bridges, culverts and other obstructions can block flood flow and trap debris, causing increased flooding upstream and increased velocity downstream.

Debris: Debris from the watershed, such as trees, rocks, and parts of damaged buildings, increases the hazard posed by moving water. Moving water will float, drag or roll objects, which then act as battering rams that can knock holes in walls and further exacerbate the effects of debris.

Contamination: Few floods have clear floodwater, and the water will pick up whatever was on the ground within the floodplain, such as soil, road oil, farm and lawn chemicals, and animal waste. In addition, if a wastewater treatment plant as inundated, the floodwaters will likely include untreated sewage. Contamination is also caused by the presence of hazardous material storage in the floodplain and in the community, as well as upstream from the community.

Velocity: Flood velocity is the speed of moving water, measured in feet per second. Velocity is determined by slope, waves, and several other factors. The damage potential of flood waters increases dramatically, sometimes exponentially, with velocity. High velocities (greater than 5 feet per second) can erode stream banks, lift buildings off their foundations, and scour away soils around bridge supports and buildings. Water velocity is a major cause of damage in the following areas:

- Areas subject to coastal wave action (velocity zones)
- Coastal inlets and over wash areas

Flood Frequency - 100-Year Flood

Floodplain managers use the term "100-year flood" to describe a flood that has a one-percent chance of occurring in any given year. Many people find it helpful to think of the 100-year flood risk as a bag of 100 marbles: 99 clear marbles and one black marble. Depending on weather conditions, a community may draw one or more marbles, or floods, from the bag. Most of these—the clear marbles—will be minor floods. It is possible, however, to draw the black marble, representing the 100-year flood, at any time. Because the marbles must be returned to the bag after they are drawn, it is even possible to draw the black marble several times in a row. Just because a community has suffered a 100-year flood *does not* mean that it won't face a flood of similar magnitude for

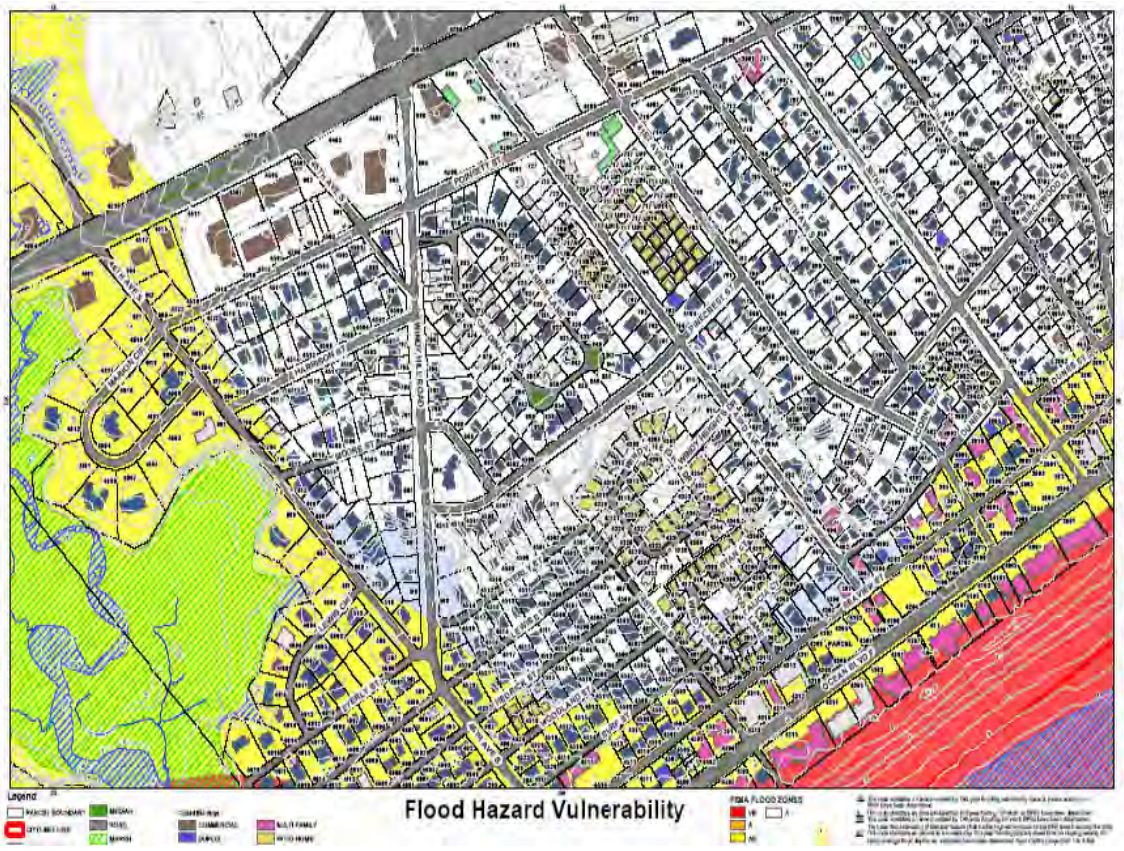
another 99 years.

The location of the 100-year floodplain is often indicated on maps, such as the National Flood Insurance Program's Flood Insurance Rate Maps (FIRMs). In practice, the location of the 100-year flood should be judged in part by community experience as well. Where the water goes in a flood depends on many changing variables, including land use that may not be accurately reflected by a map in every instance.

Floods have the potential to cause major damages to both public facilities and private property. In fact, the City has 195 repetitive loss flood prone properties. For these and a variety of other reasons, floods have been ranked as a high-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

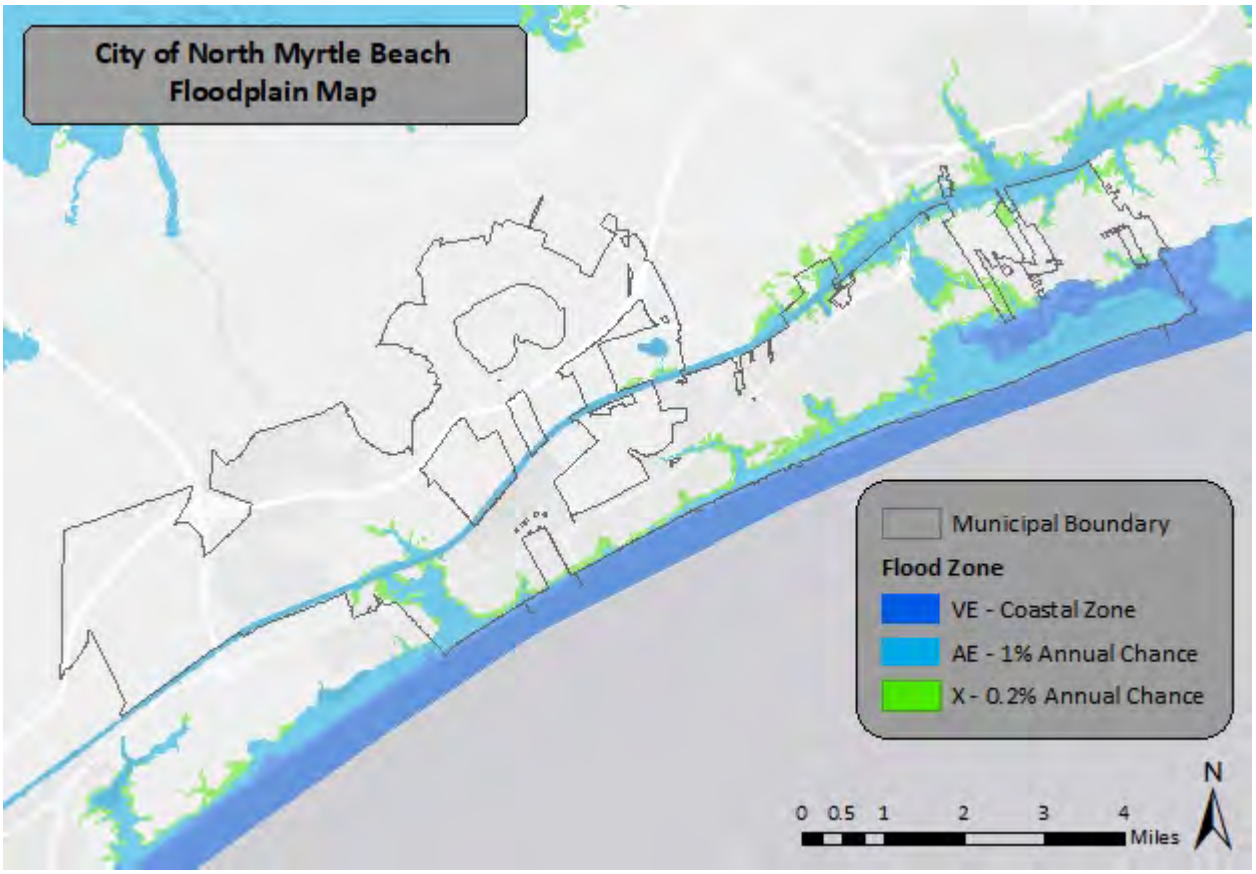
North Myrtle Beach has included its flood hazard zones as overlays in its Geographic Information System (GIS). Since the GIS also includes buildings identified by land use, zoning districts and tax information the City is able to analyze its flood hazards by land use category and tax value. There are 71 maps sheets in the GIS system with flood hazards zones and buildings by land use category. **Figure 3.12** below is an example of these maps. The maps can be viewed at the Building Department during regular business hours.

FIGURE 3.12: GIS MAP WITH FLOOD HAZARDS AND LAND USE



Source: NMB Planning and Community Development Department

FIGURE 3.13: SPECIAL FLOOD HAZARD AREAS IN NORTH MYRTLE BEACH



Historical Occurrences

Information from the National Centers for Environmental Information was used to ascertain historical flood events. The National Centers for Environmental Information reported a total of 89 events in Horry County since 1996. A summary of these events is presented in Table 3.10. These events accounted for over $21.9 million (2020 dollars) in property damage throughout the county. Flash flood and flooding events have also led to 4 deaths within Horry County.

TABLE 3.10: SUMMARY OF FLOOD OCCURRENCES IN HORRY COUNTY

Location	Number of Occurrences	Deaths	Injuries	Property Damage	Crop Damage
Atlantic Beach	0	0	0	$0	$0
Aynor	5	0	0	$258,000	$0
Briarcliffe Acres	0	0	0	$0	$0
Conway	5	0	0	$1,010,000	$0
Loris	3	0	0	$20,000	$0
Myrtle Beach	8	0	0	$1,045,000	$0
North Myrtle Beach	5	0	0	$85,000	$0
Surfside Beach	3	1	0	$250,000	$0
Unincorporated Area	60	3	0	$19,284,000	$0
Horry County	**89**	**4**	**0**	**$21,952,000**	**$0**

Historical Summary of Insured Flood Losses

The City of North Myrtle Beach joined the NFIP in October of 1977. The current effective flood map date is 8/23/1999. According to FEMA flood insurance policy records as of July 31, 2019, there are 12,270 flood insurance policies in the City and there have been 429 flood losses reported for the City of North Myrtle Beach, totaling over $49,289,495 in claims payments. It should be noted that these numbers include only those losses to structures that were insured through the NFIP policies, and for losses in which claims were sought and received. It is likely that many additional instances of flood loss in the City have been either uninsured, denied claims payment, or not reported.

Repetitive Loss Properties

FEMA defines a repetitive loss 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. Currently there are over 140,000 repetitive loss properties nationwide.

There are 195 non-mitigated repetitive loss properties in North Myrtle Beach, which have experienced at least XX total losses and more than $ 8,529,764 in claims payments under the NFIP. The average claim amount for these properties is $18,567. The properties are single family residential buildings and commercial buildings. Without mitigation these properties will likely continue to experience flood loses.

3.2.3 Nor'easter

What is a Nor'easter?

Nor'easters are extra-tropical events that produce gale-force winds and precipitation in the form of heavy rain or snow. They can cause increases in tidal elevations (storm surge), wind speed, and erosion. These cyclonic storms, called Nor'easters because of the direction of the storm winds, can last for several days and can be very large –1,000-mile wide storms are not uncommon.

Causes of Nor'easters:

The presence of the Gulf Stream off the eastern seaboard in the winter season acts to dramatically enhance the surface horizontal temperature gradients within the coastal zone.

During winter offshore cold periods, these horizontal temperature gradients can result in rapid and intense destabilization of the atmosphere directly above and shoreward of the Gulf Stream. This air mass modification or conditioning period often precedes wintertime coastal extra- tropical cyclone development.

TABLE 3.11: THE DOLAN-DAVIS NOR'EASTER INTENSITY SCALE

Storm Class	Beach Erosion	Dune Erosion	Overwash	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 and recession	Severe dune erosion or destruction	On low beaches	Loss of 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 dollars

Source: DHS - FEMA

It is the temperature structure of the continental air mass and the position of the temperature gradient along the Gulf Stream that drives this cyclone development. As a low pressure deepens, winds and waves can uninhibitedly increase and cause serious damage to coastal areas as the storm generally moves to the northeast.

Nor'easters in South Carolina:

The coastal counties of South Carolina are most vulnerable to the impacts of Nor'easters. The nor'easter is a particularly devastating type of coastal storm, named for the winds that blow from the northeast and drive the storm up the US East Coast alongside the Gulf Stream, a band of warm water that lies off the Atlantic Coast. They are caused by the interaction of the jet stream with horizontal temperature gradients ad generally occur during the fall and winter months when moisture and cold air are plentiful. Coastal storm events are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding. Since the storms often occur at night, and typically make landfall with less warning than hurricanes (due to their rapid formation right along the coast), residents may be caught at home unprepared. On the other hand, Nor'easters typically occur during the off-season when fewer non-residents are visiting the coast. As with hurricanes, vulnerability is proportional to structural strength, with mobile homes particularly vulnerable. The National

Centers for Environmental Information did not report any nor'easter events for Horry County in their database.

March 1962: (Category 5) The Ash Wednesday Storm of 1962: lasted more than 60 hours. The winds and raging surf caused the most damage for Horry County Beaches. According to the Army Corps of Engineers, the storm caused more erosion damage to oceanfront property than many hurricanes that preceded it. Along the Mid-Atlantic States more than 1,800 houses were completely destroyed causing an estimated $234M in property damage.

February 8-11, 1973: A snowstorm of historic proportions impacted the state, leaving behind a record 24 inches of snow in some areas. Snowdrifts of up to eight inches were recorded. Approximately 30,000 motorists were stranded on the state's highways – many rescued by helicopter. Eight exposure-related fatalities were reported. Over 200 buildings, in addition to thousands of awnings and carports, collapsed under the weight of the snow. Property and road damages as well as the cost of snow removal and rescue operations were estimated to total approximately $30 million.

March 13, 1993: This winter storm, which possessed an extremely low atmospheric pressure, passed across South Carolina bringing winds, recorded snowfalls of as much as 11.5 feet in portions of the mountains, and snow flurries on the southeast tip of the coast. Preliminary damage assessments at the time were estimated at the time were estimated at over $22 million. Two fatalities in South Carolina resulted from this event that is also known as the "Superstorm of the Century". This historic storm impacted 26 states and broke many historical records in the affected areas.

January 22-29, 2000: Low pressure rapidly decreased near the Carolina coast, wrapping abundant moisture back across the Piedmont of the Carolinas. By the time snow ended, accumulations ranged from 12 to 20 inches. Due to the heavy wet snow, numerous power outages occurred and buildings collapsed. On January 29, a weakening low-pressure system in the Ohio River Valley, and a low-pressure system along the Gulf Coast, coupled with arctic air across the Carolinas, resulted in an icy mess throughout Upstate South Carolina. Precipitation, which briefly began as a light mixture of sleet and snow, quickly turned to freezing rain, resulting in a glaze 1/4 to 1/2-inch-thick on exposed surfaces. Power outages were common across the region, especially in the Lower Piedmont from Abbeville to Greenwood. South Carolina requested $9.2 million in federal disaster aid to remove snow and downed trees. A total of 38 counties received a Presidential Disaster Declaration.

January 29-30, 2010: A winter storm moved up the coast with snow, sleet, and freezing rain, with accumulation primarily in Lancaster, Chesterfield, and Newberry counties. About 1/8th inch of ice was reported for elevated surfaces and trees, and snow was reported to be one to three inches for some counties. Property loss estimates for these three counties total to about $125,000. Other counties that received freezing rains and sleet include: Fairfield, Kershaw, Lee, Saluda, Lexington, Richland, Sumter, and Clarendon.

Nor'easters have the potential to cause severe erosion damage to the beach which can result in major damages to both public facilities and private property. Areas directly affected by Nor'easters are somewhat limited. For these and a variety of other reasons, nor'easters have been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.4 Coastal Erosion

Coastal erosion is the wearing away of coastal land. It is commonly used to describe the horizontal retreat of the shoreline along the ocean. Erosion is considered a function of larger processes of shoreline change, which includes erosion and accretion. Erosion results when more sediment is lost along a particular shoreline than is redeposited by the water body. Accretion results when more sediment is deposited along a particular shoreline than is lost. When these two processes are balanced, the shoreline is said to be stable. Major storms can cause coastal erosion from the combination of high winds and heavy surf and storm surge. Human interactions, such as construction and development in coastal and riparian regions, can also exacerbate erosion.

In assessing the erosion hazard, it is important to realize that there is a temporal, or time aspect associated with the average rate at which a shoreline is either eroding or accreting. Over a long-term period (years), a shoreline is considered eroding, accreting, or stable. When evaluating coastal erosion, the focus is generally on the long-term erosion situation. However, in the short-term, it is important to understand that storms can erode a shoreline that is, over the long- term, classified as accreting.

Erosion is measured as a rate, with respect to either a linear retreat (i.e., feet of shoreline recession per year) or volumetric loss (i.e., cubic yards of eroded sediment per linear foot of shoreline frontage per year). Erosion rates are not uniform, and vary over time at any single location. Annual variations are the result of seasonal changes in wave action and water levels.

South Carolina Beach Management Planning Requirements

The City of North Myrtle Beach, South Carolina Beach Management Plan (June 1992) was prepared pursuant to South Carolina Code of Laws, Section 48-39- 350, of the South Carolina Coastal Zone Management Act, as amended July 1, 1990.

The Beach Management Act required each coastal beachfront county and city to prepare a Local Comprehensive Beach-front Management Plan based on guidelines provided by the South Carolina Coastal Council (SCCC).

North Myrtle Beach's Experience

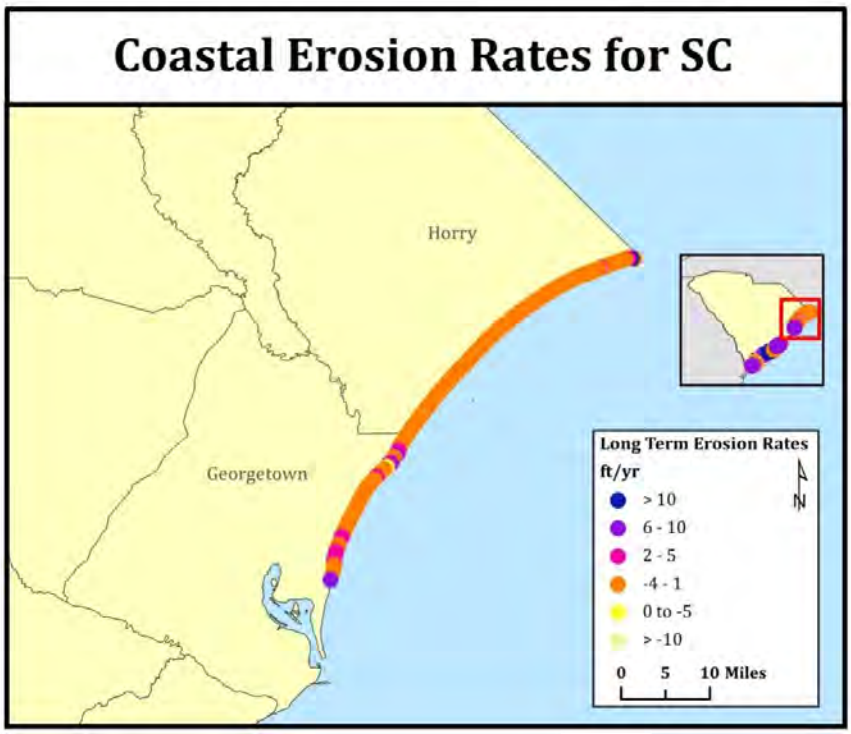
The City's shoreline development consists of a combination of single-family houses, condominiums, apartments, small motels, and large high-rise hotels along with the commercial establishments necessary to support a growing tourist trade. Few vacant lots remain along the shorefront and redevelopment has increased the density of dwelling units and hotels along the beach.

With limited land between Ocean Boulevard and the beach plus increased demand for beachfront living, high-density development has been moving closer to the shoreline, displacing much of the natural dune system. This development and periods of shoreline erosion led to the use of a variety of protection measures. The 1992 beach management study found as much as 25 percent of the oceanfront was armored with seawalls, bulkheads, or rock revetments. [16]

As these hard structures were built, the available high-tide beach diminished in some sections. Parts of Cherry Grove, for example, have virtually no "dry sand" beach during

high tide. Vertical structures and, to a lesser extent, sloping rock revetments have tended to accelerate erosion of the high-tide beach and have slowed its recovery after storms. **Figure 3.14** provides a map to summarize erosion rates for Northern South Carolina's Coast. This dataset represents true long-term erosion rates, not event specific data.

FIGURE 3.14: EROSION RATES FOR NORTHERN SOUTH CAROLINA'S COAST



Source: National Centers for Environmental Information (NCEI); Spatial Hazard Events and Losses for the US (SHELDUS); Department of Health and Environmental Control's Office of Erosion and Coastal Resource Management (DHEC-OCRM)

With only a small inlet to the northeast (Hog Inlet) and a swash south of Windy Hill, the shoreline forms a broad arc which is in general equilibrium with the principal wave approaches. A 1986 study, *North Myrtle Beach Shorefront Management Plan* (SMP), provided a detailed accounting of linear shore movement and volumetric sand losses since the 1950's. The SMP estimated erosion rates at a low 0.4 feet per year over the 40-year period and volumetric losses along the recreational profile at around 0.2 cubic yards per foot per year between 1955 and 1985. A later 1997 Sea Grant erosion inventory classified North Myrtle Beach as generally stable.

Short-term erosion rates can greatly exceed the long-term erosion rates. This was illustrated just one year after completion of the SMP. Two northeasters occurred (December 2, 1986 and January 1, 1987). The latter storm took about 40 feet of dune throughout the Grand Strand and caused over $2.5 million in property damage in North Myrtle Beach. Much of this damage involved seawalls and pools which collapsed from undermining and scour as storm waves penetrated further inland. Remedial action along the beach after the storms was largely confined to beach scraping and rebuilding seawalls.

Beach surveys by the South Carolina Coastal Council estimated the erosion loss from the 1987 winter storms at –11.2 cy/ft in North Myrtle Beach. By April 1987, 7.0 cy/ft had been recovered, for a short-term loss averaging –4.2 cy/ft. The report stated the *Cherry Grove area continues to be critically short of sand…and the sections of North Myrtle Beach with armored shorelines continue to have a lower sand volume than natural sections as seawalls exacerbate the erosion problem.*

In 1988 North Myrtle Beach adopted baselines and setback lines based on the 1986 SMP. Later, South Carolina's Beach Management Act (BMA) was adopted in1990. This Act prescribes a methodology for establishing baselines and setback lines for the purpose of enforcing state law. In 1991 the South Carolina Coastal Council adopted a baseline for North Myrtle Beach.

Hurricane Hugo and Beach Erosion

Hugo caused extensive damage and beach erosion along the North Myrtle Beach shoreline. Upwards of 75 feet of erosion occurred primarily in the recreational zone of the beach. However, with a volumetric loss in excess of 1.1 million cubic yards, much of the beach was left with little protection from a second storm.

Responding to the city's request for assistance, the Federal Emergency Management Agency (FEMA) designated 7,200 ft of shoreline for emergency protection. Under the Public Assistance Grant, construction of dunes at an elevation of +9 ft NGVD was approved. This height corresponds to the five-year return period water level. The state approved a similar emergency measure for the remaining sections of the beach.

The purpose of the emergency dune was to protect remaining structures from further damage. Emergency dunes were constructed by earthmovers and bulldozers moving sand from the intertidal beach to locations closer to ocean front buildings. The emergency work was completed by mid-October 1989. Some of the sand deposited offshore during the storm is gradually returned to the shore. By December 1989, about 225,000 cubic yards of sand had returned to the beach by this natural process.

This still left the beach with a large sand deficit that needed remediation before the next tourist season. An emergency nourishment plan was approved for the placement of 372,000 cubic yards of sand along 30,000 feet of the most critically eroded sections of the beach. The combination of emergency nourishment and natural recovery replaced almost 90 percent of the sand lost during Hugo. Emergency nourishment contributed about 40 percent of the restoration and natural recovery the remainder. Post-project surveys indicated that by October 1990 North Myrtle Beach had regained all but 124,000 cubic yards of sand.

Severe erosion can be caused by hurricanes and Nor'easters. These coastal storms have been ranked as high and moderate risk hazards for the City. Severe erosion damage to the beach can result in major damages to both public facilities and private property. For these and a variety of other reasons, coastal erosion has been ranked as a high-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.5 Severe Thunderstorm/Lightning

What Is A Thunderstorm?

Thunderstorms are the result of convection in the atmosphere. They are typically the by-product of atmospheric instability, which promotes the vigorous rising of air parcels that form cumulus and, eventually, the cumulonimbus (thunderstorm) cloud. Instability can be caused either by surface heating or upper-tropospheric (~50,000 feet) divergence of air. Generally, the former "air mass" thunderstorms form on warm-season afternoons and are not severe. The latter "dynamically- driven" thunderstorms generally form in association with a cold front or other regional-scaled atmospheric disturbance. These storms can become severe, producing strong winds, frequent lightning, hail, downbursts and even tornadoes.

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 condensation of water.

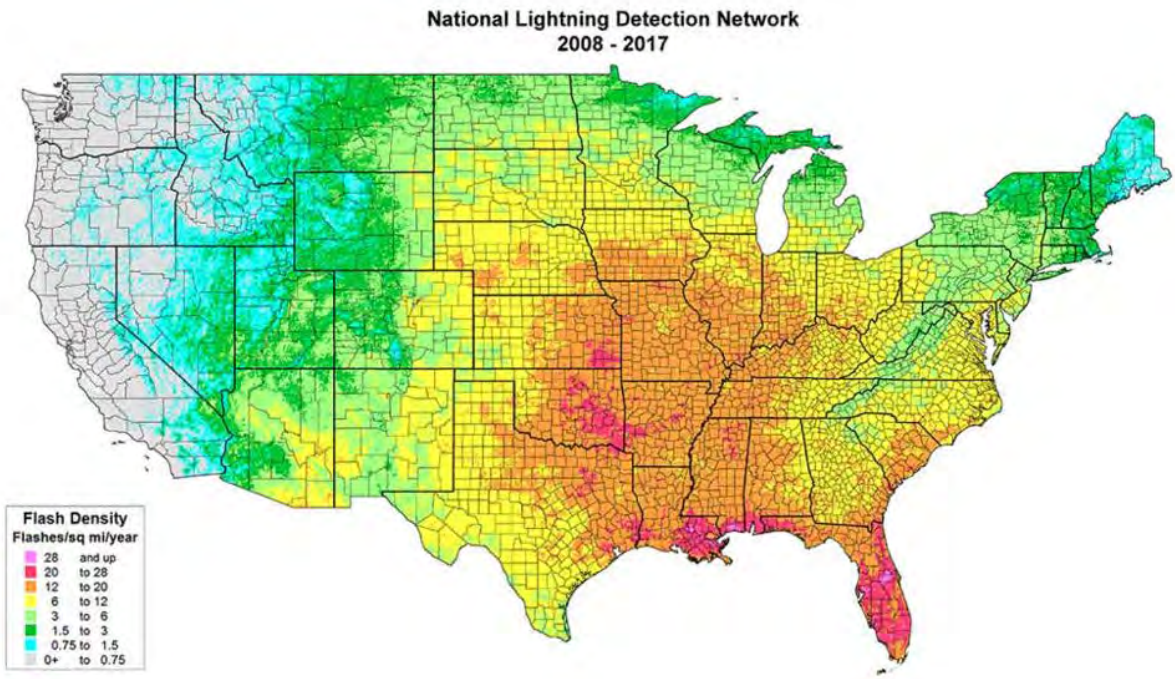
According to the National Weather Service, a severe thunderstorm is one that produces tornadoes, hail 0.75 inches or more in diameter, or winds of 50 knots (58 mph) or more. Structural wind damage may imply the occurrence of a severe thunderstorm. Hail, formed by the accretion of supercooled liquid water on ice particles in a thunderstorm updraft, can pose a serious threat to agriculture and exposed objects. Likewise, strong winds can potentially wreak havoc on fragile or flimsy structures, or yield secondary damage through the downing of trees. Lightning associated with thunderstorms poses a threat to people and animals in unsheltered areas. The tornado, however, is by far the greatest natural hazard threat from a severe thunderstorm.

What is lightning?

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes the thunder which often accompanies lightning strikes. While most often affiliated with severe thunderstorms, lightning may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

Figure 3.15 shows a lightning flash density map for the years 2008-2017 based upon data provided by Vaisala's U.S. National Lightning Detection Network (NLDN®).

FIGURE 3.15: LIGHTING FLASH DENSITY IN THE UNITED STATES



Source: Vaisala U.S National Lightning Detection Network

Lightning strikes occur in very small, localized areas. For example, they may strike a building, electrical transformer, or even a person. According to FEMA, lightning injures an average of 300 people and kills 80 people each year in the United States. Direct lightning strikes also have the ability to cause significant damage to buildings, critical facilities, and infrastructure largely by igniting a fire. Lightning is also responsible for igniting wildfires that can result in widespread damages to property.

What is hail?

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until they develop to a sufficient weight and fall as precipitation. Hail typically takes the form of spheres or irregularly-shaped masses greater than 0.75 inches in diameter. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size. **Table 3.12** shows the TORRO Hailstorm Intensity Scale which is a way of measuring hail severity.

TABLE 3.12: TORRO HAILSTORM INTENSITY SCALE

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	mm to inch conversion (inches)	Typical Damage Impacts
H0	Hard Hail	5	0-20	0 – 0.2	No damage
H1	Potentially Damaging	5-**15**	>20	0.2 – 0.6	Slight general damage to plants, crops
H2	Significant	10-**20**	>100	0.4 – 0.8	Significant damage to fruit, crops, vegetation
H3	Severe	20-**30**	>300	0.8 – 1.2	Severe damage to crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-**40**	>500	1.0 – 1.6	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-**50**	>800	1.2 – 2.0	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-**60**		1.6 – 2.4	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-**75**		2.0 – 3.0	Severe roof damage, risk of serious injuries
H8	Destructive	60-**90**		1.6 – 3.5	(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-**100**		3.0 – 3.9	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100			Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: http://www.torro.org.uk/site/hscale.php

Thunderstorm Events in South Carolina

Thunderstorms have not resulted in any disaster declarations in Horry County. According to NCEI, there have been 324 reported thunderstorm wind and high winds events since 1956 in Horry County. These events caused over $4.9 million in damages. There were 4 reported injuries and 1 death related to thunderstorm events. **Table 3.13** summarizes this information.

TABLE 3.13: SUMMARY OF THUNDERSTORM / HIGH WIND OCCURRENCES

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2020)
Atlantic Beach	0	0	0	$0
Aynor	17	0	0	$30,000
Briarcliffe Acres	0	0	0	$0
Conway	31	0	0	$1,365,500
Loris	17	0	0	$80,000
Myrtle Beach	19	0	4	$1,246,500
North Myrtle Beach	8	0	0	$120,000
Surfside Beach	4	0	0	$5,000
Unincorporated Area	228	1	0	$1,748,000
Horry County Total	**324**	**1**	**4**	**$4,595,000**

Source: NCEI

Lightning Events in South Carolina:

Lightning events are common throughout South Carolina, and have occurred in all months of the year. Lightning related deaths and injuries in South Carolina have peaked during July and August. Between 1996 and 2019 Horry County had 36 significant lightning events according to the National Centers for Environmental Information. During this period, 10 lightning-related injuries occurred within the county; and, one lightning-related deaths were reported. Property losses for these events totaled $1,617,000. **Table 3.14** summarizes this information.

TABLE 3.14: LIGHTNING OCCURRENCES IN HORRY COUNTY

Location	Number of Occurrences	Deaths	Injuries	Property Damage	Crop Damage
Atlantic Beach	0	0	0	$0	$0
Aynor	0	0	0	$0	$0
Briarcliffe Acres	0	0	0	$0	$0
Conway	5	0	1	$85,000	$0
Loris	3	0	0	$25,000	$0
Myrtle Beach	8	0	1	$300,000	$0
North Myrtle Beach	0	0	0	$0	$0
Surfside Beach	0	0	0	$0	$0
Unincorporated Area	20	1	8	$1,207,000	$0
Horry County	**36**	**1**	**10**	**$1,617,000**	**$0**

Source: NCEI

Hailstorm Events in Horry County

Hailstorm events are common throughout South Carolina, and have occurred in all months of the year. Between 1956 and 2019 Horry County had 321 significant hail events according to the National Centers for Environmental Information. During this period no lightning-related injuries or deaths were reported. Property losses for these events totaled

$605,550. **Table 3.15** below summarizes this information.

TABLE 3.15: HAIL OCCURRENCES IN HORRY COUNTY

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2020)
Atlantic Beach	0	0	0	$0
Aynor	9	0	0	$0
Briarcliffe Acres	0	0	0	$0
Conway	39	0	0	$85,700
Loris	21	0	0	$4,500
Myrtle Beach	21	0	0	$12,200
North Myrtle Beach	5	0	0	$3,000
Surfside Beach	5	0	0	$50,000
Unincorporated Area	221	0	0	$450,150
Horry County Total	**321**	**0**	**0**	**$605,550**

Source: NCEI

Severe thunderstorms can result in floods have the potential to cause major damages to both public facilities and private property. Additionally, lightning generally occurs during severe thunderstorms and have causes several injuries over the past ten years. Overall impact on the community is generally limited. Severe Thunderstorms have been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.6 Wildfire

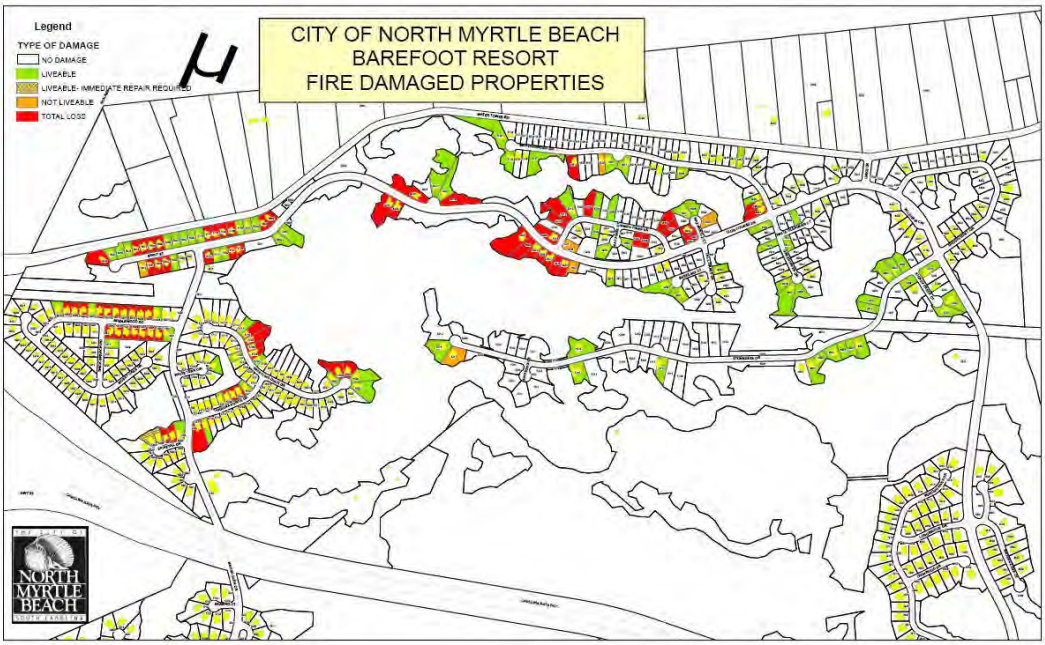
What Is A Wildfire?

A wildfire is any outdoor fire (i.e. grassland, forest, brushland) that is not under control, supervised, or prescribed. Wildfires are part of the natural management of forest ecosystems, but may also be caused by human factors.

Nationally, over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

There are three classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildfires are usually signaled by dense smoke which fills the area for miles around.

FIGURE 3.16 WILDFIRE PROPERTY DAMAGE MAP



Source: NMB Planning and Community Development Department

Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meets or intermingle with wildland or vegetative fuels.

Causes of Wildfires:

People start more than four out of every five wildfires, usually as debris burns, arson, or carelessness. Lightning strikes are the next leading cause of wildfires. Regardless of the cause, Wildfires can pose a significant risk to the human environment.

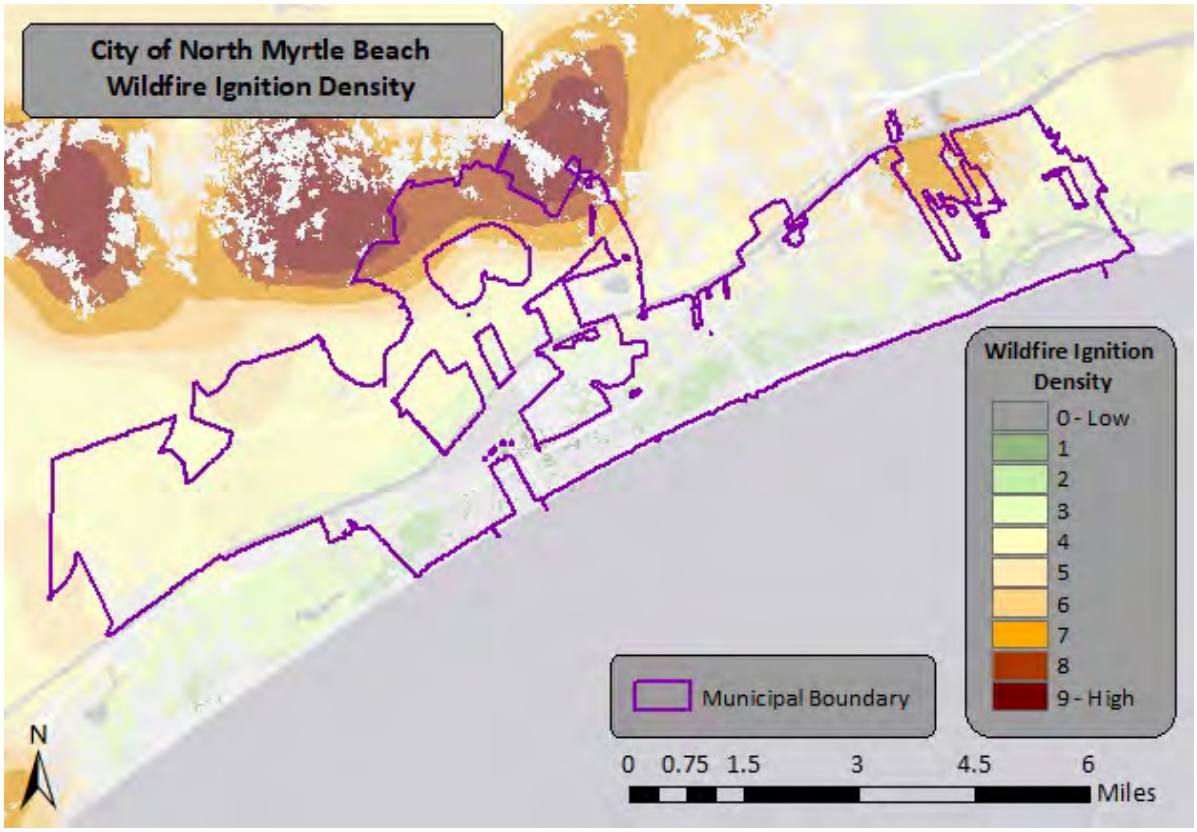
Wildfire behavior is based on three primary factors: fuel, topography and weather Fuel: The type and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential and behavior. The continuity of fuels, expressed in both horizontal and vertical components is also a factor, in that it expresses the pattern of vegetative growth and open areas.

Weather affects the probability of wildfire and has a significant effect on its behavior. Temperature, humidity, and wind (both short and long term) affect the severity and duration of wildfires. Critical Fire Weather Frequency is a set of weather conditions, usually a combination of low relative humidity and wind, whose effects on fire behavior make control difficult and threaten firefighter safety.

Technically, the entire city is at risk to a wildfire occurrence. However, several factors such as drought conditions or high levels of fuel on the forest floor, may make a wildfire more

likely. Furthermore, areas in the urban-wildland interface are particularly susceptible to fire hazard as populations formerly undeveloped areas. **Figure 3.17** shows the Wildfire Ignition Density for City of North Myrtle Beach based on data from the Southern Wildfire Risk Assessment. This data represents the likelihood of wildfire igniting in the area, which is derived from historical wildfire occurrences to create an average ignition rate map.

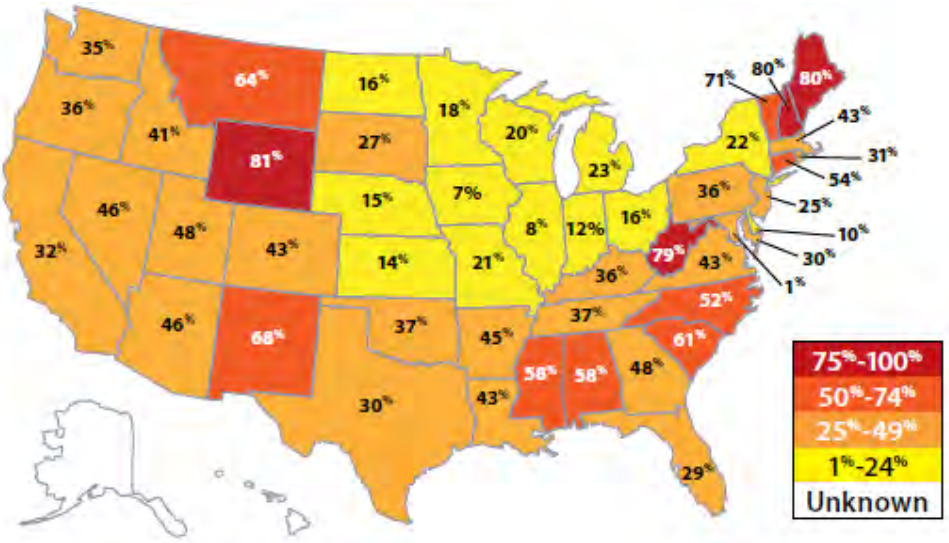
FIGURE 3.17: WILDFIRE IGNITION DENSITY



Source: Southern Wildfire Risk Assessment

Every state has a Wildland Urban Interface (WUI), which is the rating of potential impact of wildfires on people and their homes. The WUI is not a fixed geographical location, but rather a combination of human development and vegetation where wildfires have the greatest potential to result in negative impacts. Nationally, one-third of all homes lie in the WUI, which is a growing danger. Below, **Figure 3.18** shows a map of each state's WUI. Based on the data from the US Department of Agriculture, 61% of homes in South Carolina lie within the WUI.

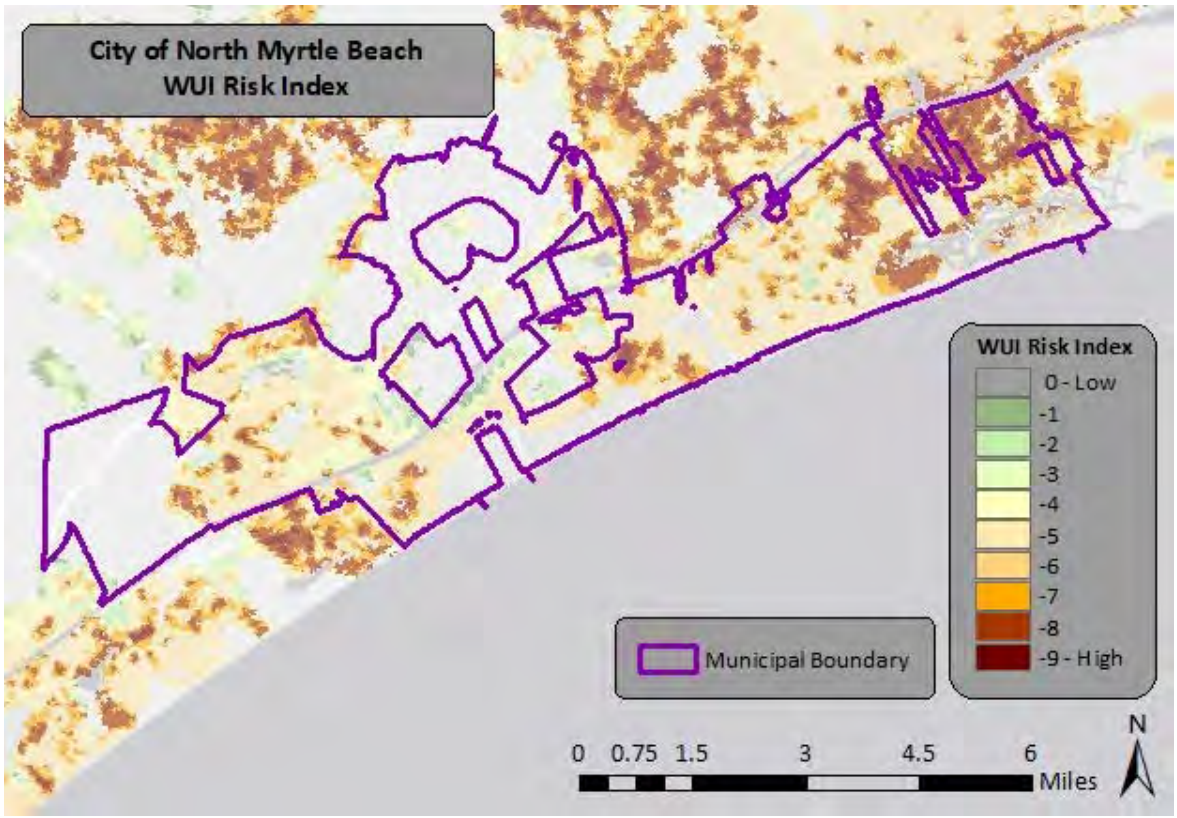
FIGURE 3.18: PERCENT OF TOTAL HOMES IN THE WILDLAND URBAN INTERFACE



Source: US Department of Agriculture

Below, **Figures 3.19** displays the WUI Risk Index for the City of North Myrtle Beach.

FIGURE 3.19: WILDLAND URBAN INTERFACE RISK INDEX



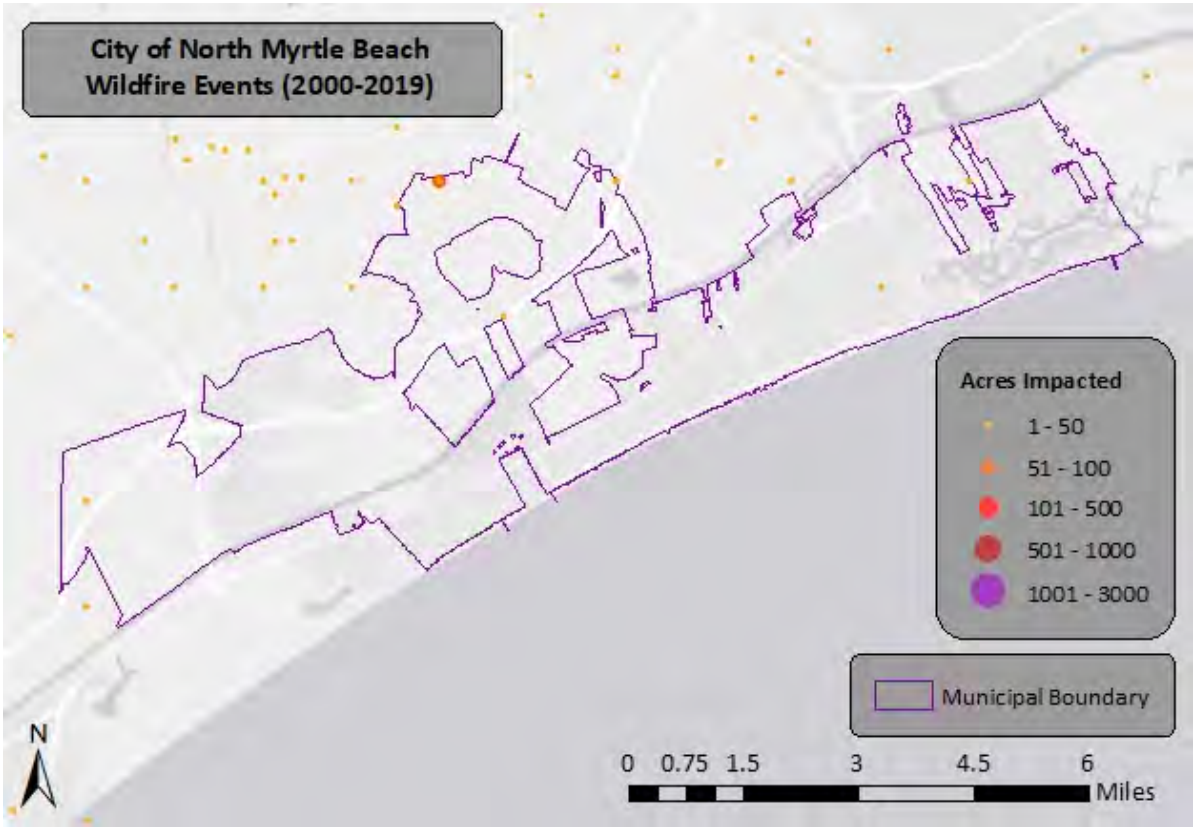
Source: Southern Wildfire Risk Assessment

Historical Occurrences

Information from the National Association of State Foresters was used to ascertain historical wildfire events. The National Association of State Foresters reported that a total of 1,224 events that impacted an area greater than 1 acre have occurred in Horry County since August 12, 1997. These events have burned a total of 33,359 acres. The largest of these events was the Highway 31 Fire which occurred in Horry County in April 28, 2009 and impacted 19,130 acres.

Figure 3.20 shows a map of wildfire incidents within the City of North Myrtle Beach and the surrounding area.

FIGURE 3.20: WILDFIRE INCIDENTS WITHIN THE CITY OF NORTH MYRTLE BEACH



Source: NASFI

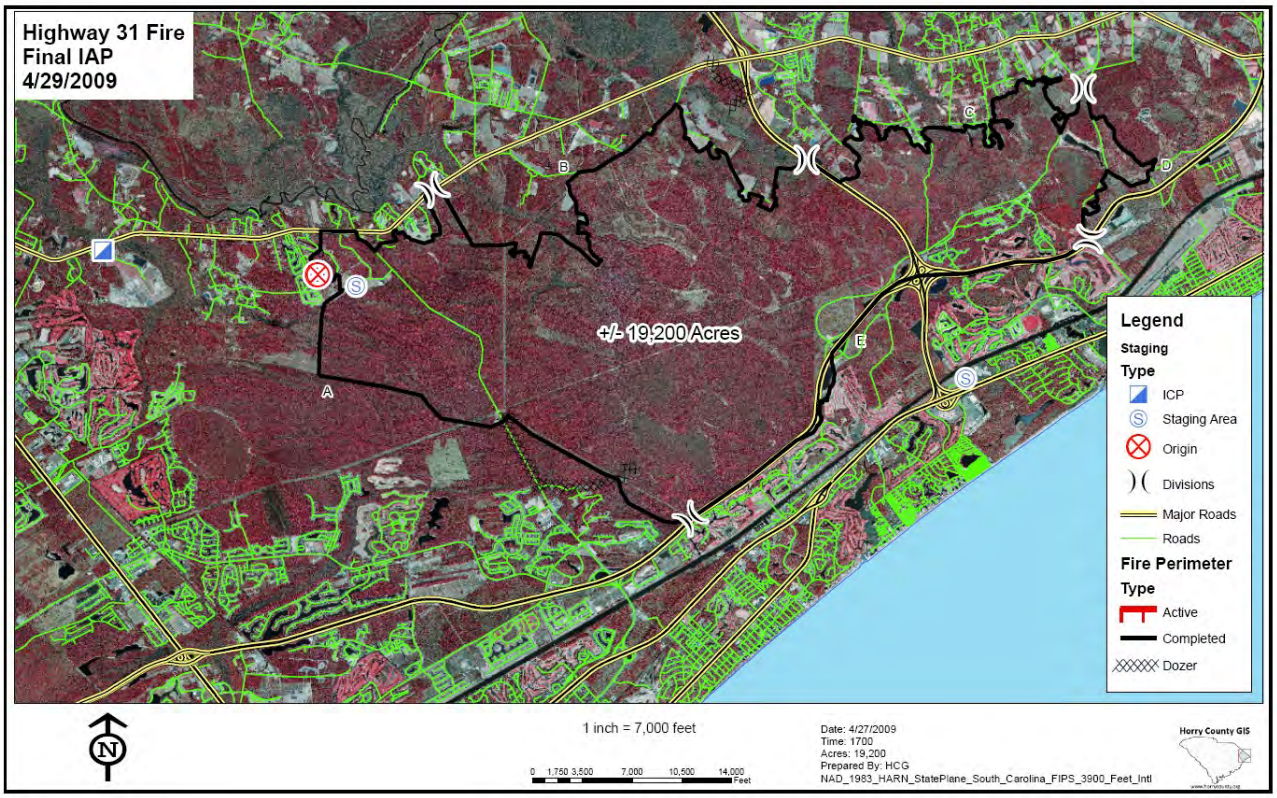
Horry County received a Fire Suppression Authorization from FEMA for the Long Bay Fire – November 9, 2001 and received a Fire Management Assistance declaration for the Legends Fire – June 17 -24, 2002.

Earth Day Fire/Highway 31 Fire – April 22, 2009: South Carolina's worst wildland urban interface fire, according to the South Carolina Forestry Commission was the Earth Day Fire or the Highway 31 Fire, began on April 22, 2009 in the International Drive area. After jumping firebreaks and a major four-lane highway during the night of the 22nd, the fire raced

into the Barefoot Resort area. The Barefoot Resort home fire ignitions were primarily caused by fire brands (burning twigs, etc.) which were lifted by the firestorm and thrown in front of the fire head or leading edge of the fire. [27]

Seventy homes were completely destroyed with dozens of others receiving various degrees of damage. Fortunately, no lives were lost, due to the evacuation initiated by the North Myrtle Beach Public Safety Officers. In total the fire burned 19,200 acres, destroyed 76 homes, damaged 97 and an estimated 500 firefighters from thirty-five agencies aided in the fight. The fire forced over 4,000 residents from their homes. The cost of the fire is estimated at $800 thousand.

FIGURE 3.21: MAP OF HIGHWAY 31 FIRE PERIMETER



Source: South Carolina Forestry Commission

Since the Highway 31 fire, North Myrtle Beach has taken actions to reduce the potential for wildfires in the future. These include:

- Adopting a revised ordinance that regulates the use of outdoor fires.
- Development of a public education program with a new information brochure.
- Changes to the City's Emergency Operations Plan.

Wildfire Measurement:

For wildfires, intensity can be expressed as fire line intensity (a measure of the rate at which a fire releases heat, or the unit length of the fire line); the rate of fire spread (feet

per second); and flame length. To determine fire hazard severity, use the Fire Hazard Severity Table below. Remember, a community may have more than one classification depending on the degrees of the slope and fuel models.

TABLE 3.16 WILDFIRE RISK

Fuel Classification	Critical Fire Weather Frequency								
	< 1 Day/Year			2 to 7 Days/Year			> 8 Days/Year		
	Slope (%)			Slope (%)			Slope (%)		
	< 40	41-60	>61	< 40	14-60	> 61	< 40	14-60	> 61
Light Fuel	M	M	M	M	M	M	M	M	H
Medium Fuel	M	M	H	H	H	H	E	E	E
Heavy Fuel	H	H	H	H	E	E	E	E	E

Source: Urban Wildland Interface Code: 2000

Heavy Fuel is vegetation consisting of round wood 3 to 8 inches in diameter
Medium Fuel is vegetation consisting of round wood 1/3 to 3 inches in diameter
Light Fuel is vegetation consisting of herbaceous plants and round wood less than ¼ inch in diameter
M = Moderate Hazard; **H** = High Hazard; **E** = Extreme Hazard
Source: FEMA Report No. 386-2

The majority of wildfires in South Carolina are caused by debris burning (30-35%) and arson (40-45%). The most likely areas for wildfires in the City are along Little River Neck Road and the Barefoot Resort areas.

While future impacts will most likely continue to be negligible meaning minor injuries may occur; critical facilities may be shut down for 24 hours or less and few properties in the community would be damaged. Wildfires have been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.7 Extreme Heat

Extreme heat, like drought, poses little risk to property. However, extreme heat can have devastating effects on health. According to FEMA (1997), extreme heat/heat waves can cause the following disorders:

***Heat Stroke**:* The body is unable to control its temperature. It will rise rapidly. Sweating does not occur. This can cause permanent disability. Those at highest risk included outdoor laborers, elderly, children, and people in poor health.

Heat Exhaustion: occurs when there is an excessive loss of water and salt released in sweat. Those at highest risk include the elderly, people with high blood pressure, outdoor laborers, and those exercising outdoors.

***Heat Syncope**:* results in a sudden loss of consciousness, which generally returns when the person lies down. There is little or no permanent harm as a result of heat syncope. This is associated with people who are not properly acclimated to the weather.

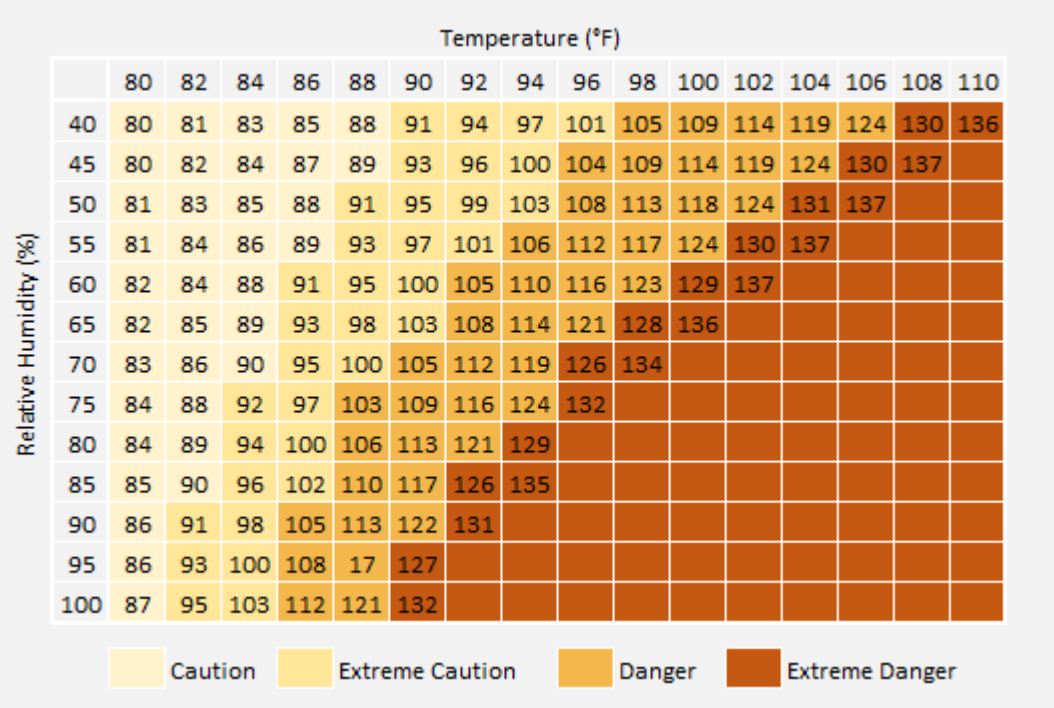
Heat Cramps: occur as a result of a mild fluid and electrolyte imbalance and generally ceases to be a problem after acclimatization. This occurs in people who exercise outdoors when they are unaccustomed to the activity.

Extreme heat can often be referred to as “extreme heat” or a “heat wave.” According to the National Weather Service, there is no universal definition for a heat wave, but the standard U.S. definition is any event lasting at least three days where temperatures reach ninety degrees Fahrenheit or higher. However, it may also be defined as an event at least three days long where temperatures are ten degrees greater than the normal temperature for the affected area. Heat waves are typically accompanied by humidity but may also be very dry. These conditions can pose serious health threats causing an average of 1,500 deaths each summer in the United States

According to the National Oceanic and Atmospheric Administration, heat is the number one weather related killer among natural hazards, followed by frigid winter temperatures[2]. The National Weather Service devised the Heat Index as a mechanism to better inform the public of heat dangers. The Heat Index Chart, shown in **Figure 3.22**, uses air temperature and humidity to determine the heat index or apparent temperature. **Table 3.17** shows the dangers associated with different heat index temperatures. Some populations, such as the elderly and young, are more susceptible to heat danger than other segments of the population.

[2] *https://www.NCEI.noaa.gov/sotc/drought/201802#det-pdi*

FIGURE 3.22: NWS HEAT INDEX CHART



Source: NOAA, National Weather Service

TABLE 3.17: HEAT DISORDERS ASSOCIATED WITH HEAT INDEX TEMPERATURE

Heat Index Temperature (Fahrenheit)	Description of Risks
80°- 90°	Fatigue possible with prolonged exposure and/or physical activity
90°- 105°	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105°- 130°	Sunstroke, heat cramps, and heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity
130° or higher	Heatstroke or sunstroke is highly likely with continued exposure

Source: National Weather Service, NOAA

In addition, NOAA has seventeen metropolitan areas participating in the Heat Health Watch/Warning System in order to better inform and warn the public of heat dangers. A Heat Health Watch is issued when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A Heat Warning is issued when an excessive heat event is expected in the next 36 hours. Furthermore, a warning is issued when the conditions are occurring, imminent, or have a high likelihood of occurrence. Urban areas participate in the Heat Health Watch/Warning System because urban areas are at greater risk to heat affects. Stagnant atmospheric conditions trap pollutants, thus adding unhealthy air to

excessively hot temperatures. In addition, the “urban heat island effect” can produce significantly higher nighttime temperatures because asphalt and concrete (which store heat longer) gradually release heat at night.

Extreme heat/Heat Waves occur when there are high temperatures combined with high humidity persist over an extended period of time.

North Myrtle Beach Extreme Heat Vulnerability Summary

An examination of temperature records for the period 1948-2019 found the highest maximum temperature to be 107 F on August 18, 1954. The South Carolina State Climatology Office also provided data for the Myrtle Beach Area. The data results were compiled by reviewing 31 years of complete temperature, dew point and relative humidity data. The results showed that on average there were 2.06 days in June with a heat index over 104.5°F, 5.91 days in July with a heat index over 104.5°F, 4.55 days in August with a heat index over 104.5°F, and 2.17 days in September with a heat index over 104.5°F. The National Centers for Environmental Information did not report any significant excessive heat events in their database.

Historical records indicate that it is possible extreme heat/heat waves will affect North Myrtle Beach; however, future impacts will most likely be negligible. For this and a variety of other reasons, extreme heat have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.8 Tornadoes/Waterspouts

What Is A Tornado?

A tornado is a violently rotating column of air extending to the ground. Over water, a tornado is called a *waterspout*. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long.

Tornadoes are among the most unpredictable of weather phenomena. Tornado season runs ordinarily from March through August; however, tornadoes can strike at any time of the year if the essential conditions are present.

Cause of Tornadoes:

Thunderstorms and hurricanes spawn tornadoes when cold air overrides a layer of warm air, causing the warm air to rise rapidly. The winds produced from hurricanes, earthquake-induced fires, and wildfires have also been known to produce tornadoes.

The nature of tornadoes is that they strike at random. While it is known that some areas of the country experience tornadoes more than others, predicting exactly what parts of your community have a greater chance of being struck by a tornado is difficult. In order to determine the likelihood and potential severity of tornado events in your community, you should ascertain the number and intensity of tornadoes that have affected the area in the past. Take note, however, that the past number and severity of events is not necessarily a predictor of future occurrences.

Tornadoes in South Carolina:

Tornadoes are a threat to the North Myrtle Beach area. South Carolina has averaged 11 tornadoes each year since 1950, resulting in 47 fatalities and 1057 injuries. South Carolina ranks twenty-sixth in the United States in the number of tornado strikes, and eighteenth in the number of tornadoes per square mile. The most common type of tornado, the relatively weak and short-lived type, occurs between March and May. However, tornadoes can occur almost anywhere at any time.

FIGURE 3.23: WIND ZONES IN THE UNITED STATES

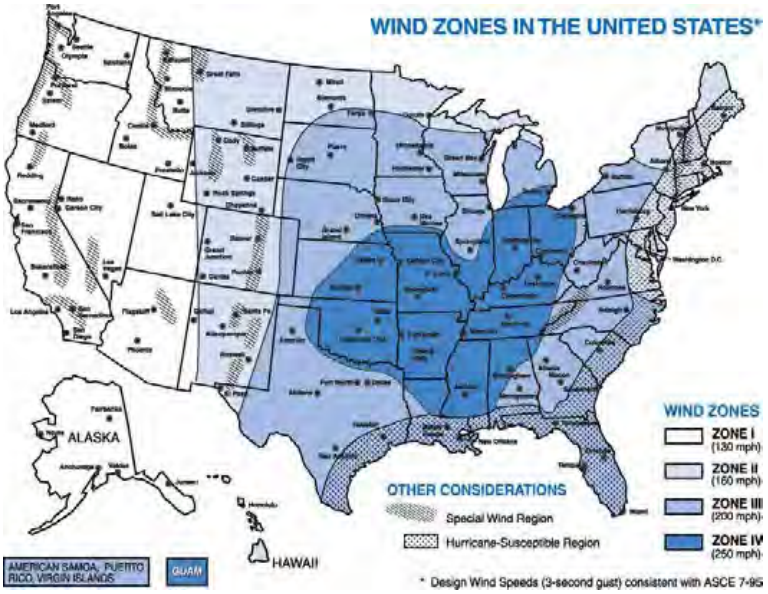


Figure 3.23 shows the shows how the frequency and strength of extreme windstorms vary across the United States. This map was produced by the Federal Emergency Management Agency and is based on 40 years of tornado history and over 100 years of hurricane history. Zone IV, the darkest area on the map, has experienced both the greatest number of tornadoes and the strongest tornadoes. As shown by the map key, wind speeds in Zone IV can be as high as 250 mph.

Tornadoes are characterized by damage pattern, F0 through F5 on the Fujita- Pearson Tornado Scale. **Table 3.18** below shows the tornado category, expected damages, and corresponding wind speed based off the Fujita-Pearson Tornado Scale.

TABLE 3.18 THE ENHANCED FUJITA-PEARSON TORNADO SCALE

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

Source: National Weather Service

North Myrtle Beach Experience with Tornadoes

North Myrtle Beach is located within Zone III. The tornado hazard in Zone III, while not as great as in Zone IV, is still significant with winds potentially reaching 200 miles per hour. According to the National Centers for Environmental Information, there have been a total of 52 recorded tornado events in Horry County since 1955 (**Table 3.19**), resulting in over $22.3 million (2020 dollars) in property damage.

TABLE 3.19: SUMMARY OF TORNADO OCCURRENCES

Location	Number of Occurrences	Deaths	Injuries	Property Damage (2020)
Atlantic Beach	0	0	0	$0
Aynor	3	0	0	$55,000
Briarcliffe Acres	0	0	0	$0
Conway	3	0	1	$1,520,000
Loris	1	0	0	$200,000
Myrtle Beach	4	0	39	$8,000,500
North Myrtle Beach	1	0	0	$800,000
Surfside Beach	0	0	0	$0
Unincorporated Area	40	0	64	$11,803,280
Horry County Total	**52**	**0**	**104**	**$22,378,780**

Source: NCEI

Tornadoes in the North Myrtle Beach area included events on:

November 7, 1995 (F2) An estimated five tornado touchdowns ran a track in ten minutes from near the Conway Raceway northeast along US Highway 378 to the Little River area on SC Highway 90. Major damage was done to 50 residential and five commercial buildings. Minor damage was done to 85 residential and 20 commercial buildings. Hundreds of large trees were twisted and snapped.

July 10, 1996 (F0) A waterspout sighted off Cherry Grove beach moved ashore. No damage was reported.

July 6, 2001 (F2) During the late afternoon of July 6, 2001, two tornadoes occurred in portions of North Myrtle Beach and Myrtle Beach, South Carolina. Between 4:25 and 4:30 pm, several reports of tornadoes in Myrtle Beach were received at the National Weather Service. A Tornado Warning was issued for Horry County at 4:33 pm. At 4:34 pm, weather observations from the Myrtle Beach airport included mention of a tornado moving southwest near the end of the runway. Tower personnel reported seeing the funnel surrounded by a debris cloud.

A preliminary damage assessment was performed during the evening of July 6th and revealed damage to many buildings, signs, utility poles, and vehicles. The magnitude of the damage suggests F2 strength for the tornado, which corresponds to peak wind speeds of 113 to 157 mph. Many automobiles and multi- story motels had their windows blown out. Several structures had damage to their roofs and stucco walls, and one wooden structure had its roof completely removed. Power lines were down and some large billboards were damaged. The power of the wind was very evident when several vehicles were actually flipped over by the tornadoes, including two tourist trolleys. The most concentrated damage occurred in the vicinity of the Myrtle Beach pavilion, although more spotty damage occurred for miles north along the coastline. Reports indicated up to thirty-sixpeople were taken by ambulance to area hospitals for only minor injuries. Damage from this

tornado is preliminarily estimated at $8,000,000. Damage to automobiles accounts for over $1,000,000 of that total. At the height of the storm, 4,000 Myrtle Beach residents were without power.

An EF0 tornado that was a result of Hurricane Matthew in 2016 caused damage to a couple of businesses and a minor damage to a few houses.

While tornadoes/waterspouts are likely to occur in North Myrtle Beach their impact is expected to be limited to a small geographic area. For these and a variety of other reasons, tornadoes/waterspouts have been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.9 Severe Winter Storms

What Are Severe Winter Storms?

Severe winter weather can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Events may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Some winter storms might be large enough to affect several states, while others might affect only localized areas. Occasionally, heavy snow might also cause significant property damages, such as roof collapses on older buildings.

All severe winter weather events have the potential to present dangerous conditions to the affected area. Larger snowfalls pose a greater risk, reducing visibility due to blowing snow and making driving conditions treacherous. A heavy snow event is defined by the National Weather Service as an accumulation of 4 of more inches in 12 hours or less. A blizzard is the most severe form of winter storm. It combines low temperatures, heavy snow, and winds of 35 miles per hour or more, which reduces visibility to a quarter mile or less for at least 3 hours. Winter storms are often accompanied by sleet, freezing rain, or an ice storm. Such freeze events are particularly hazardous as they create treacherous surfaces.

Ice storms are defined as storms with significant amounts of freezing rain and are a result of cold air damming (CAD). CAD is a shallow, surface-based layer of relatively cold, stably-stratified air entrenched against the eastern slopes of the Appalachian Mountains. With warmer air above, falling precipitation in the form of snow melts, then becomes either super-cooled (liquid below the melting point of water) or re-freezes. In the former case, super-cooled droplets can freeze on impact (freezing rain), while in the latter case, the re-frozen water particles are ice pellets (or sleet). Sleet is defined as partially frozen raindrops or refrozen snowflakes that form into small ice pellets before reaching the ground. They typically bounce when they hit the ground and do not stick to the surface. However, it does accumulate like snow, posing similar problems and has the potential to accumulate into a layer of ice on surfaces. Freezing rain, conversely, usually sticks to the ground, creating a sheet of ice on the roadways and other surfaces. All of the severe winter weather elements – snow, low temperatures, sleet, ice, etcetera – have the potential to cause significant hazard to a community. Even small accumulations can down power lines and trees limbs and create hazardous driving conditions. Furthermore, communication and power may be disrupted for days.

The winter storms that impact South Carolina generally form in the Gulf of Mexico or off the southeast Atlantic Coast. Few of these storms result in blizzard conditions, defined by the presence of winds in excess of 35 mph, falling and blowing snow, and a maximum temperature of 20 Fahrenheit.

Severe Winter Storms in South Carolina:

The entire state of South Carolina has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal areas typically face their greatest threat from Nor'easters and other severe winter coastal storms. These storms can contain strong waves and result in extensive beach erosion and flooding. Freezing rain and ice storms typically occur once every several years at coastal locations and severe snowstorms have been recorded occasionally in coastal areas.

According to the South Carolina Climatology Office, between 1960 and 2015, Horry County experienced $512,573 in annualized losses. In addition to monetary damages, there were five deaths and 2 injuries associated with severe winter weather events. The National Centers for Environmental Information reports four severe winter storm/winter weather events between 1950 and 2020. Although there are no damages associated with these events, property damage and crop damages may be underreported to NCEI.

December 23-24, 1989: Winter storms caused 14 inches of snowfall in Myrtle Beach. Gale force winds, gusting up to 60 mph, produced waves up to 34 feet high off the coast of and whipped the snow into drifts up to 8 feet high. Ice and snow caused traitorous conditions on the streets. Power outages lasted several hours. There was no major property damage reported nor were there any deaths or injuries as a result of the storm.

January 28, 2014**:** Freezing rain began falling the afternoon of Jan 28th, changed over to mostly sleet in the evening and overnight hours, and tapered off to flurries the morning of the 29th. Total ice accumulations ranged from a tenth to a half inch, and sleet accumulations along the coast were also about a half inch. Due to the nature of the precipitation, power outages were isolated, however driving was treacherous. Numerous traffic accidents were reported as well as injuries due to slips and falls.

February 11, 2014: Freezing rain began falling the morning of February 11th. The freezing rain continued intermittently before ending the morning of the 13th. Ice accumulations ranged from half an inch up to an inch. Driving conditions were treacherous and there were numerous power outages due to falling limbs and power lines.

February 24, 2015: Freezing rain fell across the county, including the coast, with one to two tenths of an inch of ice accumulation reported, mainly on trees and metal surfaces.

January 3, 2018: Snow began falling by early afternoon on January 3rd. Two inches of snow had fallen by 7 pm, and the totals for the event ranged from a trace to a half inch. A quarter inch of ice fell north of Myrtle Beach. The low pressure responsible for the winter weather bombed off the east coast, dropping 24 millibars in twenty-four hours. Record cold preceded and followed the event, lasting until January 8th.

Severe winter storms generally do not cause major damages to public facilities or private property. However, they do not occur very frequently although their impact is generally of a short duration. For these and a variety of other reasons, winter storms have been ranked as

a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.10 Drought

Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, which usually lasts a season or longer. High temperatures, high winds, and low humidity can exacerbate drought conditions. In addition, human actions and demands for water resources can hasten drought-related impacts. Prolonged drought events may also lead to more severe wildfires.

Droughts are typically classified into one or four types: 1) meteorological, 2) hydrologic, 3) agricultural or 4) socioeconomic. **Table 3.20** presents definitions for these types of droughts.

TABLE 3.20: DROUGHT CLASSIFICATION DEFINITIONS

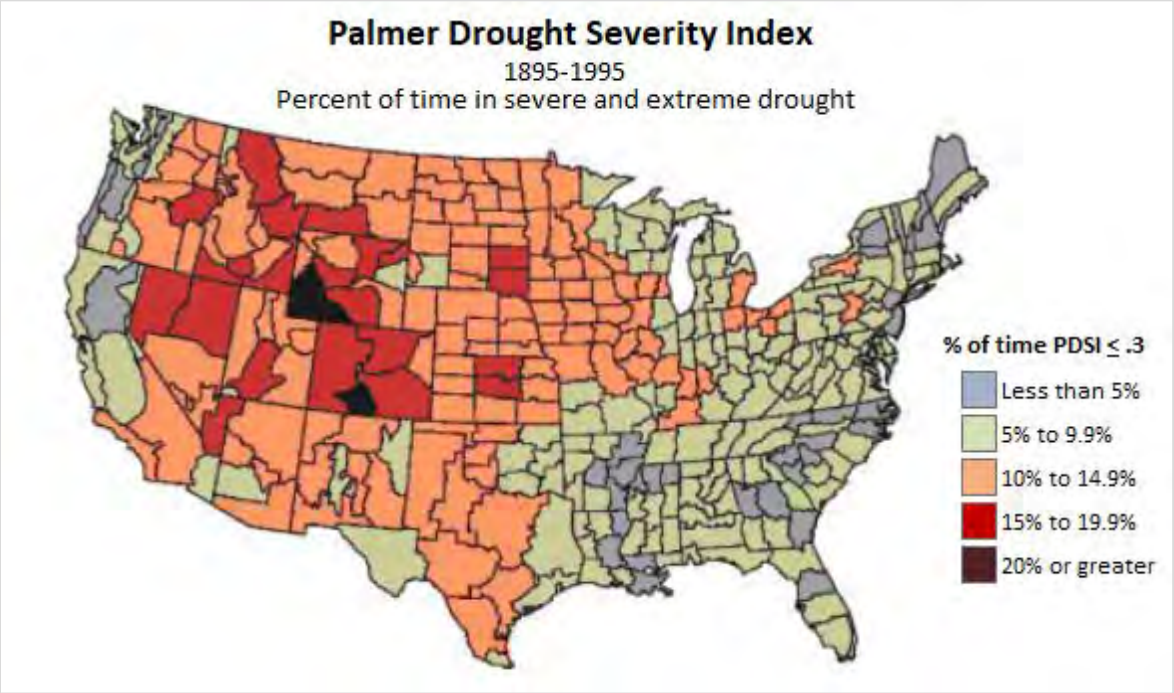
Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
Agricultural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

Source: Multi-hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, Federal Emergency Management Agency

Droughts are slow onset hazards, but, over time, can have very damaging affects to crops, municipal water supplies, recreational uses, and wildlife. If drought conditions extend over a number of years, the direct and indirect economic impact can be significant.

The Palmer Drought Severity Index (PDSI) is based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). Evident in **Figure 3.24**, the Palmer Drought Severity Index Summary Map for the United Stated, drought affects most areas of the United States, but is less severe in the Eastern United States.

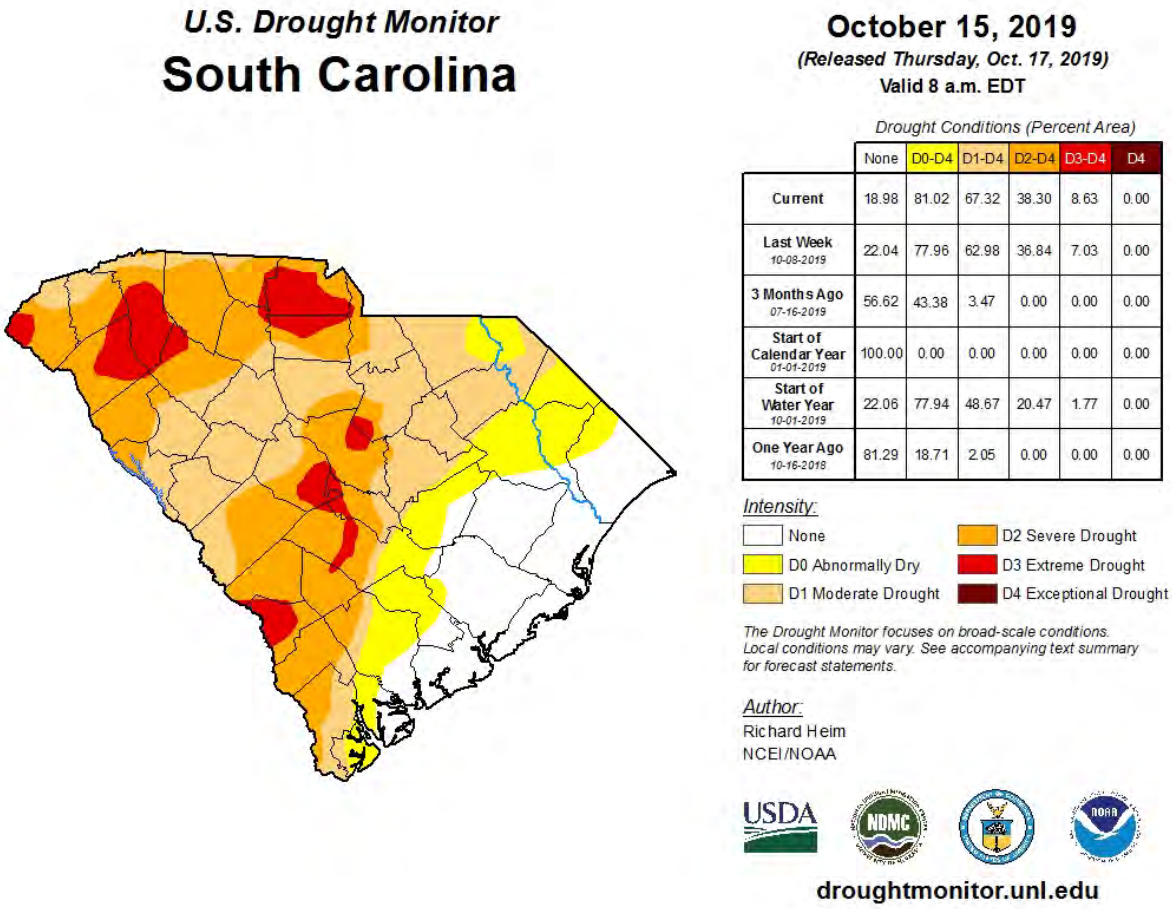
FIGURE 3.24: PALMER DROUGHT SEVERITY INDEX SUMMARY MAP FOR THE UNITED STATES



Source: National Drought Mitigation Center

The figure above is the most update version of the Palmer Drought Severity Index; however, the US Drought Monitor is updated on a weekly basis. An archived map from October 2019 can be seen below in **Figure 3.25** to reflect more current drought conditions in South Carolina.

FIGURE 3.25: SOUTH CAROLINA DROUGHT MONITOR



Source: US Drought Monitor

Historical Occurrences

The US Drought Monitor also reports data on South Carolina drought conditions from 2000 to 2019 through the North Carolina Drought Monitor. It classifies drought conditions using the scale set by the US Drought Monitor, which classifies conditions on a scale of D0 to D4. Each class is further explained in **Table 3.21**.

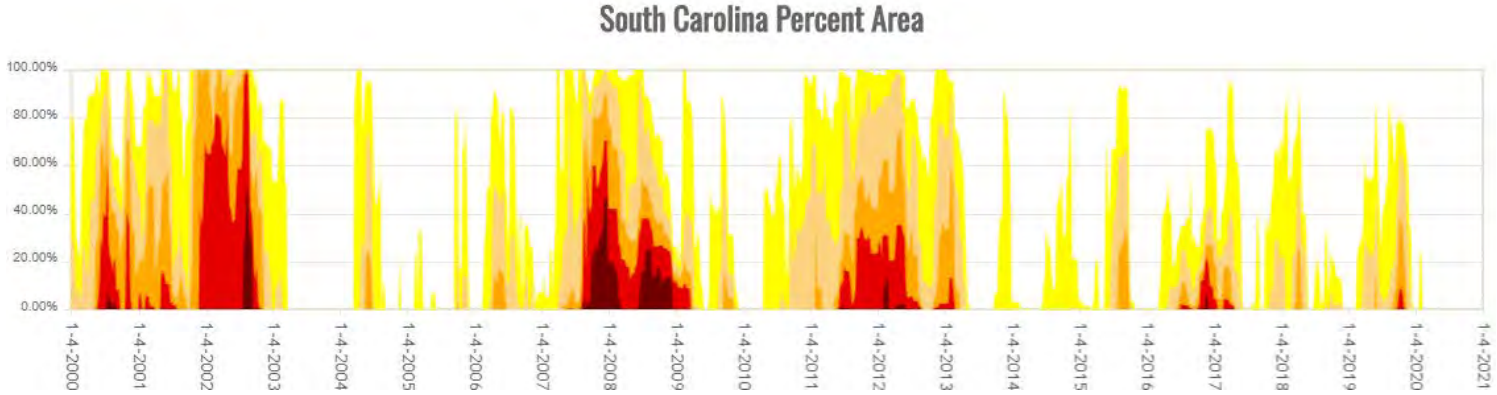
TABLE 3.21: USDM DROUGHT CLASSIFICATION

Scale	Description	Impacts
D0	Abnormally Dry	- Short-term dryness slowing planting, growth of crops - Some lingering water deficits - Pastures or crops not fully recovered
D1	Moderate Drought	- Some damage to crops, pastures - Some water shortages developing - Voluntary water-use restrictions requested

Scale	Description	Impacts
D2	Severe Drought	- Crop or pasture loss likely - Water shortages common - Water restrictions imposed
D3	Extreme Drought	- Major crop/pasture losses - Widespread water shortages or restrictions
D4	Exceptional Drought	- Exceptional and widespread crop/pasture losses - Shortages of water creating water emergencies

South Carolina experienced one of its worst multiyear droughts on record during the period from June 1998 to August 2002. The extent of this drought can be seen below in **Figure 3.26**. Average precipitation was 10-30 percent below normal during the drought. Stream flows were at historic lows throughout the State, threatening water-supply intakes and causing saltwater intrusion in coastal areas. Lakes were being drained to perilously low levels in order to sustain water demands, downstream flows and to prevent saltwater intrusion from contaminating supply intakes in the Grand Strand area. Ground- water levels in shallow and deep aquifers dropped to record lows. Pumps in municipal and domestic wells had to be lowered, wells had to be deepened and, in some cases, new wells had to be drilled to keep pace with declines. Ground water levels in some areas of the State declined to the point that streams were losing water to the ground, the reverse of what normally occurs.

FIGURE 3.26: PERCENT AREA OF DROUGHT EXTENT (2000 – 2020)



Source: US Drought Monitor

According to the South Carolina Drought Monitor, Horry County had drought occurrences (including abnormally dry) in all of the last 19 years (2000 – 2019) (**Table 3.22**). It should be noted that the South Carolina Drought Monitor also estimates what percentage of the county is in each classification of drought severity. For example, the most severe classification reported may be exceptional, but a majority of the county may actually be in a less severe condition.

TABLE 3.22: SUMMARY OF DROUGHT OCCURRENCES IN HORRY COUNTY

Year	Horry County
2019	Moderate Drought
2018	Moderate Drought
2017	Moderate Drought
2016	Abnormally Dry
2015	Moderate Drought
2014	Abnormally Dry
2013	Moderate Drought
2012	Extreme Drought
2011	Extreme Drought
2010	Moderate Drought
2009	Severe Drought
2008	Extreme Drought
2007	Extreme Drought
2006	Abnormally Dry
2005	Abnormally Dry
2004	Abnormally Dry
2003	Abnormally Dry
2002	Extreme Drought
2001	Extreme Drought
2000	Moderate Drought

Source: South Carolina Drought Monitor

Drought impacts are also compounded by population increases that have taken place during the past 50 years. The population will continue to grow and the demand for water will correspondingly increase, but the amount of water that is available will remain essentially the same.

According to the South Carolina Water Plan (200$) surface water and ground water are connected hydraulically, but their interaction is often overlooked in water-resource management considerations. During dry periods, stream flows and lake levels are maintained by discharged ground water; at other times, aquifers are recharged when water seeps from lakes and streams into the ground. Because many natural processes and human actions affect this interaction, it is important for water managers to consider ground water and surface water as a single resource.

When water enters a watershed, it becomes part of the total water budget for that watershed, whether it flows on the surface or below it. In a typical year, about 56 inches of water (averaged over the State) comes into South Carolina from all sources. Precipitation is the source of about 48 inches, or 85 percent of the total, and stream flow from North Carolina accounts for the remaining 8 inches.

Loss of water from the State occurs primarily through evapotranspiration (the conversion of liquid into vapor by the processes of evaporation and transpiration) and discharge from streams into the ocean. In an average year, 34 inches of water are evapotranspiration, 21

inches are discharged into the ocean from streams, and less than 1 inch is discharged into the ocean from aquifers.

The availability of water, especially surface water, is strongly influenced by seasonal variations in precipitation and evapotranspiration. Ground-water supplies are also subject to seasonal variation and decline due to prolonged drought, but usually to a lesser degree than surface-water supplies. Ground- water levels lowered during the summer and fall, the result of both increased pumping and reduced recharge, usually recover during the winter and spring, owing to increased aquifer recharge and reduced pumping. Multiyear droughts lower aquifer water levels by limiting the recharge that normally occurs during the wet winter and spring months.

Although ground water is a renewable resource, pumping water from wells at rates that exceed natural replenishment will deplete the resource and cause ground water levels to decline. Consequences of over pumping include reductions in well yield, increased pumping costs, reduced flow rates in streams, altered ground water flow patterns, water-level declines in lakes and wetlands, land subsidence, sinkholes, and saltwater intrusion.

Cones of depression develop where aquifers are stressed by pumping. When water is pumped from a well, it is replaced with water from the aquifer. As pumping continues, water levels in the aquifer continue to decline and take on the shape of an inverted cone, the apex of which is centered at the well. Water levels are at their deepest near the well and gradually become shallower away from the well. Deep and aerially extensive cones of depression often develop where excessive, long-term pumping occurs.

Cones of depression can impact large areas, affect hundreds of well owners, and can take decades to recover. Although cones of depression are reversible and reduced pumping will result in a return to higher water levels, significant over pumping of an aquifer can also cause permanent damage to the aquifer or the overlying land. The water level in a confined aquifer can decline to a point at which the increased stress on the aquifer system causes a rearrangement of the grains that form the aquifer skeleton, resulting in an irreversible reduction in the aquifer's water-storing capacity. Excessive pumping can also lead to the dewatering of clay layers within the aquifer system, which can cause land subsidence. This is of particular concern in South Carolina because of the large number of clay beds in the Coastal Plain aquifer systems.

North Myrtle Beach Area

Over pumping has caused significant regional water-level declines in nearly half (13) of the counties in the Coastal Plain, including Horry. However, future impacts will most likely be negligible since the City of North Myrtle Beach and neighboring communities are making changes in their water supply source. In 1991 the City received its first water from a new water treatment plant built by the City of Myrtle Beach. The water is then pumped to North Myrtle Beach through approximately six (6) miles of transmission mains.

For these and a variety of other reasons, droughts have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.11 Earthquake

What Is An Earthquake?

Earthquakes are geologic events that involve movement or shaking of the earth's crust. Earthquakes are usually caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the earth's outer crust. These fault planes are typically found along borders of the earth's 10 tectonic plates.

The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of Earth's tectonic plates. The severity of these effects is dependent on the amount of energy released from the fault or epicenter. The effects of an earthquake can be felt far beyond the site of its occurrence. They usually occur without warning and after just a few seconds can cause massive damage and extensive casualties.

The variables that characterize earthquakes are ground motion, surface faulting, ground failure, and seismic activity. Ground motion is the vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions.

Surface faulting is the differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.

Liquefaction is the phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop on gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil supporting structures liquefies. This can cause structures to tip and topple.

Measurement:

Earthquakes are measured in terms of their magnitude and intensity. There are several different scales that are commonly used, including Richter Magnitude (**Table 3.23**), Modified Mercalli Intensity (MMI) (**Table 3.24**), Moment Magnitude and Peak Ground Acceleration (PGA) (**Figure 3.27**), among others.

Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that

describes the energy release of an earthquake through a measure of shock wave amplitude. Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 244-fold increase in energy.

Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale. It is a twelve-level scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using Roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction).

The Global Earthquake Model Global Hazard Map depicts the geographic distribution of the Peak Ground Acceleration (PGA) with a 10% probability of being exceeded in 50 years. The data represents the probability that the ground motion will reach a certain level during an earthquake. The map was created by collating maps computed using national and regional probabilistic seismic hazard models developed by various institutions and projects, and by GEM Foundation scientists. This indicates that the region as a whole exists within an area of low to moderate seismic risk.

TABLE 3.23: RICHTER SCALE

Richter Magnitudes	Earthquake Effects
< 3.5	Generally, not felt, but recorded.
3.5 – 5.3	Often felt, but rarely causes damage.
5.4 – 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 – 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 – 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: Federal Emergency Management Agency

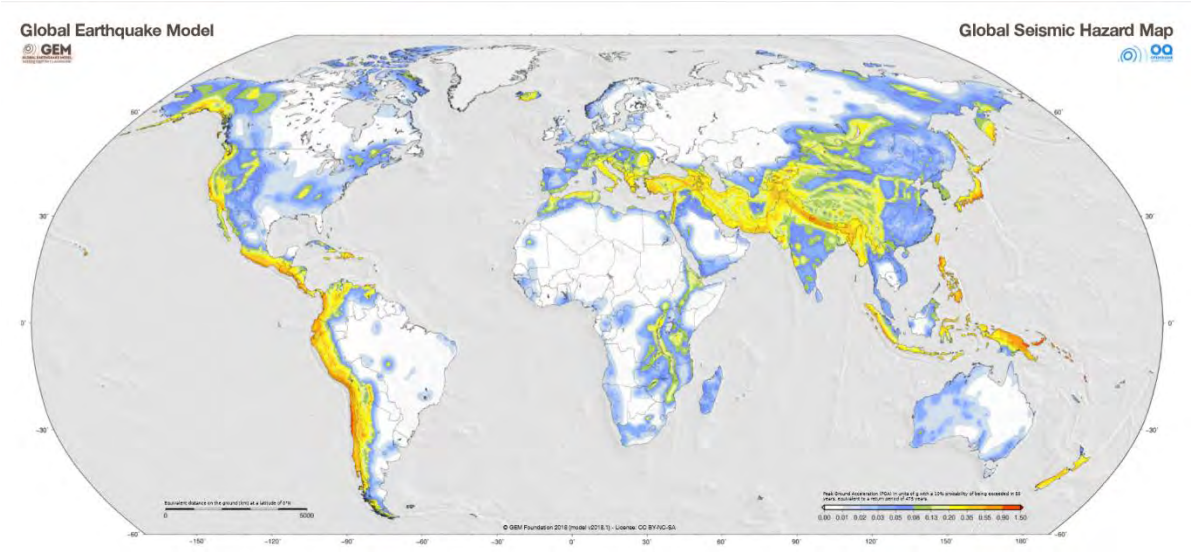
TABLE 3.24: MODIFIED MERCALLI SCALE OF EARTHQUAKE INTENSITY

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	Corresponding Richter Scale
I	Instrumental	Not felt except by a very few under especially favorable conditions.	<10	
II	Feeble	Felt only by a few persons at rest, especially on upper floors of buildings.	<25	<4.2
III	Slight	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.	<50	

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	Corresponding Richter Scale
IV	Moderate	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.	<100	
V	Slightly Strong	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.	<250	<4.8
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	<500	<5.4
VII	Very Strong	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.	<1000	<6.1
VIII	Destructive	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.	<2500	
IX	Ruinous	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.	<5000	<6.9
X	Disastrous	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	<7500	<7.3
XI	Very Disastrous	Not felt except by a very few under especially favorable conditions.	<9800	<8.1
XII	Catastrophic	Felt only by a few persons at rest, especially on upper floors of buildings.	>9800	>8.1

Source: Federal Emergency Management Agency

FIGURE 3.27: PEAK ACCELERATION WITH 10 PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS

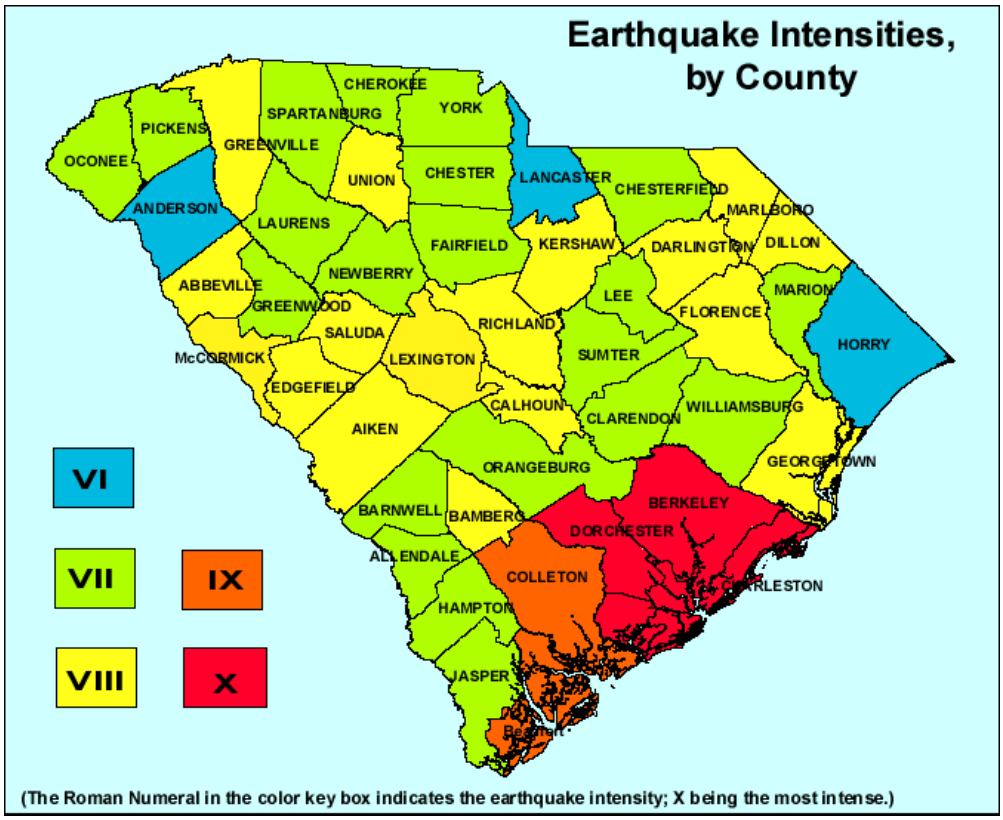


Source: Global Earthquake Model, 2018

Earthquakes in South Carolina:

Earthquakes are relatively infrequent but not uncommon in South Carolina. Epicenters of South Carolina earthquakes are generally concentrated in the active Eastern Tennessee Seismic Zone, which is second in activity in the eastern United States only to the New Madrid Fault. The Eastern Tennessee Seismic Zone is part of a crescent of moderate seismic activity risk extending from Charleston, South Carolina northwestward into eastern Tennessee and then curving northeastward into central Virginia. While there have not been any earthquakes with a MMI intensity greater than IV since 1928 in this area, it has the potential to produce an earthquake of significant intensity in the future. A projected earthquake intensity map produced by South Carolina Department of Natural Resources is shown in **Figure 3.28**.

FIGURE 3.28: ESTIMATED EARTHQUAKE INTENSITY



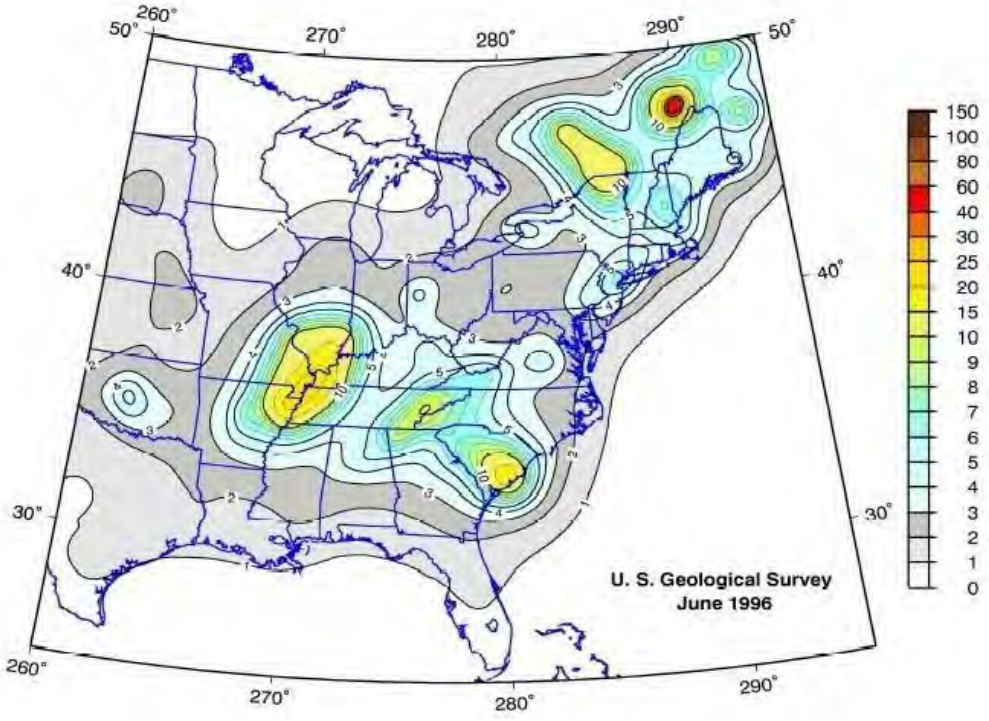
Source: SCDNR

August 31, 1886: Most violent earthquake (7.3 Richter) to affect Horry County and North Myrtle Beach. The earthquakes initial tremors occurred at 9:50 PM, with aftershocks at 10:00 PM, 10:12 PM, and 10:25 PM. The epicenter was in Charleston South Carolina. Though the MMI scale is an 11 and would list this event as a very disastrous event, the damage reported in North Myrtle Beach was minimal.

2012 – 2017: Numerous minor earthquakes have been registered, including eight in 2009, two in 2010, and ten in 2011. The highest of these registered earthquakes is a 3.2 on the Richter Scale that originated around Summerville, Dorchester County. The August 23, 2011 major earthquake in central Virginia was felt widespread in South Carolina, with reports of buildings shaking in Greenville, Georgetown, Myrtle Beach and Rock Hill. Several buildings in downtown Columbia were evacuated; this was a Magnitude 5.8 event.

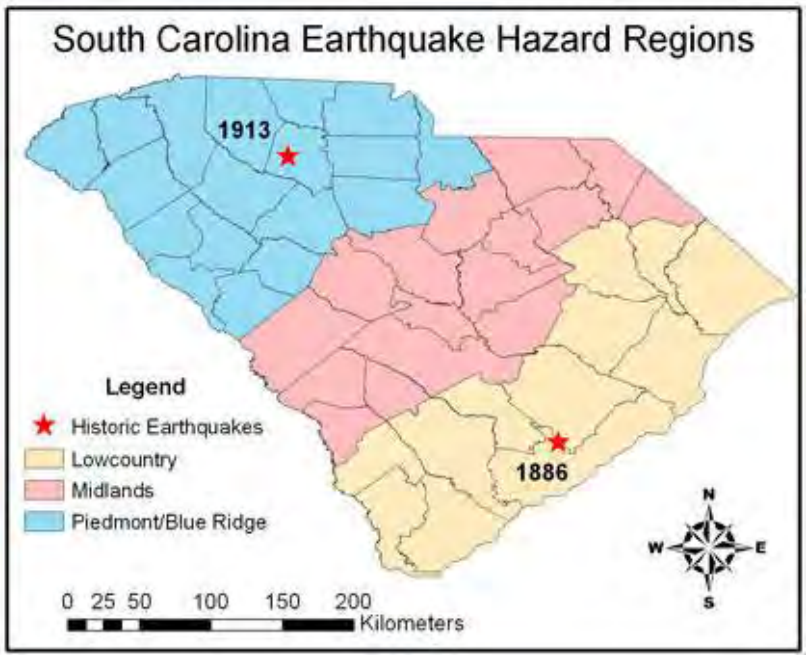
February 14, 2014: A 4.1 magnitude earthquake at 10:23 p.m. with the epicenter near Edgefield. Tremors were felt across the state but no major damage or injuries were reported.

FIGURE 3.29: PEAK ACCELERATION (%G) WITH 10% PROBABILITY OF EXCEEDANCE IN 50 YEARS



Source: United States Geological Survey

FIGURE 3.30: EARTHQUAKE REGIONS AND MAJOR HISTORIC EPICENTERS



Source: South Carolina Earthquake Education and Preparedness Program

According to the National Centers for Environmental Information, at least 14 earthquakes have known to have affected Horry County since August 1, 1886. The strongest of these measured a 6 on the Modified Mercalli Intensity (MMI) scale. **Table 3.25** provides a summary of earthquake events reported by the National Geophysical Data Center between 1638 and 1985.

TABLE 3.25: SUMMARY OF SEISMIC ACTIVITY IN HORRY COUNTY

Location	Number of Occurrences	Greatest MMI Reported	Richter Scale Equivalent
Atlantic Beach	0	n/a	
Aynor	1	4	<4.5
Briarcliffe Acres	0	n/a	
Conway	4	6	unknown
Loris	0	n/a	
Myrtle Beach	4	5	<4.7
North Myrtle Beach	1	3	<4.5
Unincorporated Area	4	6	unknown
Horry County Total	**14**	**n/a**	**n/a**

Source: National Centers for Environmental Information

Earthquakes have the potential to cause major damages to both public facilities and private property; however, they do not occur very frequently. For these and a variety of other reasons, earthquakes have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.12 Tsunami

A Tsunami is defined as a large seismic wave, impulsively generated by shallow- focus, underwater earthquakes. A Tsunami wave can travel unnoticed across the ocean at speeds of up to 500 mph and, upon connection with a coastline, can cause significant damage to shore protection structures, buildings, as well as, severe erosion, extensive inland flooding and loss of life (FEMA 1997).

Significant damage as a result of Tsunamis has been identified in the Western States of Alaska, Hawaii and American Samoa. In the Atlantic Ocean and Caribbean Sea, events have occurred in the vicinity of Puerto Rico and the U.S. Virgin Islands, but are much less frequent.

North Myrtle Beach is at a very slight risk for tsunamis. A tsunami is a series of ocean waves started by a sudden displacement of ocean water, usually by an earthquake. A tsunami's waves rapidly travel in all directions away from the disturbance and can spread across entire ocean basins. They can also be caused by volcanic eruptions, landslides, undersea slumps, or even meteorites. The best information available indicates two possible scenarios for North Myrtle Beach concerning its tsunami risk. The first threat is from a 9.0 magnitude earth quake along the Puerto Rico Trench. The tsunami could have a wave height of 1.4 meters (4-5 feet) and reach the North Myrtle Beach coast in about 4-5 hours.

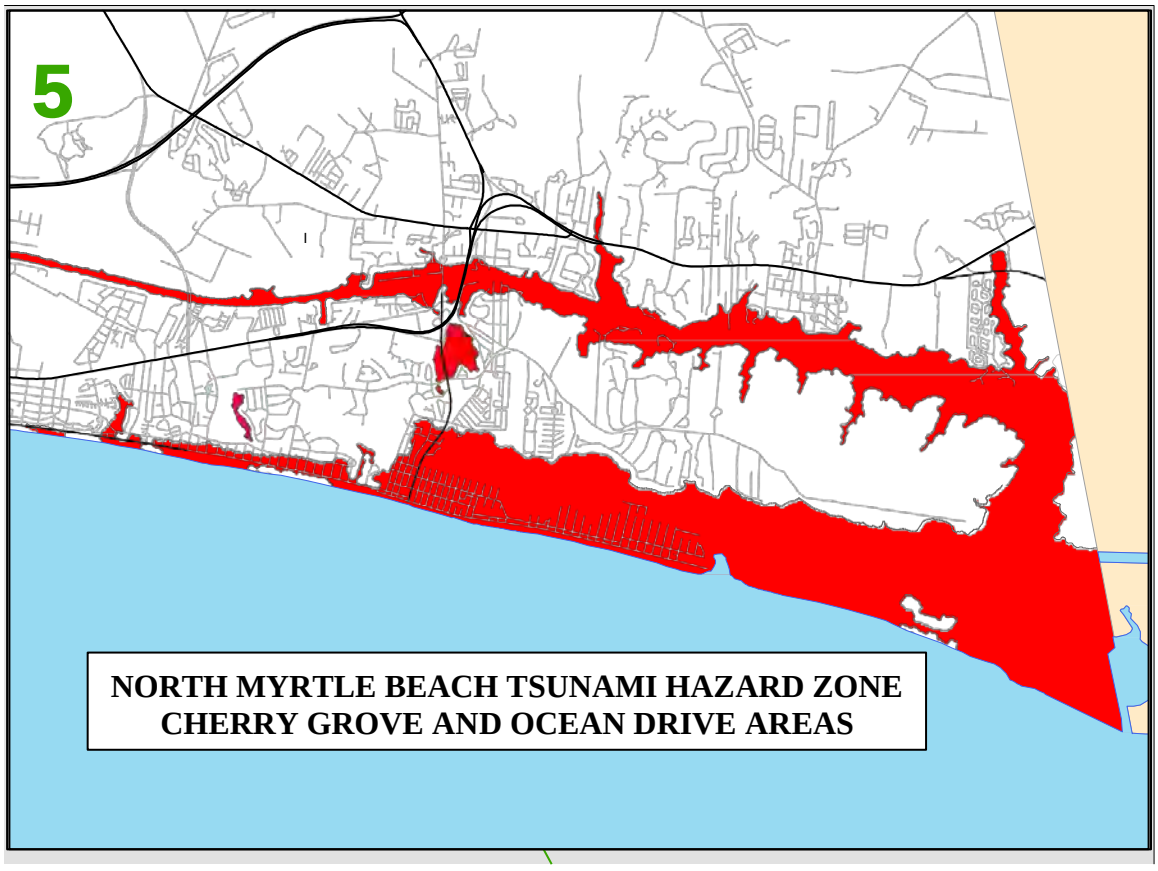
Less is known about the second scenario, which would be a tsunami generated by a

submarine landslide of the east coast of the US. This scenario depending on the location of the occurrence could shorten the arrival time of the tsunami. In addition, the wave heights could be much greater.

The greatest risk during a tsunami is the immediate coast-line, where throughout the year many visitors populate the beach. During summer months, there may be over 100,000 people on the beach at any given time throughout the day. During the off-season, or winter months, that number decreases to approximately several thousand people on the beach at any given time.

Figures 3.31 through 3.33 depict areas of expected inundation in the event of a tsunami. These figures were provided by Horry County Emergency Services.

FIGURE 3.31: CHERRY GROVE AND OCEAN DRIVE TSUNAMI ZONE



Source: Horry County Emergency Services

FIGURE 3.32: CRESCENT BEACH TSUNAMI ZONE

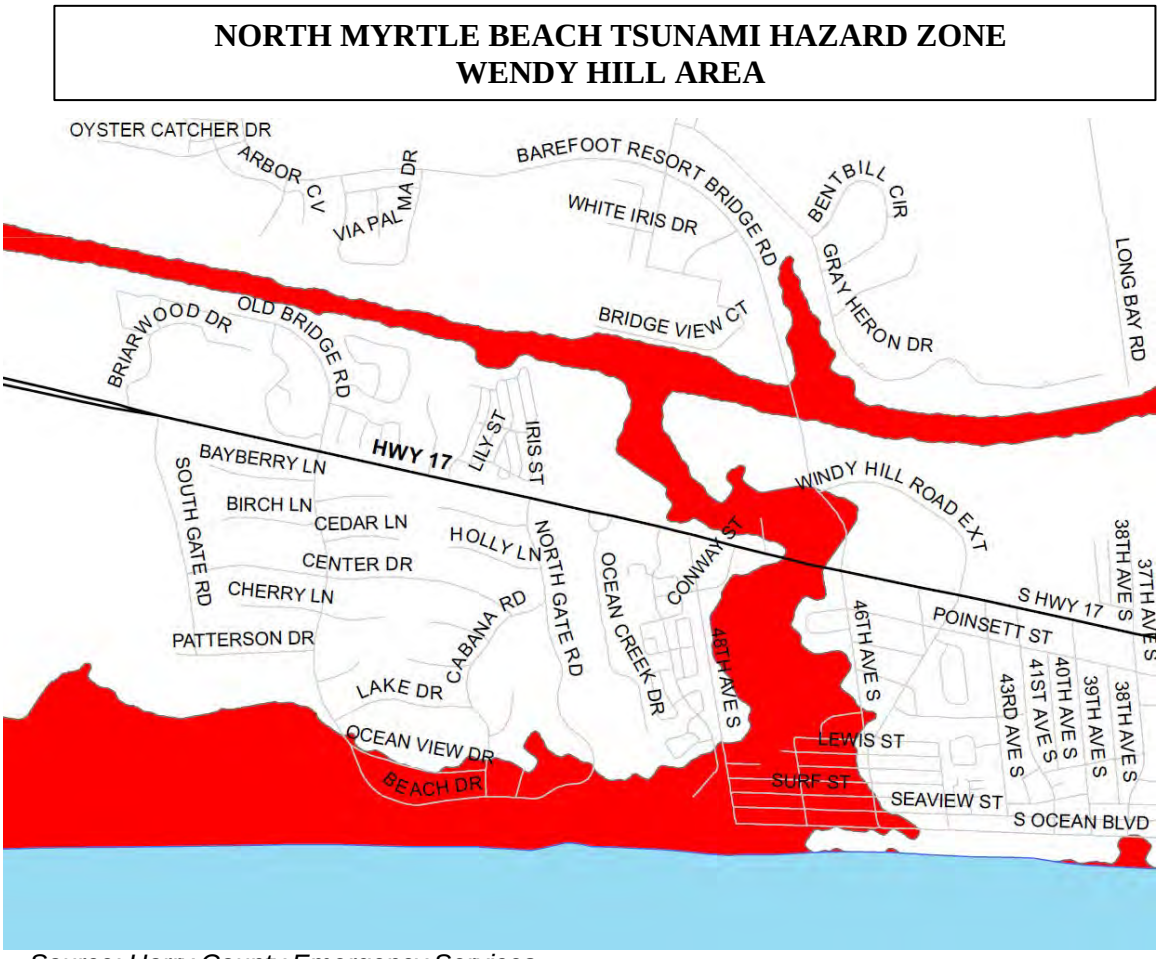
NORTH MYRTLE BEACH TSUNAMI HAZARD ZONE
CRESCENT BEACH AREA

Source: Horry County Emergency Services

To avoid the dangerous tsunami waves the City and County Tsunami Action Plans recommend, people both residents and visitors who may be located in the risk area along the coast-line "will need to evacuate inland at minimum 300 feet and/or 15 feet vertically prior to the arrival of tsunami waves".

The prompt and effective evacuation of high-risk areas requires the cooperation and coordination of the Horry County and the North Myrtle Beach Public Safety Departments. Horry County Emergency Management Department will assist in coordinating this effort.

FIGURE 3.33: WINDY HILL TSUNAMI ZONE



Source: Horry County Emergency Services

An examination of the tsunami inundation maps indicates the City and County should extend the evacuation zone in the Cherry Grove area. See the above map and the maps on the previous two pages.

While a tsunami event is highly unlikely, now is the time to plan to ensure the lives of resident and visitors are saved. The City has been designated a Tsunami Ready Community by the National Weather Service.

Additionally, the City has prepared a Tsunami Annex to its Emergency Operations Plan. The Annex is a good start; however, it could be improved by:

- Evaluating the warning evacuation zones.
- Describing how the warning will be disseminated to the public.
- Preparing pre-scripted warning messages.
- Identifying evacuation routes.
- Identifying buildings that will be used for vertical evacuations.
- Identifying how critical facilities will be warned.

- Describing how the “all clear” message will be disseminated.

Tsunamis have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.13 Sinkholes

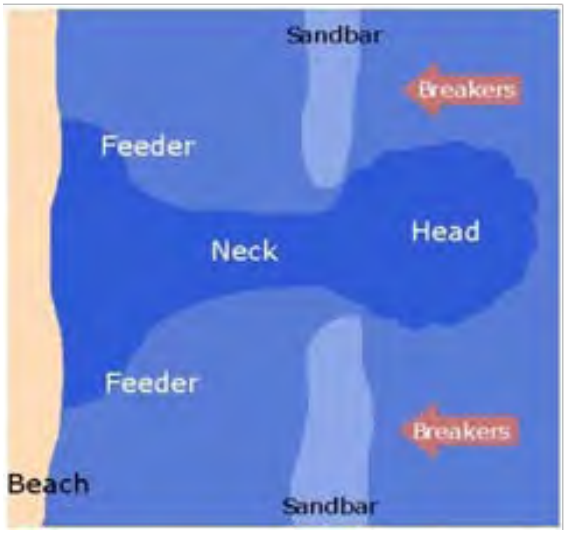
Collapse sinkholes form with little warning and leave behind a deep, steeply sided hole. They occur because of weakening of the rock of the aquifer by erosion and are often triggered by changes in water levels in the surficial aquifers. The development of collapse sinkholes can be triggered by natural conditions as well as human interference such as dredging, constructing reservoirs, diverting surface water, and pumping groundwater.

According to the USGS, the most damage in the United States from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. North Myrtle Beach has a low probability of having sinkholes. For these and a variety of other reasons, sinkholes have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.14 Rip Currents

A rip current is an extremely dangerous hazard, killing approximately 100 people each year (according to the National Weather Service). Rip currents form in the surf-zone as waves disperse. According to the NOAA, waves break on the sandbar, move towards the beach and then return to the ocean through a channel. Water becomes trapped between the beach and the sandbar, causing the water to move away from the beach in a narrow, river-like channel. There are three parts to a rip current: 1) the feeder, 2) the neck, and 3) the head. A rip current diagram can be seen in **Figure 3.34** below.

FIGURE 3.34: RIP CURRENTS DIAGRAM



Source: NOAA

The feeder current flows parallel to the shore, converging at the neck and flowing, as a rip current, towards the head. At the head, the current expands and releases slack. Rip

currents are typically mushroom-shaped and brown in color due to sand being picked up. However, some may have no color at all. Rip currents also vary in size and shape.

According to the National Oceanic and Atmospheric Administration, there are four different types of rip currents including traveling, fixed, permanent, and flash.

- **Flash**: A flash current is short in duration (less than 10 minutes) and is enhanced by large swell. This causes unpredictable conditions where they occur.
- **Permanent:** This type of rip current develops along jetties, groins, and piers
- **Fixed:** These rip currents are dependent upon the shape of bays, coasts, reefs, or sandbars.
- **Traveling:** This type of rip current forms along long beach currents which run parallel to the beach. The long beach current pushes the rip away from its original location, weakening it.

Rip currents form along coastal areas in large bodies of water including oceans and the Great Lakes. The coastal area along North Myrtle Beach is uniformly at-risk to rip currents. Further, this area is equally susceptible to any of the four types of rip currents.

A total of nineteen (19) rip current events have been documented by the National Centers for Environmental Information for Horry County from 2004 to 2018 resulting in eighteen (18) deaths and one (1) injury.

This hazard occurs naturally along the shorelines of the North Myrtle Beach area. Inclement weather conditions may hasten the severity of this hazard. This is a very dangerous natural hazard in North Myrtle Beach that, unlike other hazards, only affects life instead of property.

Rip currents have been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.15 Hazardous Materials

Hazardous materials can be found in many forms and quantities that can potentially cause death, serious injury, long-lasting health effects and damage to buildings, homes and other property in varying degrees. Such materials are routinely used and stored in many homes and businesses and are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This subsection on the hazardous material hazard is intended to provide a general overview of the hazard, and the threshold for identifying fixed and mobile sources of hazardous materials is limited to general information on rail, highway, and FEMA-identified fixed HAZMAT sites determined to be of greatest significance as appropriate for the purposes of this plan.

Hazardous materials (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation's highways, and on the water. Approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway

incidents, 991 on railroad incidents and 266 are due to other causes.[3] In essence, HAZMAT incidents can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and possibly wildlife as well.

HAZMAT incidents can also occur as a result or of in tandem with natural hazard events, such as floods, hurricanes, tornadoes and earthquakes, which in addition to causing incidents can also hinder response efforts. In the case of Hurricane Floyd in September 1999, communities along the Eastern United States were faced with flooded junkyards, disturbed cemeteries, deceased livestock, floating propane tanks, uncontrolled fertilizer spills, and a variety of other environmental pollutants that caused widespread toxological concern.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, special nuclear material from a nuclear accident; and (4) the normal application of fertilizer.

As a result of the 1986 Emergency Planning and Community Right to Know Act (EPCRA), the Environmental Protection Agency provides public information on hazardous materials. One facet of this program is to collect information from the industrial facilities on the releases and transfers of certain toxic agents. This information is then reported in the Toxic Release Inventory (TRI). TRI sites indicate where such activity is occurring. The City of North Myrtle Beach has no TRI sites.

In addition to “fixed” hazardous materials locations, hazardous materials may also impact the region via roadways and rail. Many roads in the region are narrow and winding, making hazardous material transport in the area especially treacherous. All roads that permit hazardous material transport are considered potentially at risk to an incident.

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) is an agency of the United States Department of Transportation that was established in 2004. The PHMSA maintains a database of hazardous materials incidents for communities across the United States. A “serious incident” is a hazardous incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,

[3] FEMA, 1997.

- a release or exposure to fire which results in the closure of a major transportation artery, the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

However, prior to 2002, a hazardous material "serious incident" was defined as follows:

- a fatality or major injury due to a hazardous material,
- closure of a major transportation artery or facility or evacuation of six or more person due to the presence of hazardous material, or
- a vehicle accident or derailment resulting in the release of a hazardous material.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) is an agency of the United States Department of Transportation that was established in 2004. The PHMSA maintains a database of hazardous materials incidents for communities across the United States. There is only one (1) reported hazardous materials incident in North Myrtle Beach. The incident caused one hundred and fifteen ($115) dollars in damages, but no injuries or fatalities were reported.

Hazardous materials incidents have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.16 Public Health Hazards/Infectious Disease

Infectious Disease

Communicable, or infectious, diseases are conditions that result in clinically evident illness which are transmissible directly from one person to another or indirectly through vectors such as insects, air, water, blood, or other objects. The impact of communicable disease can range from the mild effects of the common cold to the extreme lethality of pneumonic plague or anthrax. The public health system in the United States was developed in large part as a response to the often urgent need to respond to or prevent outbreaks of communicable diseases. Through public health methods of disease reporting, vaccinations, vector control, and effective treatments; most communicable diseases are well controlled in the United States and in North Myrtle Beach. However, control systems can fail and when people come together from locations outside of the state, outbreaks can occur, even in the most modern of communities. In this section, some of the more significant potential communicable disease concerns are described.

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

diseases have not (yet) mutated into a form that can infect humans, or otherwise lie dormant in nature.

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

Other communicable diseases pose a much more frequent threat to the citizens of in the region. Some of the infectious diseases of greatest concern include influenza, particularly in a pandemic form, as well as norovirus, and multiple antibiotic-resistant tuberculosis. Even in one of its normal year-to-year variants, influenza (commonly referred to as “flu”) can result in serious illness and even death in young children, and elderly and immune-compromised persons. But there is always the potential risk of the emergence of influenza on one of the pandemic H1N1 from, such as the “Spanish” outbreak of 1918-1919, which killed over 50 million people worldwide. Every year, South Carolina sees hundreds of cases of influenza, leading to hundreds of hours of lost productivity in businesses due to sick employees. Of note, a vaccine for influenza is produced every year and, according to the CDC, is highly effective in preventing the disease.

Norovirus is recognized as the leading cause of foodborne-disease outbreaks in the United States. The virus can cause diarrhea, vomiting, and stomach pain, and is easily spread from person to person through contaminated food or water, and by surface-to-surface contact. Especially vulnerable populations to this virus include those living or staying in nursing homes and assisted living facilities and other healthcare facilities, such as hospitals. Norovirus could also be a threat in the event of large public gatherings such as: sporting events, concerts, festivals, and so forth. No vaccine or treatment exists for Norovirus, making it especially dangerous for the public in the event of an outbreak.

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

Vector-Borne Disease

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

The most common vector-borne diseases found in South Carolina are carried by ticks and mosquitoes. The tick-borne illnesses most often seen in the state are Rocky Mountain Spotted Fever, ehrlichiosis, Lyme disease and Southern Tick-Associated Rash Illness (STARI). The most frequent mosquito-borne illnesses, or "arboviruses," in South Carolina include La Crosse encephalitis, West Nile virus and Eastern equine encephalitis.

Extent is difficult to measure for an infectious disease event as the extent is largely dependent on the type of disease and on the effect that it has on the population (discussed above). Extent can be somewhat defined by the number of people impacted, which depending on the type of disease could number in the tens of thousands within the state. Information from the South Carolina Department of Health and Environmental Concern was used to monitor and track cases of the infectious disease COVID-19. A COVID-19 Pandemic disaster declaration was declared for South Carolina on March 24th, 2020. As of April 9, 2021, Horry County has reported 37,344 cases and 559 deaths from COVID-19.

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

Public health hazards/infectious disease has been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

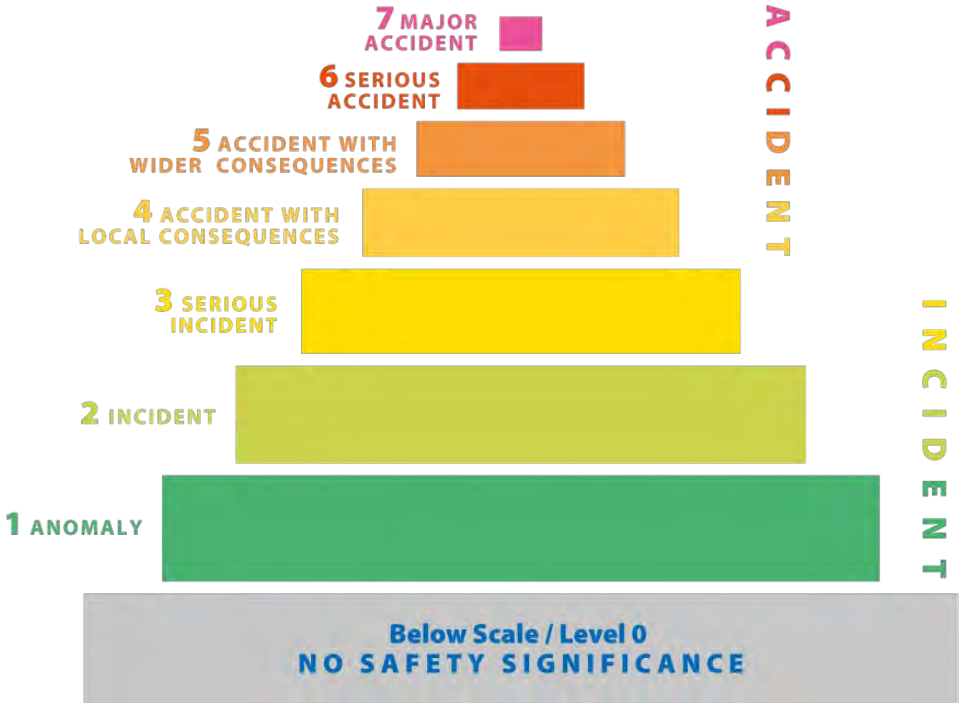
3.2.17 Nuclear Power Plants

A nuclear and radiation accident is defined by the International Atomic Energy Agency as "an event that has led to significant consequences to people, the environment or the facility. Often, this type of incident results from damage to the reactor core of a nuclear power plant which can release radioactivity into the environment. The degree of exposure from nuclear accidents has varied from serious to catastrophic. While radiological emergencies generally are a rare occurrence, many incidents are extremely well known due to their large-scale impact and serious effects on people and the environment.

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

The International Atomic Energy Association has developed a scale called the International Nuclear and Radiological Event Scale (INES) which provides a quantitative means of assessing the extent of a nuclear event. This scale, like the MMI used for earthquakes, is logarithmic which means that each increasing level on the scale represents an event 10 times more severe than the previous level (**Figure 3.35**).

FIGURE 3.35: INTERNATIONAL NUCLEAR EVENT SCALE



Source: International Atomic Energy Agency

Although there has been no major nuclear event at the Brunswick Nuclear Power Plant there is some possibility that one could occur as there have been incidents in the past in the United States at other facilities and at facilities around the world. A nuclear event is a very rare occurrence in the United States due to the intense regulations of the industry.

Nuclear power plant incidents have been ranked as a moderate-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

3.2.18 Terrorism

Terrorism is defined in the United States by the Code of Federal Regulations is "the unlawful use of force or violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance of political or social objectives." Terrorist acts may include assassinations, kidnappings, hijackings, bombings, small arms attacks, vehicle ramming attacks, edged weapon attacks, incendiary attacks, cyber-attacks (computer based), and the use of chemical, biological, nuclear and radiological weapons. For the purposes of this plan, cyber-attacks are included as a separate hazard.

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

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

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

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

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

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

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

All parts of South Carolina are vulnerable to a terror event; however, terrorism tends to target more densely populated areas. The most recent population count for North Myrtle Beach is 16,819 (2019 population estimate).

No extreme cases of terror attacks have previously affected the City of North Myrtle Beach. However, as the population in the area continues to increase, so does the chance of an attack. Terrorist attacks have been ranked as a low-risk hazard for the City based Priority Risk Index discussed in Section 3.5. However, it is recognized that one large event could cause severe impacts.

3.3 Conclusions on Hazard Risk

The hazard profiles presented in this section were developed using best available data and result in what may be considered principally a qualitative assessment as recommended by FEMA in its "How-to" guidance document titled *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA Publication 386-2). It relies heavily on historical and anecdotal data, stakeholder input, and professional and experienced judgement regarding observed and/or anticipated hazard impacts. It also carefully considers the findings in other relevant plans, studies, and technical reports.

Table 3.27 describes the extent of each natural hazard identified for Horry County and North Myrtle Beach where available. The extent of a hazard is defined as its severity or magnitude, as it relates to the planning area.

TABLE 3.27: HAZARD EXTENT SUMMARY TABLE

<table>
<tr><th colspan="2">Natural Hazards</th></tr>
<tr><td>Hurricanes and Tropical Storms</td><td>Hurricane extent is defined by the Saffir-Simpson Scale which classifies hurricanes into Category 1 through Category 5 (Tables 3.6 and 3.7) The greatest classification of hurricanes to traverse directly through Horry County was Hurricane Hazel 1954 which reached peak wind speed of 110 knots in the county (Category 3).</td></tr>
<tr><td>Flood</td><td>Flood extent can be measured by the amount of land and property in the floodplain as well as flood height and velocity. The number of buildings in the floodplain accounts for 35% of the buildings in North Myrtle Beach. The amount of total land area within a AE or VE flood hazard area accounts for 7% or 160 acres of the total land area in North Myrtle Beach.
Flood depth and velocity are recorded via the United States Geological Survey stream gages throughout the county. The greatest peak discharge recorded for the city of North Myrtle Beach was reported on June 14, 1999. Water reached a discharge of 5480 cubic feet per second and the stream gage height was recorded at 12.19 ft.
Additional peak discharge readings and gage heights are in the table below.
<table>
<tr><th>Location/Jurisdiction</th><th>Date</th><th>Peak Discharge (cfs)</th><th>Gage Height (ft)</th></tr>
<tr><td>Horry County</td><td></td><td></td><td></td></tr>
<tr><td>Highway 9 at Nixon's Crossroads, SC</td><td>14-Jun-99</td><td>5480</td><td>12.19</td></tr>
<tr><td>Myrtlewood Golf Course at Myrtle Beach, SC</td><td>1-Apr-83</td><td>7210</td><td>18.5</td></tr>
<tr><td>Waccamaw River at Conway Marina at Conway, SC</td><td>26-Sep-18</td><td>49000</td><td>21.16</td></tr>
</table>
</td></tr>
</table>

Nor'easter	Nor'easter extent can be measured using the Dolan-Davis Nor'easter Intensity Scale which classifies nor'easter into storm class 1 (Weak) to 5 (extreme) (**Table 3.11**). The greatest classification of nor'easter to affect the city of North Myrtle Beach was the Ash Wednesday Storm in 1962 which was rated as a 5 (extreme).
Coastal Erosion	The extent of coastal erosion can be defined by the measurable rate of erosion that occurs. According to the data from the NCDC, SHELDUS, and DHEC-OCRM, long term erosion rates from the Horry County coastline measure from 2-5 ft/yr to 6-10 ft/yr. Additional, data from the 1997 Sea Grant erosion inventory classified the City of North Myrtle Beach as generally stable.
Severe Thunderstorms and Lightning	Lighting: According to the Vaisala flash density map (**Figure 3.15**), the majority of Horry County is located in an area that experiences 12 - 20 flashes per square kilometer per year. It should be noted that future lightning occurrences may exceed these figures Hail: Hail extent can be defined by the size of the hail stone. The largest hail stone reported in Horry County was 4.5 inches (reported on May 10, 2011). It should be noted that future events may exceed this. Thunderstorms: Thunderstorm extent is defined by the number of thunder events and wind speeds reported. According to a 64-year history from the National Centers for Environmental Information, the strongest wind event in Horry County was reported on August 10, 2007 at 95 knots (approximately 109 mph). It should be noted future events may exceed these historical occurrences.
Wildfire	Wildfire data was provided by the Southern Wildfire Risk Assessment and National Association of State Foresters. Analyzing the data for Horry County indicates the following wildfire hazard extent for each county. ***Horry County*** The greatest number of fires to occur in any year was 213 in 2001. The greatest number of acres burn in a single year occurred in 2009 when 19,337 acres were burned.
Extreme Heat	The extent of extreme heat can be defined by the maximum temperature reached. The highest temperature recorded in North Myrtle Beach is 107 degrees Fahrenheit (last reported on August 18, 1954).
Tornadoes and Waterspouts	Tornadoes: Tornado hazard extent is measured the Enhanced Fujita Scale (**Tables 3.18**). The greatest magnitude reported as an F3 (last reported on November 24, 1967). It should be noted that an F5 tornado is possible although highly unlikely.
Severe Winter Storms	The extent of winter storms can be measured by the amount of snowfall received (in inches). The greatest 24-hour snowfall reported in the region was 17 inches on December 22, 1989.
Drought	Drought extent is defined by the South Carolina Drought Monitor Classifications which include Abnormally Dry, Moderate Drought, Severe Drought, Extreme Drought, and Exceptional Drought (**Table 3.21**). According to the South Carolina Drought Monitor Classifications, the most severe drought condition is Exceptional. Horry County has never received this classification.

Earthquakes	Earthquake extent can be measured by the Richter Scale (**Table 3.23**) and the Modified Mercalli Intensity (MMI) scale (**Table 3.24**) and the distance of the epicenter from Horry County and the City of North Myrtle Beach. According to the data provided by the National Geophysical Data Center, the greatest MMI to impact the county was reported on August 1, 1886 with an MMI of 6 with an unknown correlating Richter Scale measurement.
Tsunami	Maps of tsunami inundation zones **(Figures 3.31 through 3.33)** provide the expected potential extent of inundation in North Myrtle Beach.
Sinkholes	There is a low probability for sinkholes to form in North Myrtle Beach. There has been no loss data collected for this hazard.
Rip Currents	There is currently no scale for determining rip current extent. Extent can generally be defined by the number of people that could be potentially killed in a rip current event, which can be multiple deaths.
Technological Hazards	
Hazardous Materials	According to the USDOT PHMSA, the largest hazardous materials incident reported in the City of North Myrtle Beach was 15 LGA of gasoline released from a storage tank on March 3, 1996. It should be noted that larger events are possible.
Public Health/Infectious Disease	Infectious disease extent can be measured by how many lives are taken as a result of the event and how many economic dollar losses are caused by disease. While dollar losses are difficult to capture, lived lost are not. The COVID-19 pandemic continues unfolding and is shaping up to be the deadliest and costliest infectious disease outbreak to impact Horry County.
Nuclear Power Plants	Although there is no history of a nuclear accident at the Brunswick Nuclear Power Plant, other events across the globe and in the United States in particular indicate that an event is possible. Since several national and international were Level 7 events on the INES, the potential for a Level 7 event at Brunswick possible.
Terrorism	Although no severe terrorism attacks have been reported in the City of North Myrtle Beach, the entire area is still at risk to a future event. Densely populated areas, such as cities, are considered susceptible. Terror events have the potential to affect the human population, buildings and infrastructure, and the economy in the City of North Myrtle Beach.

3.4 Hazard Vulnerability Assessment

The *Vulnerability Assessment* section builds upon the information provided in the *Hazard Analysis* by identifying community assets, potentially at-risk populations and development trends in the City, then assessing the potential impact and amount of damage (loss of life and/or property) that could be caused by each hazard event addressed in this risk assessment. The primary objective of this level of vulnerability assessment is to prioritize hazards of concern to the City. Because of data limitations and other constraints, some hazards were not analyzed for vulnerability. However, hazards where data was available includes the following[4]:

- Hurricanes and Tropical Storms
- Flood
- Severe Thunderstorms and Lightning
- Extreme Heat

[4] Human caused/technological hazards are not addressed in the vulnerability assessment.

- Tornadoes and Waterspouts
- Severe Winter Storms
- Drought
- Earthquakes

The findings presented in this section were developed using best available data, and the methods applied have resulted in an approximation of risk. These estimates should be used to understand relative hazard risk and the potential losses that may be incurred. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning specific hazards and their effects on the built environment and also from approximations that are necessary in order to provide a comprehensive analysis.

Two distinct risk assessment methodologies were used in the formation of this vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies more on local knowledge and rational decision making. Upon completion, the methods are combined to create a "hybrid" approach for assessing hazard vulnerability for the City that allows for some degree of quality control and assurance. The methodologies are briefly described and introduced here and are further illustrated throughout this section. For each hazard addressed in this section, vulnerability is summarized in part by an annualized loss estimate specific to that hazard, along with a "PRI" value (described in detail below).

The primary objective of the vulnerability assessment is to prioritize hazards of concern to the City. To prioritize the hazards the committee considered the likelihood of occurrence, the level of impact, the extent of the city that might be impacted, the time available to warn the public, and the duration of the event.

44 CFR Requirement

> Part 201.6(c) (2) (ii): The risk assessment shall include a description of the jurisdiction's vulnerability to the hazards described in paragraph (c) (2) (i) of this section. The description shall include an overall summary of each hazard and its impact on the community. 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 hazard areas; (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 op

Exposure

As of 2020, the total value of parcels in North Myrtle Beach is $6,025,038,400 according to Horry County Tax Assessment data. The entire City is uniformly exposed to the following hazards (meaning they have no spatial boundaries inside which they occur) and the entire City could be considered vulnerable to these hazards.

- Severe Thunderstorms/Lightning
- Extreme Heat
- Tornadoes/Waterspouts
- Severe Winter Storms

- Drought
- Earthquake

Flood Vulnerability

Approximately 35% of the buildings in North Myrtle Beach are located in a special hazard area designated by FEMA. While only 4% of the buildings are located near the oceanfront and are subject to the impacts of waves during hurricanes, they are valued at over $1.3 billion. Over 100 of the oceanfront buildings are multi-family structures that are constructed with engineered designs. Major damage to these buildings during a storm could represent a significant loss to the City's tax base and a major disruption to the City's economy.

Twenty-one percent of the buildings are located in the AE flood zone. They are valued at over $1.5 billion. Together, buildings in the VE and AE flood hazard areas represent almost 2/3 of the building value in the City.

Data showing the number of structures by flood hazard zone and type of land use are shown in **Table 3.28**. The value of these buildings by flood hazard zone and land use category is shown in **Table 3.29**.

TABLE 3.28 NUMBER OF BUILDINGS BY FLOOD HAZARD AREA

Buildings by Type	V-Zone	AE-Zone	X-Zone	City Total
Single-Family	295	2,668	5,730	8,693
Duplex	15	149	166	330
Hotel/Motel	11	14	7	32
Mobile Home	0	391	787	1,178
Multi-Family/Townhouse	132	554	585	1,271
RV/Campground	0	6	413	419
Public, Social, Cultural	3	52	98	153
Commercial/Amusement/Industrial	4	195	405	604
Open Space	2	15	9	26
Other Land Use	3	41	81	125

Source: North Myrtle Beach Planning & Development Department, September 16, 2015

Single-family structures represent the largest number of buildings in the City. The 2,963 single-family structures make up 34% of the single-family buildings in the City. They are valued at over $475 million which is 36% of the value of single-family buildings.

TABLE 3.29: VALUE OF BUILDINGS (COST IMPROVEMENTS) BY FLOOD HAZARD AREA BY BUILDING TYPE

Buildings by Type	V-Zone	AE-Zone	X-Zone	City Total
Single-Family	$76,680,900	$398,661,500	$830,814,700	$1,306,157,100
Duplex	$8,663,800	$22,696,500	$23,382,900	$54,743,200
Hotel/Motel	$3,075,100	$12,245,600	$13,206,200	$28,526,900
Mobile Home	$0	$2,557,100	$10,868,600	$13,425,700
Multi-Family/Townhouse	$1,308,581,000	$1,037,468,800	$515,029,500	$2,861,079,300
RV/Campground	$0	$122,500	$7,106,800	$7,229,300
Public, Social, Cultural	$2,000	$7,083,000	$17,313,500	$24,398,500
Commercial/Amusement/Industrial	$441,900	$50,757,900	$153,216,400	$204,416,200
Open Space	$0	$4,675,900	$6,088,200	$10,764,100
Other Land Use	$25,200	$1,706,000	$6,313,900	$8,045,100
Total	$1,397,469,900	$1,537,974,800	$1,583,340,700	$4,518,785,400

Source: North Myrtle Beach Planning & Development Department, September 16, 2015

Since 2000 the number of acres of vacant has increased substantially due to the annexation of land across the Intracoastal Waterway. Just over half of the vacant land is zoned for Planned Unit Development. This gives the City the best opportunity to guide the development in ways that avoid flood hazard areas. Within the areas designated as PDD, 160 acres or 7% of the area is in AE or VE flood hazard areas.

TABLE 3.30: ACREAGE OF VACANT LAND BY FLOOD HAZARD AREA

VACANT LAND BY ZONING CATEGORY				
Zoning District	**V-Zone**	**AE-Zone**	**x-Zone**	**City Total**
R-1	2.7	127.0	154.6	284.3
R-2	0	29.3	36.1	65.4
R-2A	0.1	28.3	930.5	958.9
R-4	14.0	149.7	241.5	405.2
HC	0	24.6	223	247.6
PDD	27.7	133.2	2117.7	2278.6
OTHER ZONES	0.1	17.7	148.4	166.2
Total Acres	**44.6**	**509.8**	**3851.8**	**4406.2**

Source: North Myrtle Beach Planning & Development Department, September 16, 2015

Table 3.31 was developed by overlaying the FEMA flood hazard GIS layer with 2020 tax

information from Horry County by parcel. This gives an indication of the number of parcels that intersect with the various flood hazard areas. However, this analysis does not take into consideration the elevation of the structures that is needed to determine the true vulnerability. Elevation data for each structure in the City would help fine-tune this assessment.

TABLE 3.31: IMPROVED VALUE OF STRUCTURES IN SPECIAL FLOOD HAZARD AREAS

Flood Zone	Total Improved Value (Structure Only) of Parcels Intersecting
Floodway	$5,930,800
VE	$849,788,200
A and AE	$2,938,206,100
0.2 PCT ACH FLD	$1,589,400,900
TOTAL	**$5,383,326,000**

Source: FEMA Flood Maps and Horry County Tax Assessor Data, 2020

Hurricane Vulnerability

Hurricanes have the potential to cause catastrophic damages to both public facilities and private property. For these and a variety of other reasons, hurricanes have been ranked as a high-risk hazard for the City based Priority Risk Index discussed in Section 3.5.

TABLE 3.32: Building Exposure By Hurricane Category

Hurricane Category	Building Value	Buildings
Category 1	$1,493,125,100	2,524
Category 2	$2,547,747,000	3,885
Category 3	$3,178,146,200	6,339
Category 4	$3,864,893,300	9,768
Category 5	$4,278,399,200	11,653

Source: North Myrtle Beach Planning and Development Department

The above Table illustrates the significant impact a direct hit from a hurricane could have on the City. The building value for the City of North Myrtle Beach is estimated at over $6 billion by the Horry County Tax Department. Even a Category 1 hurricane is expected to flood over 2,500 homes and businesses worth almost $1.5 billion. That is one-fourth of the City's property tax value.

Critical Facilities

North Myrtle Beach has a number of critical facilities exposed to flooding at various levels of risk. Maps showing the locations of these critical facilities are included in Section 6.

Knowing when critical facilities are at risk from flooding is critical to the development of an effective emergency operations and response plan. That information is also needed for effective recovery planning. Critical facilities for North Myrtle Beach are grouped below by categories commonly addressed in emergency planning.

TABLE 3.33: EMERGENCY OPERATIONS/COMMAND AND CONTROL FACILITIES

CRITICAL FACILITY NAME	SFHA	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
North Myrtle Beach City Hall/EOC						YES
North Myrtle Beach Police Department						YES
Horry County Fire Station 18						
Horry County Fire Station 5						
Horry County Fire Station 32						
Horry County Fire Station 2					YES	YES
North Myrtle Beach Fire Station 1						YES
North Myrtle Beach Fire Station 2	YES	YES	YES	YES	YES	YES
North Myrtle Beach Fire Station 3						YES
North Myrtle Beach Fire Station 4					YES	YES
North Myrtle Beach Fire Station 5				YES	YES	YES

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and Development Department Land Use Data September 2015.

While some facilities may not be subject to flooding, loss of access can cause a critical situation, especially if they are that are needed to support community flood/hurricane response efforts.

TABLE 3.34: TRANSPORTATION

CRITICAL FACILITY NAME	SFHA	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
Grand Strand Airport					YES	YES
Little River (AICWW) Bridge	YES	YES	YES	YES	YES	YES
Intracoastal Waterway (Robert Edge Pky) Bridge	YES	Yes	YES	YES	YES	YES
Barefoot Resort (AICWW) Bridge		YES	YES	YES	YES	YES
Hwy 22 Bridges	YES	YES	YES	YES	YES	YES
Swing Bridge Sea Mtn Hwy	YES	YES	YES	YES	YES	YES

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and Development; Department Land Use Data September 2015.

As indicated by the Table above, while the bridge decking may be above a designated flood elevation, the roadway approaching the bridge may be covered by water during a storm. This has a significant impact on the timing for evacuation plans.

Maintaining the capability to communicate with responders, adjacent governmental agencies, private sector suppliers, the public, organizations and businesses that have facilities in flood inundation areas, and others is essential before, during and after a disaster. Below is a list of communications facilities that are important to the North Myrtle Beach response and recovery.

TABLE 3.35: COMMUNICATIONS

Critical Facility Name	SHFA	Cat 1	CAT 2	CAT 3	CAT 4	CAT 5
North Myrtle Beach Tower					YES	YES
Cell Tower North Myrtle Beach Fire Station 1						YES
Cell Tower/Bay Street					YES	YES
Cell Tower/Antenna 42nd Ave S						YES
Cell Tower/Antenna Edge Dr						YES
Verizon Wireless					YES	YES
Cell Tower/Antenna Located Near Sea Mtn & Hwy 90						YES
Cell Tower/Antenna County Located						YES
Radio Tower 1018 2nd Avenue N						YES
Private Cell Tower/Antenna Baywatch	YES		YES	YES	YES	YES
Private Cell Tower/Antenna North Shore	YES	YES	YES	YES	YES	YES
Private Cell Tower/Antenna Prince Resort	YES	YES	YES	YES	YES	YES
Cell Tower/Antenna Water Tank LRNR						YES
Private Cell Tower/Antenna Mar Vista	YES	YES	YES	YES	YES	YES
Cell Tower/Antenna Water Tank 31st Ave N	YES	YES	YES	YES	YES	YES
Cell Tower/Antenna Water Tank MB near cemetery				YES	YES	YES
Cell Tower/Antenna Punk Rd County						
Cell Tower/Antenna Water Tank King Rd (County)						YES

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and Development Department Land Use Data September 2015.

The coordination of the flood warning and response plan with water and wastewater facilities will allow more timely and effective protection of them and a more rapid response and community recovery after a flood event.

TABLE 3.36: WATER SUPPLY

CRITICAL FACILITY NAME	SFHA	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
Cherry Grove Water Tank			YES	YES	YES	YES
Tidewater Plantation Water Tank						YES
Cherry Grove Water Tank 31st Ave N	YES	YES	YES	YES	YES	YES
Cherry Grove Water Tank 59th Ave N	YES	YES	YES	YES	YES	YES
Ocean Drive Water Tank				YES	YES	YES
Barefoot Landing Water Tank				YES	YES	YES
Barefoot Resort Water Tank (3245 Club						
Briarcliff RV Park Area Water Tank				YES	YES	YES
Windy Hill Water Tank					YES	YES

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and DevelopmentDepartment Land Use Data September 2015.

TABLE 3.37 WASTEWATER TREATMENT

CRITICAL FACILITY NAME	SFHA	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
North Myrtle Beach Wastewater Treatment Facility					YES	YES
North Myrtle Beach Ocean Drive Treatment Plant					YES	YES
Vereen Wastewater Treatment Plant						

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and Development Department Land Use Data September 2015.

TABLE 3.38: SCHOOLS

CRITICAL FACILITY NAME	SFHA	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
Ocean Drive Elementary						
North Myrtle High School						

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and Development Department Land Use Data September 2015.

While neither school is in the SFHA or an identified Hurricane inundation area both may need to be warned before or during a disaster event. Ocean Drive Elementary is in an evacuation zone. North Myrtle High School has been designated as a shelter by Horry County.

TABLE 3.39: PRIVATE BUSINESSES AND FACILITIES

CRITICAL FACILITY NAME	SFHA	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
Alligator Adventure	YES	YES	YES	YES	YES	YES

Source: NOAA Coastal Service Center maps and North Myrtle Beach Planning and Development Department Land Use Data September 2015.

Some critical facilities have their own flood warning and response plans that have been developed, reviewed, or accepted by the community. Alligator Adventure has a response plan that identifies procedures for relocating alligators at its facility. The plan is on file with the City and it receives a special warning and notification from the City before a hurricane.

The City should update the list of critical facilities annually, including the names and contact numbers for both public and private operators.

Hurricane Hazus Run Results

To determine vulnerability and loss estimates to hurricane winds for the City of North Myrtle Beach, a Probabilistic Scenario was run in Hazus version 4.2.3. According to the Hazus Hurricane Model User Guidance, the probabilistic scenario “considers the associated impacts of many thousands of potential storms that have tracks and intensities reflecting the full spectrum” of hurricanes that could impact the City of North Myrtle Beach.

The tables below present expected wind speeds and damages that could be experienced in North Myrtle Beach as a result of the different return periods modeled through the probabilistic model runs.

TABLE 3.40: HAZUS HURRICANE MODEL RESULTS FOR RESIDENTIAL BUILDINGS DAMAGED

Return Period (Year)	Expected Wind Speeds (MPH)	Minor	Moderate	Severe	Destruction	TOTAL
10	64-65	58	4	0	0	63
20	79-81	705	130	2	0	838
50	100-102	3,368	1,181	41	22	4,612
100	112-114	5,659	3,029	301	154	9,143
200	121-123	6,275	5,042	1,043	531	12,891
500	134-136	5,073	6,543	2,828	1,408	15,852
1,000	142-144	3,655	6,617	4,367	2,480	17,118

TABLE 3.41: HAZUS HURRICANE MODEL RESULTS FOR TOTAL BUILDINGS DAMAGED

Return Period (Year)	Expected Wind Speeds (MPH)	Minor	Moderate	Severe	Destruction	TOTAL
10	64-65	64	4	0	0	68
20	79-81	738	134	3	0	875
50	100-102	3,553	1,252	49	22	4,875
100	112-114	5,958	3,252	363	156	9,729
200	121-123	6,591	5,391	1,223	536	13,741
500	134-136	5,307	6,956	3,235	1,425	16,923
1,000	142-144	3,821	7,009	4,927	2,509	18,266

Some additional summary results from that assessment concluded the following:

- Schools would lose 100% of their functionality due to a 100-year return period storm (wind speeds 112-114 mph)
- City police stations should be able to remain functional until a 500-year return period storm (wind speed 134-136) and fire stations should remain functional during any type of event (through the 1000-year event).

Earthquake Vulnerability

To determine vulnerability and loss estimates to earthquakes for the City of North Myrtle Beach, a Probabilistic Scenario for a 100-year earthquake with a moment magnitude of 5.0 was run in Hazus version 4.2.3. Based on the model run, there is negligible damage expected from a 100-year, moment magnitude 5.0 probabilistic earthquake.

3.5 Priority Risk Index

In order to draw some meaningful planning conclusions on hazard risk for the City, the results of the hazard profiling process were used to generate hazard classifications according to a "Priority Risk Index" (PRI). The purpose of the PRI is to categorize and prioritize all potential hazards that could impact the City as high, moderate, or low risk. Combined with the asset inventory and quantitative vulnerability assessment provided above, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for the City to consider as part of their proposed mitigation strategy.

The prioritization and categorization of identified hazards for the City is based principally on the PRI, a tool used to measure the degree of risk for identified hazards in a particular planning area. The PRI is used to assist the City's Hazard Mitigation Planning Committee in gaining consensus on the determination of those hazards that pose the most significant threat to North Myrtle Beach based on a variety of factors. The PRI is not scientifically based, but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in the City of North Myrtle Beach based on standardized criteria.

The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor[5], as summarized in **Table 3.42**. To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

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

According to the weighting scheme and point system applied, the highest possible value for any hazard is 4.0. When the scheme is applied for the City of North Myrtle Beach, the highest PRI value is 3.3 (flooding hazard). Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the Mitigation Planning Committee.

[5] The Mitigation Planning Committee, based upon any unique concerns or factors for the planning area, may adjust the PRI weighting scheme during future plan updates.

TABLE 3.42 PRIORITY RISK INDEX FOR THE CITY OF NORTH MYRTLE BEACH

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 10% annual probability	2	
	Likely	Between 10 and 100% annual 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 and 100% of area affected	4	
Warning Time	More than 24 hours	Self-explanatory	1	10%
	12 to 24 hours	Self-explanatory	2	
	6 to 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 one week	Self-explanatory	3	
	More than one week	Self-explanatory	4	

Table 3.43 summarizes the degree of risk assigned to each category for all initially identified hazards based on the application of the PRI. Assigned risk levels were based on the detailed hazard profiles developed for this section, as well as input from the Regional Hazard Mitigation Planning Committee. The results were then used in calculating PRI values and making final determinations for the risk assessment.

TABLE 3.43 SUMMARY OF PRI RESULTS FOR CITY OF NORTH MYRTLE BEACH

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Hurricane and Tropical Storms	Highly Likely	Critical	Large	More than 24 hours	Less than 6 hours	3.1
Coastal Erosion	Likely	Minor	Large	More than 24 hours	More than one week	2.8
Severe Thunderstorms and Lighting	Likely	Limited	Moderate	6 to 12 hours	Less than 6 hours	2.5
Tornadoes/Waterspouts	Possible	Minor	Small	6 to 12 hours	Less than 6 hours	1.7
Flooding	Highly Likely	Critical	Large	More than 24 hours	Less than one week	3.3
Wildfire	Possible	Limited	Small	Less than 6 hours	Less than 6 hours	2.1
Nor'easter	Likely	Limited	Moderate	6 to 12 hours	Less than 24 hours	2.6
Drought	Possible	Minor	Large	More than 24 hours	More than one week	2.2
Hail	Possible	Minor	Large	6 to 12 hours	Less than 6 hours	2.1
Winter Storms	Possible	Minor	Large	6 to 12 hours	Less than 6 hours	2.1
Earthquakes	Possible	Minor	Negligible	Less than 6 hours	Less than 6 hours	1.6
Landslides and Mass Wasting	Unlikely	Minor	Small	Less than 6 hours	Less than 6 hours	1.5
Rip Currents	Possible	Catastrophic	Negligible	Less than 6 hours	Less than 6 hours	2.5
Hazardous Materials	Unlikely	Minor	Small	Less than 6 hours	Less than 24 hours	1.6
Public Health Hazards/Infectious Disease	Unlikely	Limited	Moderate	More than 24 hours	More than one week	2

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Nuclear Power Plants	Unlikely	Minor	Large	Less than 6 hours	More than one week	2.2
Sea Level Rise		Minor	Large	More than 24 hours	More than one week	
Tsunami	Unlikely	Critical	Large	Less than 6 hours	Less than 6 hours	2.5
Terrorism	Unlikely	Critical	Moderate	Less than 6 hours	Less than 6 hours	2.3

3.5 Final Determinations

The conclusions drawn from the hazard profiling process for the City, including the PRI results, vulnerability information, and input from the Mitigation Planning Committee, resulted in the classification of risk for each identified hazard according to three categories: High Risk, Moderate Risk and Low Risk (**Table 3.44**). For purposes of these classifications, risk is expressed in relative terms according to the estimated impact that a hazard will have on human life and property throughout the City. It should be noted that although some hazards are classified below as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases and their assigned classification will continue to be evaluated during future plan updates.

TABLE 3.44: CONCLUSIONS ON HAZARD RISK FOR THE CITY OF NORTH MYRTLE BEACH

HIGH RISK	Hurricane and Tropical Storms Flooding
MODERATE RISK	Severe Thunderstorms Public Health Hazards/Infectious Disease Coastal Erosion Wildfires Rip Currents Nuclear Power Plant Tornadoes/Waterspouts Nor'easter
LOW RISK	Hazardous Materials Drought Extreme Heat Winter Storms Earthquake Tsunami Sinkholes Terrorism

3.6 Summary of Hazard Mitigation Problems

The following is a general list of issues and vulnerabilities caused by the hazards identified in this section. Sections 5 (Goals, Strategies and Possible Mitigation Actions), 6 (Mitigation Measures) and 8 (Mitigation Action Plan) provide the goals, potential mitigation solutions and selected mitigation solutions for implementation to reduce future occurrences of the problems listed below.

High Winds (Hurricanes, Nor'easters, and Tornadoes)

- Loss of roof shingles and sheathing.
- Wind borne debris damage to buildings.
- Trees blown on houses and utilities.
- Power, telephone and cable lines damaged.
- Evacuation routes must be closed early.

Storm Surge (Hurricanes)

- Destruction and major damages to buildings located in V-Zones and

coastal AE-Zones.
- Destruction of roads and utilities.

Coastal Erosion (Hurricanes and Nor'easters)

- Loss of the recreational beach.
- Building foundations fail due to being undermined by erosion and scour.

Flooding (Hurricanes and Severe Thunderstorms)

- Damage to buildings not elevated above the flood level.
- Damage to buildings with enclosures below the flood level.
- Damage to buildings and utilities from water borne debris.
- Flood Hazard Maps that do not adequately reflect the flood risk to buildings.
- Evacuation routes closed.

Wildfire

- Destruction of buildings and utilities.
- Destruction of natural resources, including wildlife habitat.

Severe Winter Storms

- Beach erosion.
- Destruction of power, telephone and cable lines damaged.

Earthquake

- Building failure from shaking and liquefaction.
- Damage to bridges, pipes and cables.
- Destruction of trees, some of which may block evacuation and emergency response teams.

Chapter 4 Repetitive Loss Area Analysis

4.1 Background

The National Flood Insurance Program (NFIP) is continually faced with the task of paying claims while trying to keep the price of flood insurance at an affordable level. It has a particular problem with repetitive loss properties, which are estimated to cost $200 million per year in flood insurance claim payments. There is constant pressure on the Department of Homeland Security's Federal Emergency Management Agency (FEMA) to increase flood insurance premium rates in order to keep the NFIP in its current self-supporting mode and to minimize the burden of flood damage on the general taxpayer.

Repetitive loss properties represent only one percent of all flood insurance policies, yet historically they account for nearly one-third of the claim payments (over $4.5 billion between 1978 and 2005). Mitigation of the flood risk to these repetitive loss properties will reduce the overall costs to the NFIP as well as to individual homeowners.

A "repetitive loss property" is one which has received two flood insurance claim payments of at least $1,000 have been paid by the NFIP within any 10-year period since 1978 (e.g., two claims during the periods 1978–1987, 1979–1988, etc.). These properties are important to the National Flood Insurance Program because they account for one-third of the country's flood insurance claim payments. Therefore, FEMA programs encourage communities to identify the causes of their repetitive losses and develop a plan to mitigate the losses.

North Myrtle Beach is a Class 6 community in the NFIP's Community Rating System (CRS). Since there are more than 10 repetitive loss properties on the list provided by FEMA, the City must complete specific tasks to maintain its CRS rating. These include:

- Review and describe its repetitive loss problem,
- Prepare a map of the repetitive loss area(s),
- Undertake an annual outreach project to the repetitive loss area(s) and submit a copy of the outreach project with each year's recertification.
- Prepare a floodplain management plan for its repetitive loss area(s).

4.2 Description of the Repetitive Loss Problem

There are 226 repetitive flood loss properties on the North Myrtle Beach list provided by DHS – FEMA. Eight have been removed from the list by FEMA because insufficient information was provided to the City to identify their locations. Another twenty-three properties are no longer considered repetitive loss properties because they have been mitigated by the removal of the structure, modifications to the structure (such as elevation above the base flood elevation) or by constructing a new building on the site that meets the flood loss prevention code.

This leaves 195 repetitive loss structures on the DHE – FEMA list that still need mitigation to eliminate or reduce future losses from flooding. These repetitive loss properties have had 465 claims paid since 1979. The flood insurance claim payments for these losses total $8,633,009 for an average payment of $18,567 per claim and $43,165 per building.

An examination of the claim files shows the following flood events have caused flood losses within the City.

4.3 Flood Loss Events

Dates of Loss	Events	NMB Flood Frequency
September 4, 1979	Hurricane David	10-year
August 19, 1981	Tropical Storm Dennis	10-year
January 2, 1983	Heavy Rain	Less than 10-year
March 17, 1983	Storm from Gulf	10-year
September 13, 1984	Hurricane Diana	50-year
July 24-25, 1985	Hurricane Bob	10-year
January 1, 1987	Coastal Storm	25-year
September 22, 1989	Hurricane Hugo	50-year
August 12, 1991	Thunderstorm	Less than 10-year
December 25, 1994	Thunderstorm	10-year
September 5, 1996	Hurricane Fran	50-year
September 15, 1999	Hurricane Floyd	100-year
September 1, 2004	Hurricane Charley	
October 7, 2004	Tropical Storm Frances	
October 5, 2015	Severe Storms and Flooding	
October 11, 2016	Hurricane Matthew	
October 16, 2017	Hurricane Irma	
September 16, 2018	Hurricane Florence	
September 30, 2019	Hurricane Dorian	

Source: Adapted from National Flood Insurance Program Claims File; National Weather Service, National Climatic Data Center, Extreme Weather and Climate Events File; and U. S. Weather Bureau (1961), "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years." U. S. Weather Bureau, Technical Paper 40. National Weather Service Storm Reports from the National Climatic Data Center were also reviewed.

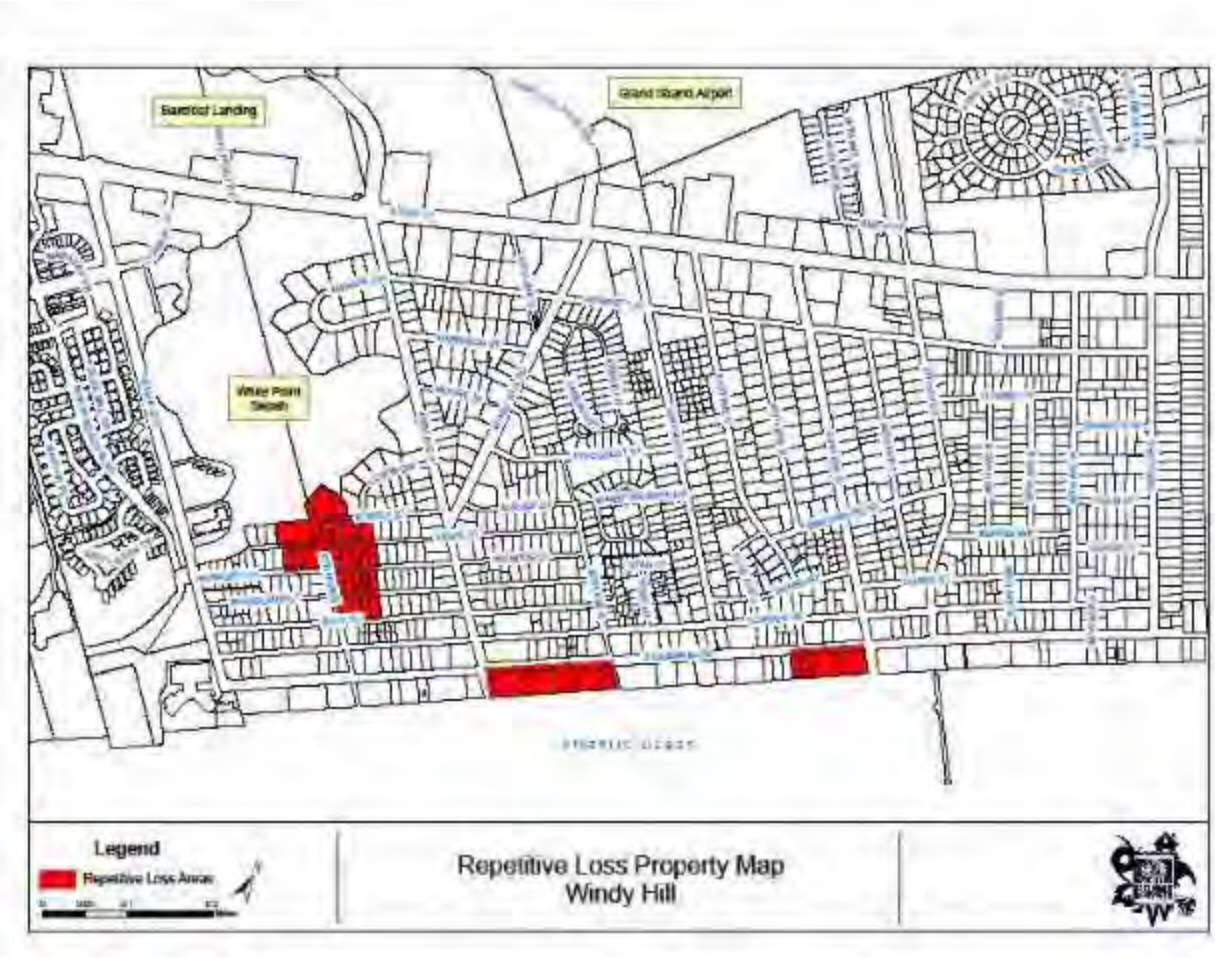
4.4 Identification of Repetitive Loss Areas

Focusing on the repetitive loss list understates the magnitude of the flood hazard problem in the City. Most buildings in the City with flood insurance claim payments are not repetitive loss properties. This may be because the building has had only one flood event, or the claim payments have been less than $1,000, including some so small that the claim did not exceed the policy deductible. Many properties do not have flood insurance claims only because they are not covered by flood insurance.

To obtain a better understanding of the potential repetitive loss problem the 195 repetitive loss properties have been plotted, along with other properties that have a similar exposure to flooding. These properties have been grouped into 48 Repetitive Loss Areas. Each property in the Repetitive Loss Areas has been visited and data on the property and the area are summarized in this "area analysis."

North Myrtle Beach was established by the consolidation of the communities of Cherry Grove, Ocean Drive, Crescent Beach and Windy Hill into one city. Each of these areas is used as an area in this analysis. An additional area includes the area north of Highway 17 Business and the area along Little River Neck Road. This latter area has grown substantially in recent years and added to North Myrtle Beach through annexations.

4.4.1 Windy Hill



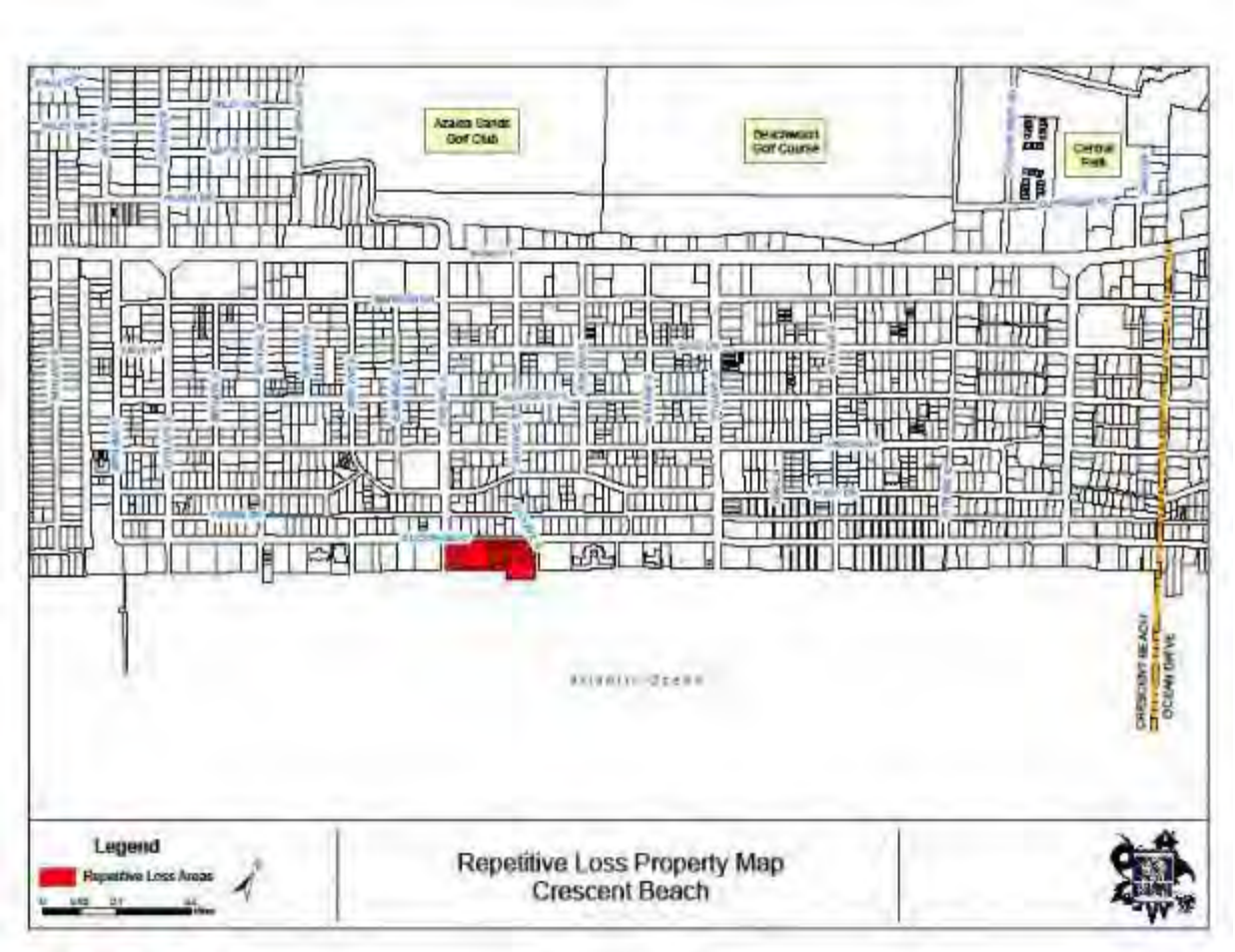
The Windy Hill area includes 3 repetitive loss area neighborhoods. The flood hazard includes the White Point Swash, AE and VE flood zones. While high intense rain storms can cause minor flooding, the significant floods come from tropical storms and hurricanes.

- Structures within the three repetitive loss neighborhoods are valued at $41 million. The repetitive loss building in these three neighborhoods are valued at $5.5 million.
- 33% of the buildings in the repetitive loss neighborhoods are repetitive loss structures.
- 56% of the buildings are under insured for the peril of flood.
- 67% of the buildings are on piling foundations; however, 15 % have enclosures below the lowest floor.
- 31% of the buildings have enclosures larger than 299 square feet.
- 25% of the buildings are on a slab foundation.

4.4.2 Crescent Beach

Crescent Beach has only one repetitive loss neighborhood. On the south it is bordered by the Atlantic Ocean and on the North two major golf courses.

- Structures within the repetitive loss neighborhood are valued at just under $1 million. The repetitive loss buildings in the neighborhood are valued at $300,000.
- 33% of the buildings in the repetitive loss neighborhood are repetitive loss structures.
- 44% of the buildings are under insured for the peril of flood.
- 67% of the buildings are on piling foundations; however, 78 % have enclosures below the lowest floor.
- 11% of the buildings are on a slab foundation.



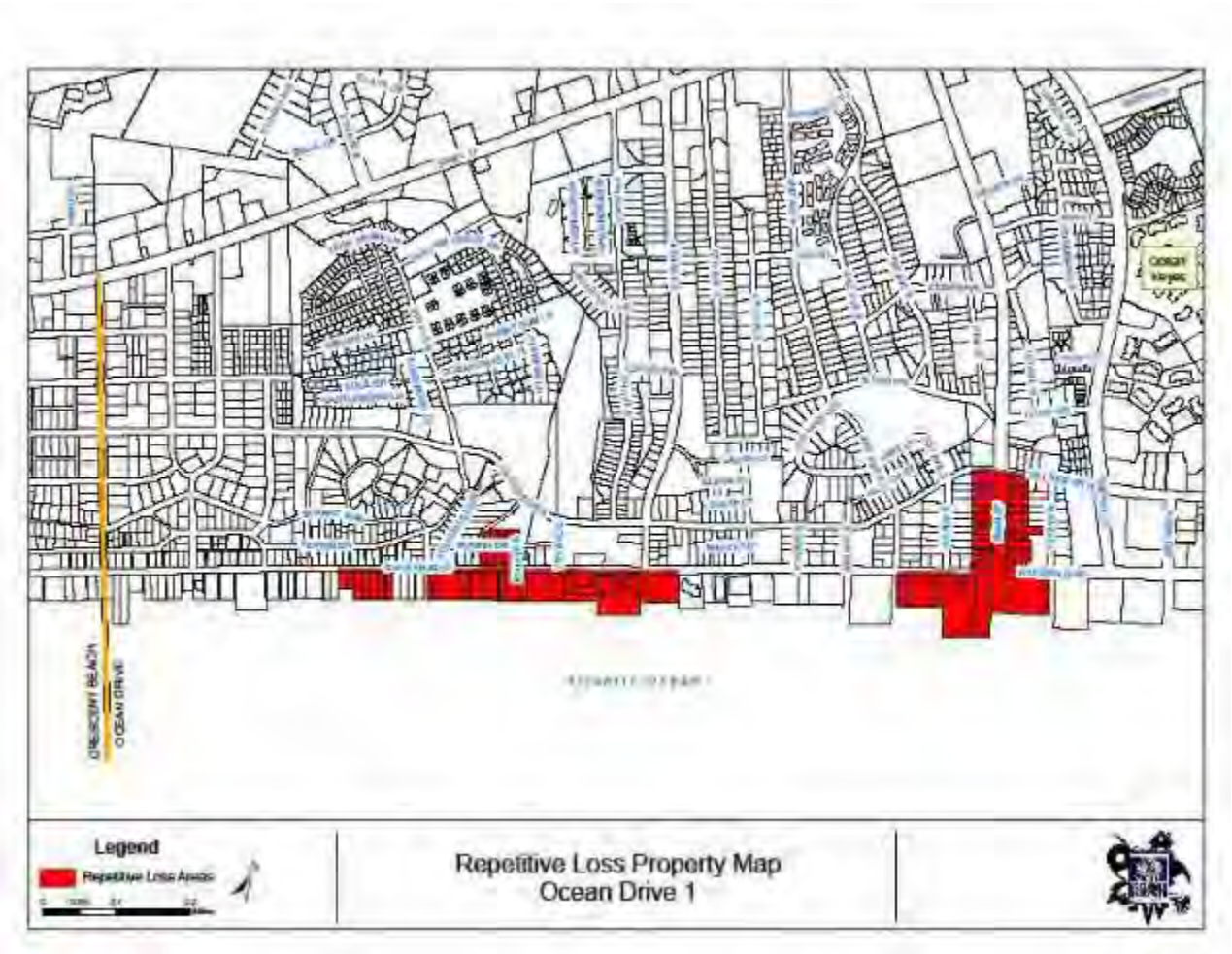
4.4.3 Ocean Drive

Ocean Drive is located in the center of the City. It is bounded on the north by Highway 17 and on the south by the Atlantic Ocean. The flood hazard includes the White Point Swash, AE and VE flood zones. While high intense rain storms can cause minor flooding, the significant floods come from tropical storms and hurricanes.

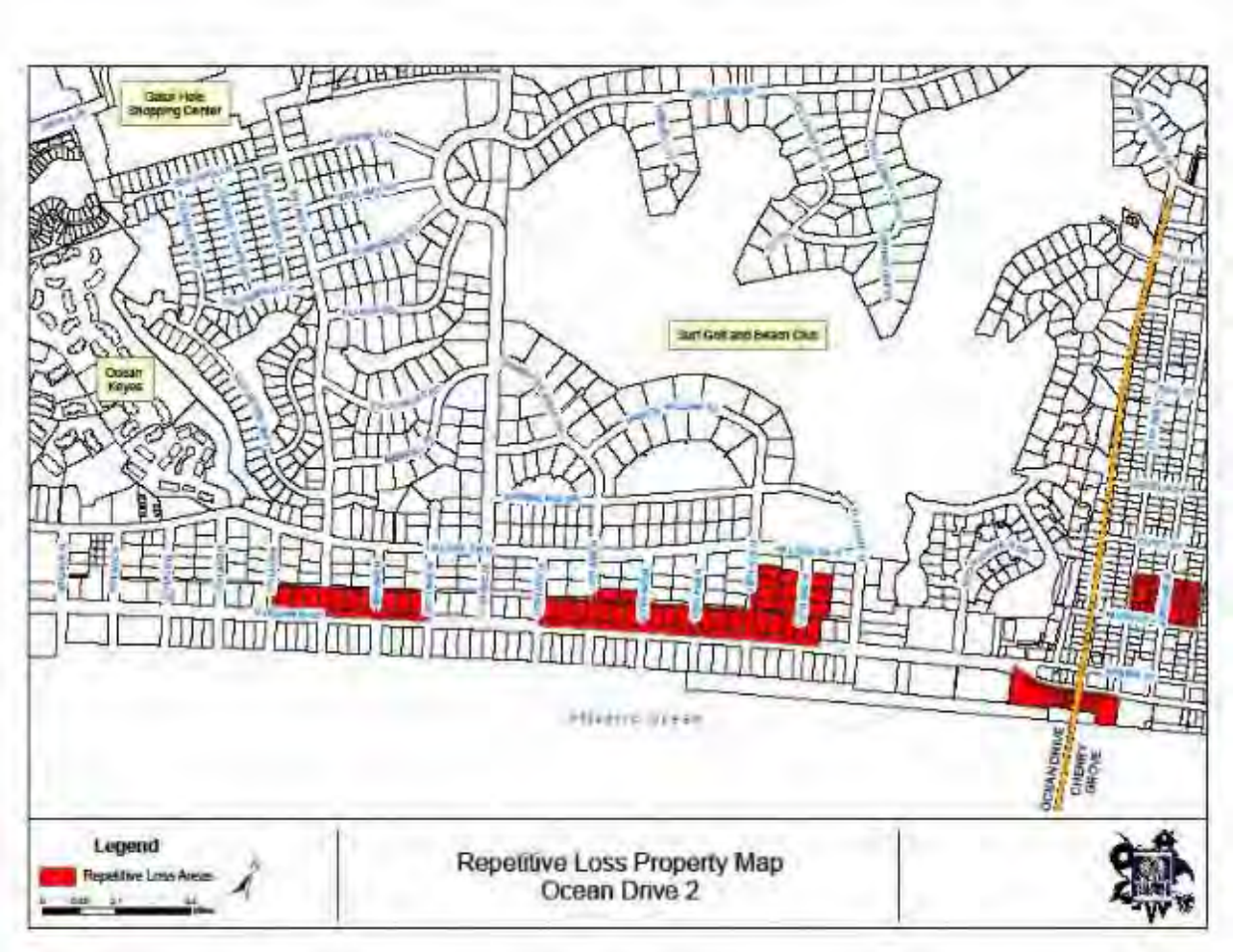
Ocean Drive has 7 repetitive loss neighborhoods.

- Structures within the seven repetitive loss neighborhoods are valued at $118 million. The repetitive loss building in these three neighborhoods are valued at $38 million.
- 27% of the buildings in the repetitive loss neighborhoods are repetitive loss structures.
- 54% of the buildings are under insured for the peril of flood.
- 37% of the buildings are on piling foundations; however, 47 % have enclosures below the lowest floor.

- 33% of the buildings have enclosures larger than 299 square feet.
- 53% of the buildings are on a slab foundation.



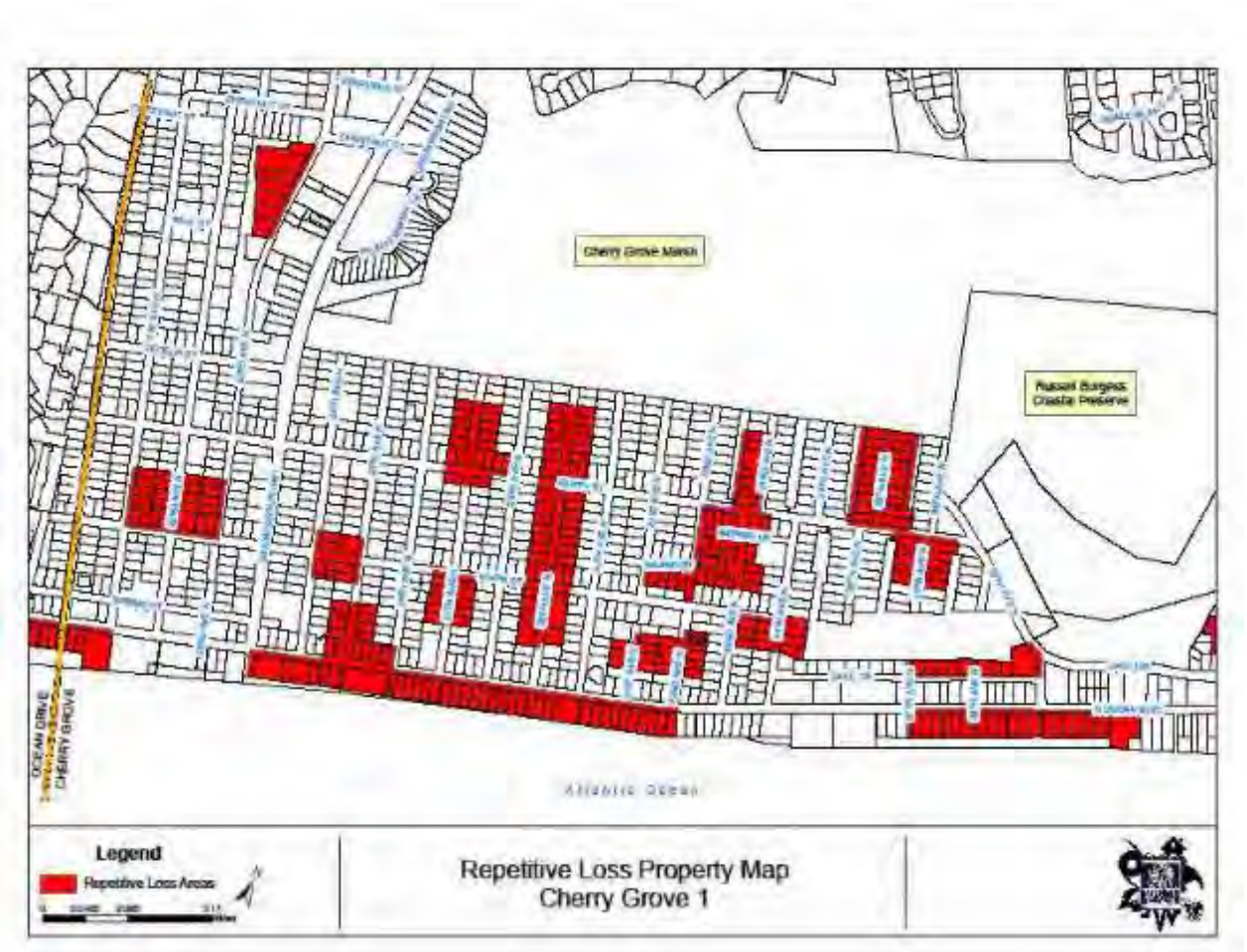
Most of the buildings in the Main Street repetitive loss neighborhood are commercial establishments with slab foundations. These buildings have the highest risk of failure during a major hurricane. However, this neighborhood has the highest concentration of jobs among all of the repetitive loss neighborhoods. Over the next 5-years the mitigation committee should work with local businesses in the area to identify approaches for reducing this risk. Otherwise, a major hurricane could result in the loss of a significant number of jobs. Current efforts to improve the appearance of the Main Street area should also address flood loss reduction measures.



4.4.4 Cherry Grove

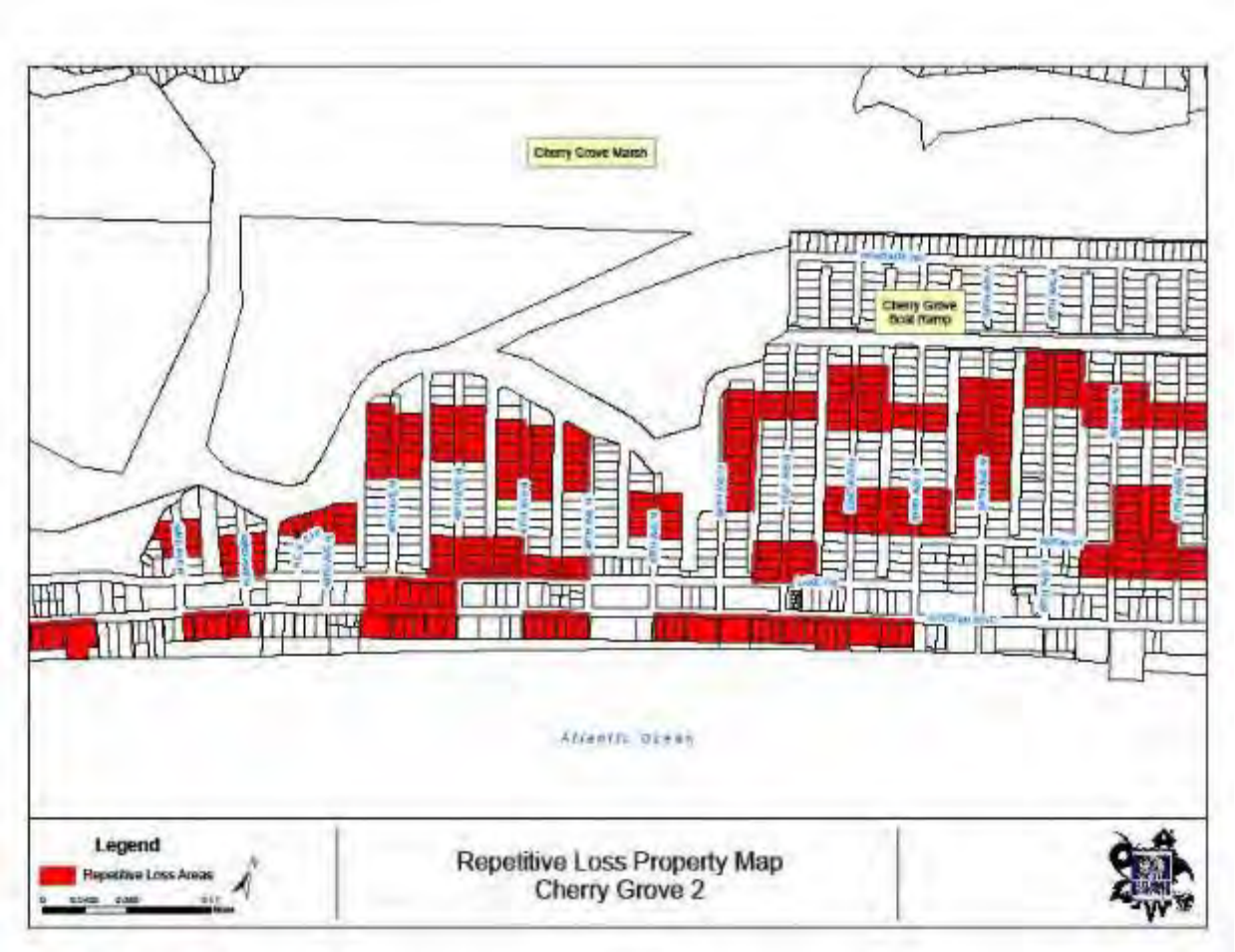
Cherry Grove is located as the eastern end of the City. It is bounded by Hog Inlet to the east, the Atlantic Ocean to the south and the Cherry Grove marsh and Little River Neck road. Some streets and lots in the area have shallow flooding during a heavy rain at high tide. This problem will continue to get worse as the sea level rises in the future. Because of the frequent shallow flooding property owners should be encouraged to remove enclosures below their elevated homes.

Cherry Grove has 37 repetitive loss neighborhoods. Together these neighborhoods have 635 properties or 81% of all properties in repetitive loss neighborhoods. 152 repetitive loss properties are located in the Cherry Grove repetitive loss neighborhoods. They account for 78% of the repetitive loss properties in North Myrtle Beach.

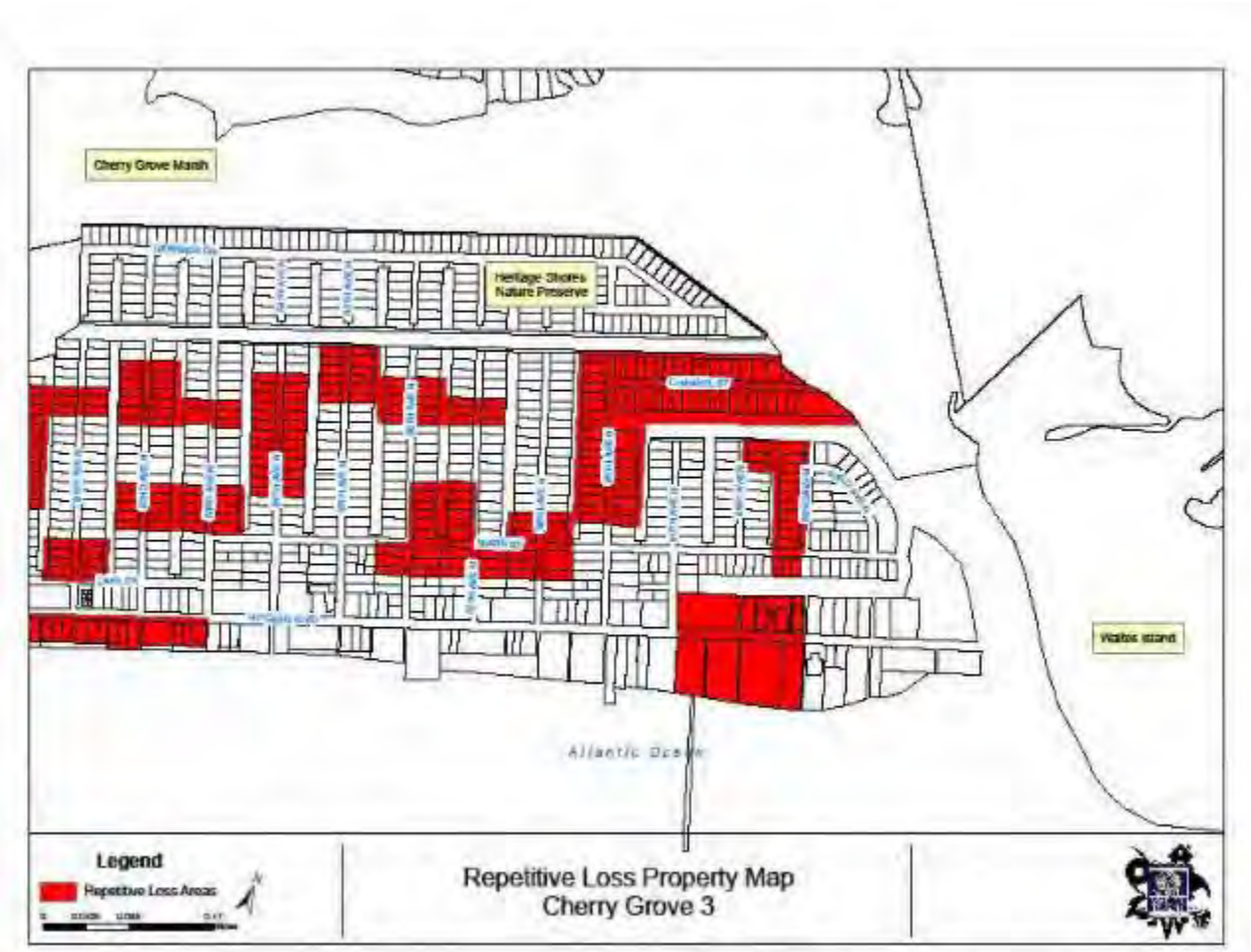


Within the Cherry Grove repetitive loss neighborhoods:

- Structures within the thirty-seven repetitive loss neighborhoods are valued at $176.5 million. The repetitive loss buildings in these neighborhoods are valued at $70.5 million.
- 24% of the buildings in the repetitive loss neighborhoods are repetitive loss structures.
- 37% of the buildings are under insured for the peril of flood.
- 78% of the buildings are on piling foundations; however, 81 % of the buildings have enclosures below the lowest floor.
- 26% of the buildings have enclosures larger than 299 square feet.
- 8% of the buildings are on a slab foundation.



Property owners in the Cherry Grove area continue to stress the problems with inadequate drainage. The Mitigation Committee and the City should meet with area residents to discuss the drainage issues so that a more complete understanding of the problems and potential solutions can be understood by all.



4.4.5 Highway 17 and Little River Neck Road

Much of this area has been annexed over the past 10-years. Most of the construction was built under recent codes, including the City's freeboard standard. A good portion of the area has higher ground elevations and there is a smaller percentage of the area mapped with flood hazard zones. Additionally, a good deal of the development hasn't experienced a major storm. Therefore, there are fewer flood insurance claims in this area and there are no repetitive loss properties.

4.5 Flood Insurance Coverage

There are 195 buildings on the repetitive loss list. They are only 2% of the flood insurance policies. However; repetitive loss building claims have totaled $8,529,764 or 23% of the flood insurance claims paid in North Myrtle Beach. Outreach to those property owners continues to be important to ensure continued progress in reducing the threat to these buildings and improve the economic stability of the community.

	AE, A1-30, AO, AH, A	VE, V1-30, V	B, C, X	TOTAL
RL Buildings (Total)	168	23	4	195
RL Buildings (Insured)	64	7	3	74
Percentage Insured	38%	30%	75%	38%

The City has mapped the locations of repetitive loss properties and identified 48 repetitive loss areas. These areas are shown on the repetitive loss maps later in this report.

	REPETITIVE LOSS AREA	STRUCTURES	REPETITIVE LOSS STRUCTURES	FLOOD INSURANCE POLICIES	MITIGATED REP LOSS STRUCTURES
1	WINDY HILL	27	9	17	
2	45TH AVENUE SOUTH	7	1	6	
3	39TH AVENUE SOUTH	4	1	3	
4	20TH AVENUE SOUTH	5	1	5	
5	PERRIN DR.	9	3	5	
6	OCEAN BLVD & 7TH AVE SOUTH	15	7	11	1
7	OCEAN BLVD & 9TH AVE SOUTH	6	1	3	
8	MAIN STREET	34	7	20	
9	8TH AVENUE N	8	2	6	
10	13TH AVENUE N	12	3	10	
11	17TH AVENUE N	17	4	9	
12	20TH AVENUE N	8	3	5	1
13	22ND AVENUE N	23	6	13	
14	NIXON & 24TH AVENUE N	7	1	2	
15	OCEAN BLVD & 25TH AVENUE N	53	19	36	8
16	27TH AVENUE N	9	1	6	
17	DUFFY & 27TH AVENUE N	15	5	8	2
18	29TH AVENUE N	38	6	26	1
19	31ST AVENUE N	12	2	8	
20	INLAND ST and MERRIS LANE	32	7	22	
21	34TH AVENUE N	9	3	6	
22	DUFFY & 35TH AVENUE N	14	3	12	

	REPETITIVE LOSS AREA	STRUCTURES	REPETITIVE LOSS STRUCTURES	FLOOD INSURANCE POLICIES	MITIGATED REP LOSS STRUCTURES
24	OCEAN BLVD & 38TH AVENUE N	19	5	17	
25	LAKE DRIVE	9	2	5	
26	42ND AVENUE N	10	2	4	
27	OCEAN BLVD & 42ND AVENUE N	6	1	4	
28	43RD AVENUE N	8	2	7	
29	RICE DR	8	4	6	
30	OCEAN BLVD & 44TH AVENUE N	13	3	11	
31	45TH AVENUE N	14	4	11	
32	46TH AVENUE N	11	2	6	
33	OCEAN BLVD & 47TH AVENUE N	6	2	5	
34	47TH AVENUE N	15	6	10	1
35	LAKE & 47TH AVENUE N	16	4	7	1
36	48TH AVENUE N	6	3	4	
37	49TH AVENUE N	9	2	9	
38	OCEAN BLVD & 50TH AVENUE N	19	3	14	
39	50TH AVENUE N	19	6	14	
40	51ST AVENUE N	7	3	6	
41	52ND AVENUE N	16	4	9	
42	53RD AVENUE N	21	6	13	
43	54TH AVENUE N	25	2	15	
44	55TH AVENUE N	40	11	34	
45	56TH AVENUE N	27	6	15	
46	CHANNEL STREET	62	9	49	1
47	OCEAN BLVD & 60TH AVENUE N	9	2	5	
48	62ND AVENUE N	16	4	13	
	MITIGATED PROP NOT IN RL AREAS	0	0		9
	UNABLE TO LOCATE – NO BUILDING	0	0		6
	TOTAL	785	195	538	31

4.6 Outreach – Program for Public Information

A survey of repetitive loss property owners was conducted so the PPI Committee could determine how much repetitive loss property owners understand about the flood hazard and their mitigation options. The Program for Public Information included as Chapter 7 of the Hazard Mitigation Plan has several recommendations for outreach to repetitive loss property owners. For example, the public outreach to repetitive loss property owners should include topics such as:

- ✓ WHAT SHOULD I KNOW ABOUT FLOOD INSURANCE?
- ✓ WHY ARE MY FLOOD INSURANCE PREMIUMS INCREASING?
- ✓ WHAT DOES FREE OF OBSTRUCTION MEAN?
- ✓ WHAT CAN I DO TO LOWER THE COST OF MY FLOOD INSURANCE PREMIUM?
- ✓ HOW MUCH DOES MY ENCLOSURE INCREASE MY FLOOD INSURANCE PREMIUM?
- ✓ WHY SHOULD I GET AN ELEVATION CERTIFICATE?

Responses from the Property Owner Questionnaire		
Question	**Number of Responses**	**Percentage**
Total Respondents	336	43%
Those who KNOW their property has flooded in the past	189	56%
Those who KNOW of water in their lower enclosed area	69	37%
Those who KNOW of water in their first-floor area	42	22%
Those who have taken flood mitigation measures	213	63%
Removed enclosure	4	
Elevated electrical equipment	97	
Elevated AC/heat pump	174	
Installed flood vents	65	
Elevated house/building	69	
This is their primary residence	70	22%
Have a flood insurance policy	277	82%
Interested in pursuing mitigation measures	205	61%

Twenty-two percent (22%) of those responding to the questionnaire indicated the building included in the survey is their primary home. This is a slightly higher response than the primary home ownership percentage for the city.

While most of the property owners live elsewhere, over half (56%) were aware that their property had flooded at some point. Many are aware because they continue to get flooding during heavy rains, especially on a high tide.

The thing that was a surprise is the number of property owners who report having taken some mitigation action to reduce flood losses at their property. 213 or 63% of those responding to the questionnaire reported completing some flood mitigation action. Most reported elevating electrical or mechanical equipment servicing the building. However,69 said they had elevated their home. Most of the homes reported as elevated are not on the FEMA repetitive loss list. Several continue to be at risk of flooding because enclosures have been constructed below the elevated building.

277 or 82% of the respondents said they have a current flood insurance policy. A few indicated they did not renew their policy because of the increased premium cost. The PPI Committee recognizes this will probably be a growing trend. The committee decided to focus some of its activity on messages about the importance of financial protection that comes with carrying a flood insurance policy and wind coverage.

While 63% of the respondents to the survey indicated they have already taken measures to reduce the potential for flood loss at their property, 61% said they were interested in receiving additional information on flood loss reduction measures.

4.7 Potential Flood Hazard Mitigation Measures

Addressing repetitive flood losses is one of the priorities of the Hazard Mitigation Plan. The Plan tentatively identified possible mitigation projects and funding sources for the various property protection measures. The plan stated “The specific measure to use on each property should be determined by an audit of the building and the owner’s preferences. In each case, no action should be taken without the owner’s full willing cooperation.”

Six alternative approaches for protecting properties from flooding were analyzed:

- A flood control project that would stop the flooding
- Constructing small levees or floodwalls around one or more houses
- Buying out and clearing the properties in the flood hazard area
- Elevating the houses above the 100-year flood level

— Removing enclosures below the lowest floor
— Purchasing flood insurance coverage on the building

Each approach has its pros and cons. The last four are considered "nonstructural" approaches. More detailed discussion of nonstructural approaches can be found in the references listed at the end of this report.

Flood Control: Constructing a floodwall around the neighborhood is neither economically feasible nor environmentally acceptable. Since it is not supported by the residents it is not politically feasible either.

In each situation the project would require:

- the purchase and removal of buildings in order to locate the floodwall,

- either the destruction of coastal wetlands or the removal of additional buildings in order to create a setback to protect the wetlands,

- a method to close openings that allow access to the neighborhood, and

- a wall constructed to withstand the forces of coastal waves along certain sections.

Barriers: Small levees, berms or floodwalls might be constructed around one or more properties. These could provide different levels of protection, depending on how high they were.

Barriers require:

- Adequate room on the lot. An earthen barrier needs 6 feet for each foot in height. Less room is needed for a concrete barrier, but they are more expensive.

- A system that collects water that falls or seeps into the protected area and pumps it outside the barrier.

- Relatively impervious soils to minimize underseepage.

- A method to close openings. Generally, this requires "human intervention," meaning someone needs to be available and have enough time to take action.

Local barriers are not recommended for flood depths greater than 3 feet. Based on surveyed elevations of the lowest adjacent grades and the protection level required,

including one foot of freeboard, the project is not recommended. Soils in the area present additional engineering concerns.

Buyout: This measure involves buying one or more properties and clearing the site. If FEMA funds are to be used, three requirements apply:

- The applicant for FEMA funds must demonstrate that the benefits exceed the costs, using FEMA's benefit/cost software,

- The owner must be a willing seller, and

- The parcel would be deeded to a public agency that agrees to keep in forever in open space.

None of the respondents in the survey of property owners expressed a desire to sell their property to the City.

Elevation: Raising the structure above the flood level is generally viewed as the best flood protection measure short of removing the building from the floodplain. It is usually cost-effective for buildings on crawlspaces because it is easiest to get lifting equipment under the floor and disruption of the habitable part of the house is minimal.

Most of the cost to elevate a building is in the mobilization and foundation construction. Thus, elevating a structure to the 100-year flood level increases the costs relatively little compared to elevating just to the 10-year level. Further, FEMA will only fund a project that is elevated to at least the 100-year level.

Most of the homes in repetitive loss areas are on piling or crawlspace foundations. Elevating the houses three feet above the 100-year flood level would raise them 6 feet to 9 feet above grade. Elevating the houses gives the property owner an extra margin of flood protection, and allows parking below the house.

Under FEMA regulations and the City Code the area below the elevated building in the SFHA can only be used for building access, parking or storage. To receive grant assistance the City requires owners to agree to not convert this area to an improved, damage-prone use. This is accomplished using a "non-conversion agreement" which is filed with the property's deed.

FEMA mitigation grants can fund the elevation of a structure above the 100-year flood level. As with an acquisition project, the calculated benefits must exceed the costs. The most important factor is depth of flooding.

North Myrtle Beach Elevation Project. The City has received a planning grant from FEMA to identify up to 10 repetitive loss buildings to be elevated. Over twenty property owners in the repetitive loss areas have expressed an interest in participating in the project.

The City is currently waiting on new flood insurance rate maps so that the benefit/cost ratios and elevation standards can be established.

There are nine buildings in the repetitive loss area with slab foundations. None of the property owners have expressed willingness for their property to be considered for an elevation grant.

These buildings will need an engineering evaluation before elevation can be considered.

Removal of Enclosures Below Elevated Structures. Removal of the enclosure below an elevated structure may be a very cost-effective way for property owners to reduce the flood risk for the building. Plus, the insurance premium reduction benefits make this such an attractive approach that some property owners undertake the removal of enclosures without grant assistance from the City, State or FEMA.

Flood Insurance. Only 67% percent of the repetitive loss neighborhood respondents to the questionnaire stated they have a current NFIP flood insurance policy.

Although not a mitigation measure that reduces property damage from a flood, a flood insurance policy has the following advantages:

- Many floods do not reach conditions sever enough for a disaster declaration. Therefore, flood insurance may be the only source of assistance to help owners of flood damaged property pay for cleanup and repairs.

- Even with a disaster declaration the only assistance to repair the building may be through a loan that must be repaid to the Federal Agency.

- A policy is always in effect − there is no need for human intervention.

- A policy will cover damage caused by any flood. It is an excellent “backup” for an elevation project where the flood is higher than the protection level.

- Coverage is available for the contents of a home or business as well as for the structure.

- Renters can buy contents coverage, even if the building owner does not buy coverage for the structure itself.

Mitigation funding: There is a special funding provision in the NFIP for insured buildings that have been substantially or repetitively damaged by a flood, “Increased Cost of Compliance.” ICC coverage pays for the cost to comply with floodplain management regulations after a flood if the building has been declared substantially damaged or repetitively damaged. This payment is in addition to the damage claim payment that would be made under the regular policy coverage. In certain cases, an ICC claim can be paid if the building is repetitively flooded and has had two or more claims averaging
25 percent or more of the building’s value within a 10-year period.

ICC will pay up to $30,000 to help cover elevation, relocation, demolition, and (for nonresidential buildings) floodproofing. ICC is available for any flood insurance claim and, therefore, is not dependent on the community receiving a disaster declaration.

Coverage under the ICC does have limitations:

- It covers only damage caused by a flood;
- The building’s flood insurance policy must have been in effect during the flood;

- ICC payments are limited to $30,000 per structure; and
- Claims must be accompanied by a substantial or repetitive damage determination made by the local floodplain administrator.

4.8 Coordination

There are only a few agencies and organizations that could participate in a flood mitigation project with the City of North Myrtle Beach. The following were contacted by the consulting team:

- FEMA was contacted for flood insurance data.
- A mitigation planning grant has been awarded by FEMA and the State to the City to examine the feasibility of elevating 10 repetitive loss structures.
- The State NFIP Coordinator was contacted for an update on the status of the Flood Insurance Study and a grant extension.
- The South Carolina Department of Natural Resources was contacted concerning environmental rules and permits.
- The US Army Corps of Engineers, Charleston District was contacted concerning coastal wetlands regulations.
- The historical status of structures is being coordinated with the State Historic Preservation Officer.

4.9 Summary of Findings

- ✓ Elevation of the building by removal of an enclosure below an elevated structure is the most appropriate protection measure for many buildings on piling or column foundations.
- ✓ Where necessary to achieve increased protection above the regulatory flood protection level (BFE plus 1 foot) elevation of the structure is appropriate.
- ✓ Given the low benefit/cost ratios and the lack of outside funding, acquisition and clearance of properties is generally not a feasible option.
- ✓ Purchasing flood insurance is a wise investment.

The advantages and disadvantages of the six approaches are summarized in the table below.

Summary of the Alternative Mitigation Measures		
Measures	**Advantages**	**Disadvantages**
Flood Control	Can provide protection for low level flood events	High cost Not environmentally acceptable

Summary of the Alternative Mitigation Measures		
Barriers	Effective for low flood events if water goes down quickly	High cost Subject to seepage in coastal soils Dependent on human intervention
Buyout	100% flood protection	High cost Low benefit/cost ratios mean FEMA funding unlikely
Removal of Enclosures	Reduce cost of flood insurance Lower cost than elevating structure May provide Reg. Flood Protection	May not provide meet regulatory flood protection level requirements.
Elevation	Can provide protection for deep flooding and wave action Creates area for covered parking and storage Flood Insurance premium reduction	Cost can be $35,000 or higher. Low benefit/cost ratios mean FEMA funding unlikely
Flood Insurance	Always in effect Works for all levels of flooding ICC can provide a source of funding for buyout or elevation	Does not prevent flood damage


LEWIS CIR
EYERLY ST
LEWIS ST
HEDRICK ST
WOODLAND ST
SURF ST
47TH AVE S
SEAVIEW ST
NORTH MYRTLE BEACH
SOUTH CAROLINA
Windy Hill RL Area
0
100
200
400
Feet
Legend
Repetitive Loss Area

WINDY HILL REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	28	9
With Flood Insurance	17	6
Value of Structures	$5,020,600	$772,350
Number Under Insured for Flood	14	0
Foundation Types		
Piling	18	3
Pier and Wall	3	2
Slab	7	4
Enclosures		
None	11	5
299 sq. ft. or less	9	1
300 sq. ft. or more	8	3
Vacant Lots	5	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015


LEWIS ST
HEDRICK ST
45TH AVE S
STAN CT
WOODLAND ST
WINDY LN
TODD LN
SHELLY CT
SURF ST
46TH AVE S
SEAVIEW ST
S OCEAN BLVD
NORTH MYRTLE BEACH
45th Avenue S RL Area
0
100
200
400
Feet
Legend
Repetitive Loss Area

45th AVENUE SOUTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	7	1
With Flood Insurance	6	1
Value of Structures	$20,870,000	$1,241,500
Number Under Insured for Flood	4	1
Foundation Types		
Piling	5	1
Pier and Wall	0	0
Slab	2	0
Enclosures		
None	3	0
299 sq. ft. or less	2	1
300 sq. ft. or more	2	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015


ACORN WAY
NORAME
38TH AVE S
42ND AVE S
DUNES ST
39TH AVE S
DUNES ST
SEAVIEW ST
41ST AVE S
S OCEAN BLVD
NORTH MYRTLE BEACH
39th Avenue S RL Area
0
100
200
400
Feet
Legend
Repetitive Loss Area

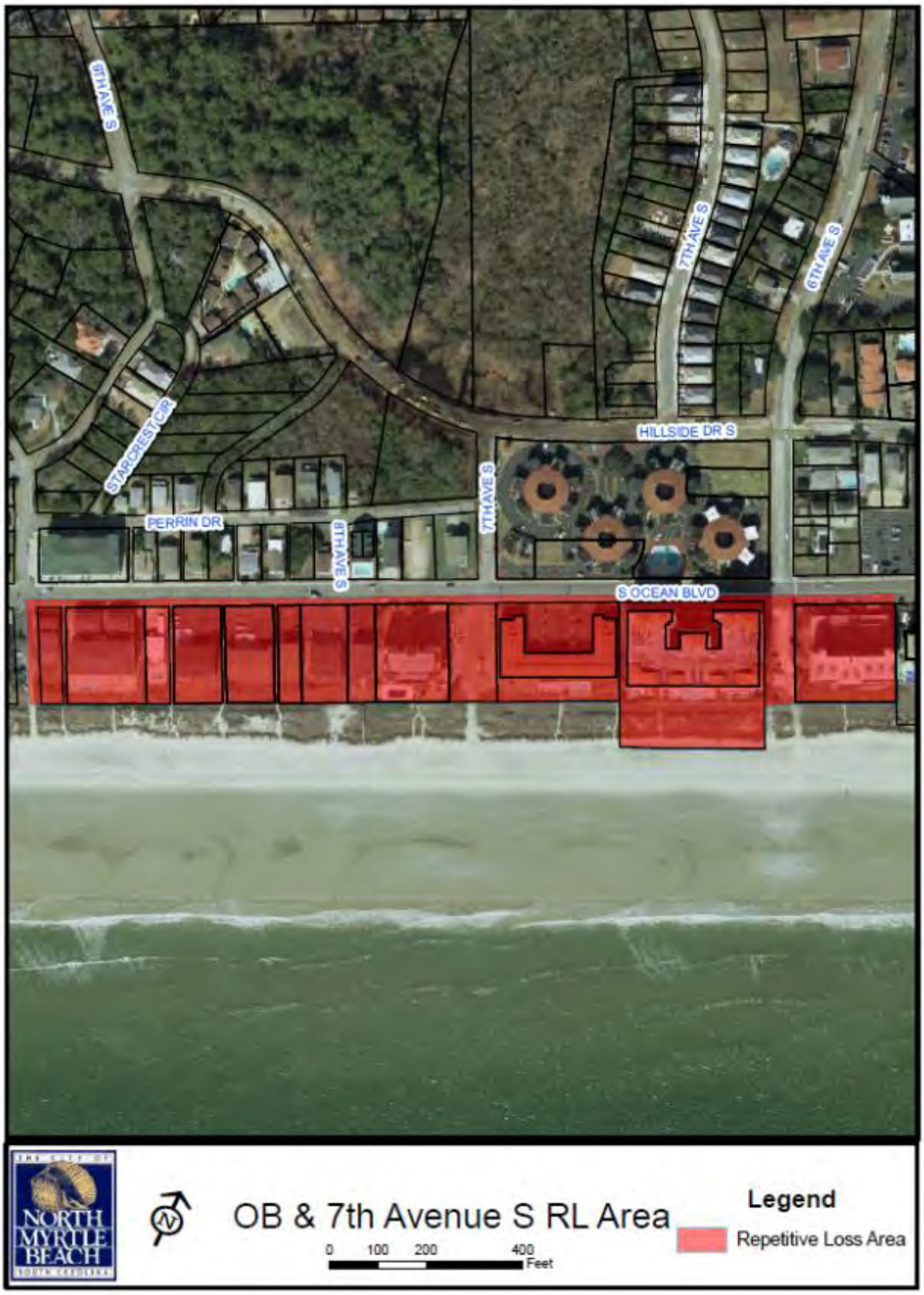
39TH AVENUE SOUTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	4	1
With Flood Insurance	3	0
Value of Structures	$16,187,600	$3,534,800
Number Under Insured for Flood	3	1
Foundation Types		
Piling	3	1
Pier and Wall	0	0
Slab	1	0
Enclosures		
None	1	0
299 sq. ft. or less	1	0
300 sq. ft. or more	2	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015


HILLSIDE DR S
STARCREST CIR
PERRIN DR
9TH AVE S
8TH AVE S
7TH AVE S
S OCEAN BLVD
NORTH MYRTLE BEACH
Perrin Drive RL Area
0
100
200
400
Feet
Legend
Repetitive Loss Area

PERRIN STREET REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	9	3
With Flood Insurance	5	2
Value of Structures	$842,200	$286,700
Number Under Insured for Flood	4	1
Foundation Types		
Piling	6	2
Pier and Wall	2	0
Slab	1	1
Enclosures		
None	2	1
299 sq. ft. or less	6	2
300 sq. ft. or more	1	0
Vacant Lots	1	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015


9TH AVE S
7TH AVE S
6TH AVE S
STARCREST CIR
HILLSIDE DR S
7TH AVE S
PERRIN DR
8TH AVE S
S OCEAN BLVD
NORTH MYRTLE BEACH
OB & 7th Avenue S RL Area
0 100 200 400
Feet
Legend
Repetitive Loss Area

OB & 7TH AVENUE SOUTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	15	7
With Flood Insurance	11	7
Value of Structures	$95,187,900	$31,265,100
Number Under Insured for Flood	10	5
Foundation Types		
Piling	9	3
Pier and Wall	4	2
Slab	2	2
Enclosures		
None	2	2
299 sq. ft. or less	3	0
300 sq. ft. or more	10	5
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

OB & 9th Avenue S RL Area

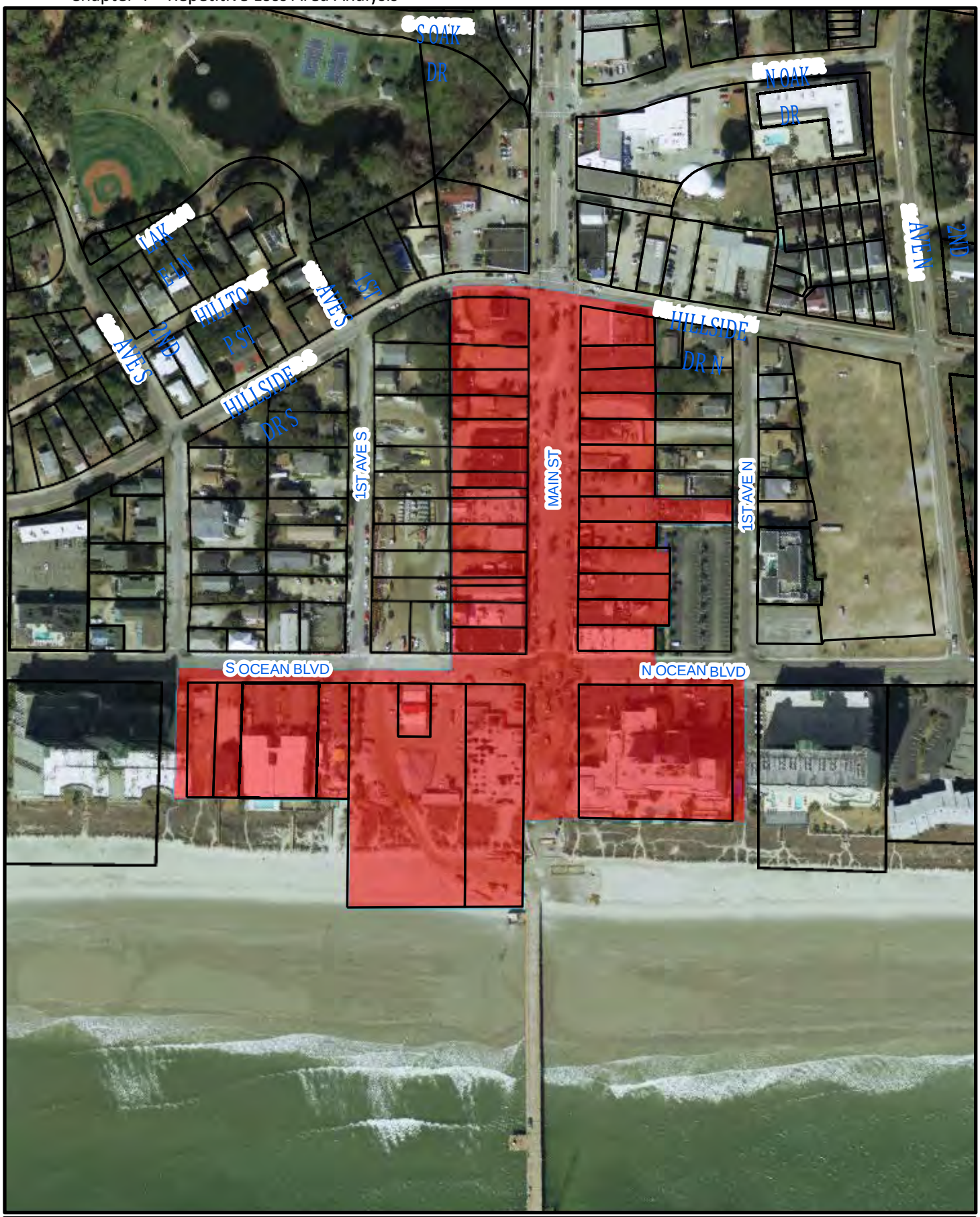
0 100 200 400 Feet

Legend

Repetitive Loss Area

OB & 9TH AVENUE SOUTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	6	1
With Flood Insurance	3	0
Value of Structures	$547,800	$236,800
Number Under Insured for Flood	3	1
Foundation Types		
Piling	2	0
Pier and Wall	0	0
Slab	4	1
Enclosures		
None	4	1
299 sq. ft. or less	1	0
300 sq. ft. or more	1	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

Main Street RL Area

0 100 200 400
Feet

Legend

Repetitive Loss Area

MAIN STREET REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	34	7
With Flood Insurance	18	4
Value of Structures	$10,013,000	$1,184,200
Number Under Insured for Flood	20	3
Foundation Types		
Piling	3	0
Pier and Wall	1	0
Slab	30	7
Enclosures		
None	30	7
299 sq. ft. or less	0	0
300 sq. ft. or more	4	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

8th Avenue N RL Area

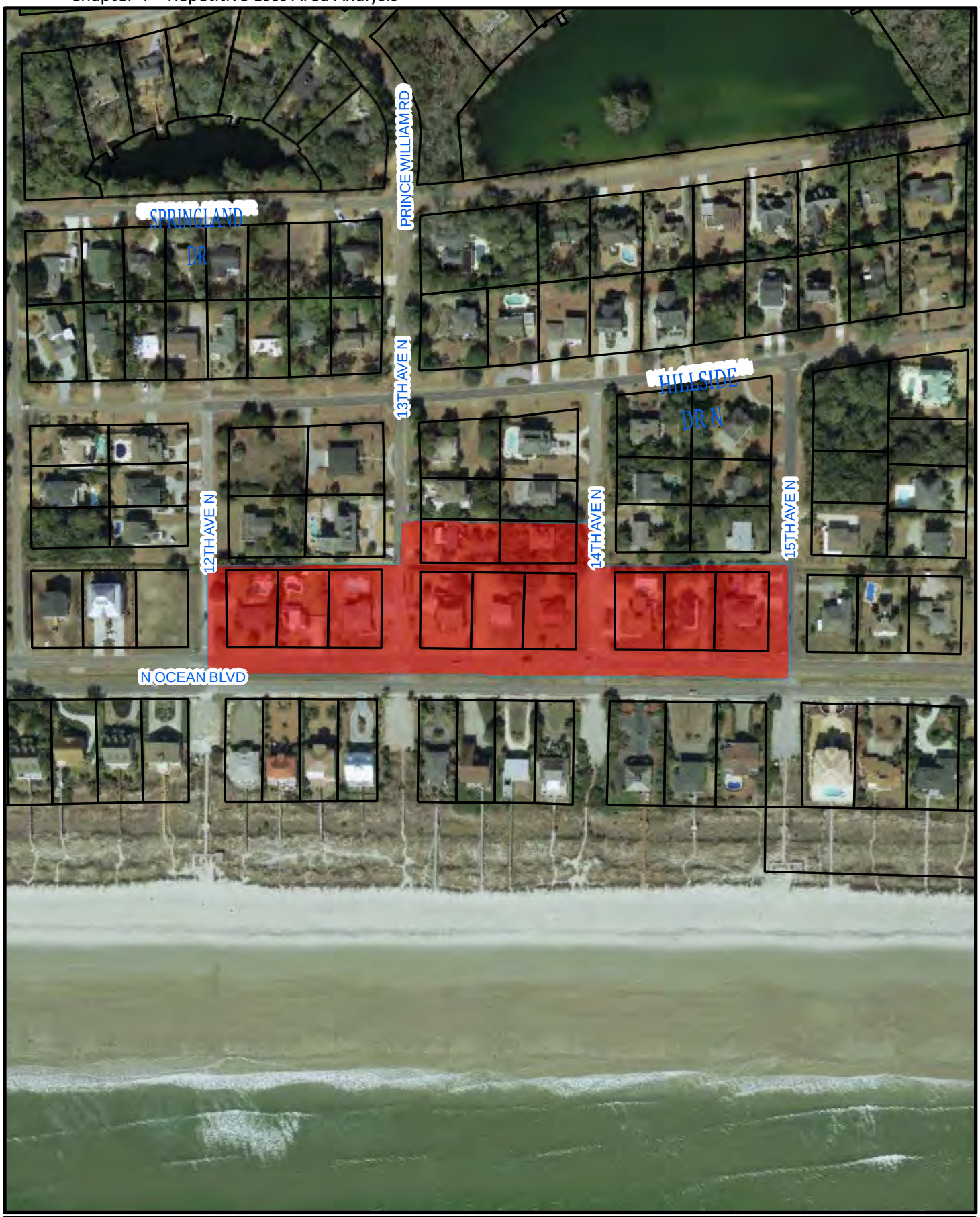
0 100 200 400 Feet

Legend

Repetitive Loss Area

8TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	8	2
With Flood Insurance	6	2
Value of Structures	$2,022,900	$343,900
Number Under Insured for Flood	4	0
Foundation Types		
Piling	3	0
Pier and Wall	2	1
Slab	3	1
Enclosures		
None	3	1
299 sq. ft. or less	3	0
300 sq. ft. or more	2	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

13th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

13TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	12	3
With Flood Insurance	10	3
Value of Structures	$2,015,300	$448,400
Number Under Insured for Flood	3	0
Foundation Types		
Piling	6	2
Pier and Wall	0	0
Slab	6	1
Enclosures		
None	6	1
299 sq. ft. or less	0	0
300 sq. ft. or more	6	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

17th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

17TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	17	4
With Flood Insurance	9	2
Value of Structures	$3,502,600	$1,090,200
Number Under Insured for Flood	10	3
Foundation Types		
Piling	11	2
Pier and Wall	2	1
Slab	4	1
Enclosures		
None	4	1
299 sq. ft. or less	5	1
300 sq. ft. or more	8	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

20th Avenue N RL Area

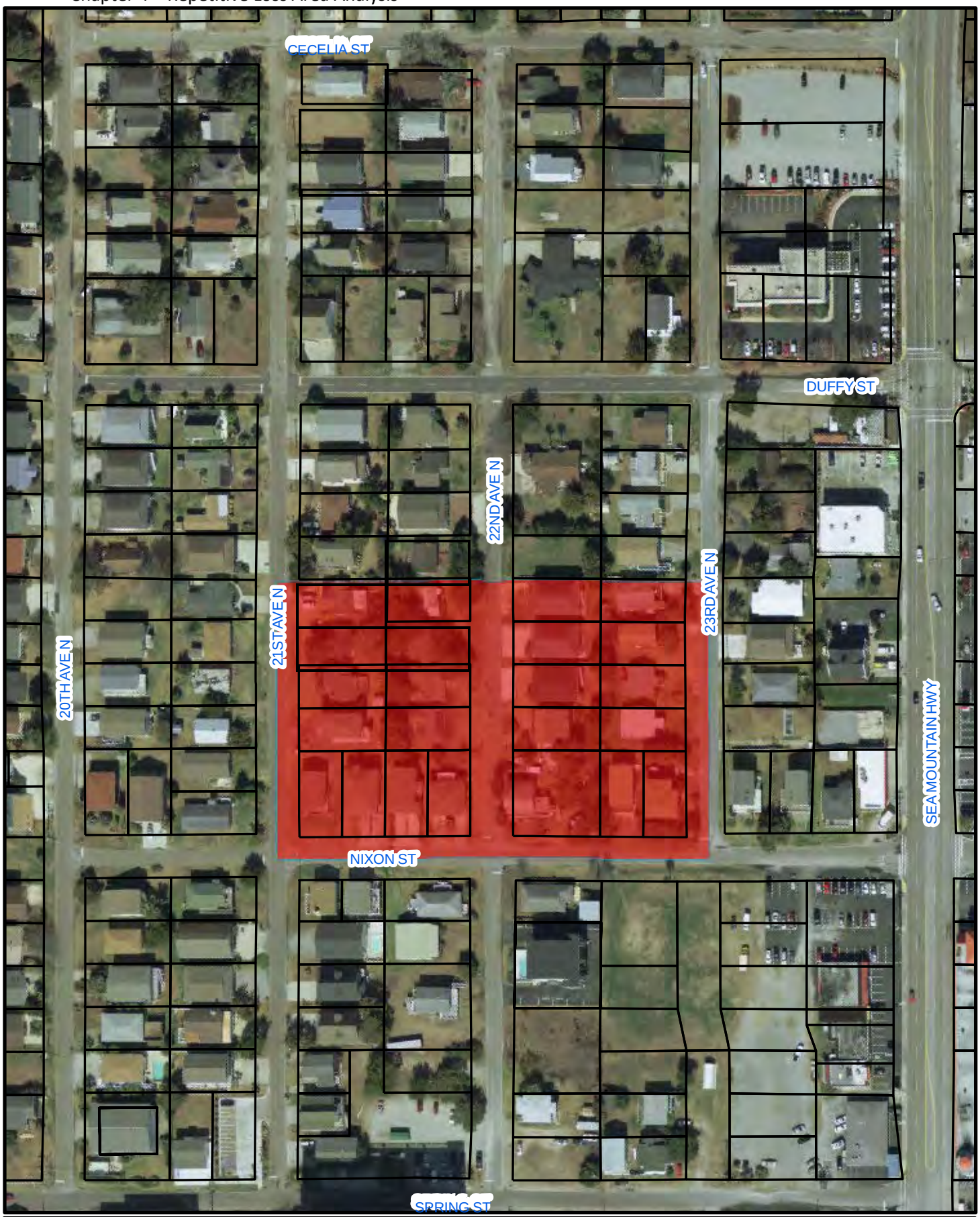
0 100 200 400 Feet

Legend

Repetitive Loss Area

20TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	8	3
With Flood Insurance	6	3
Value of Structures	$5,127,800	$3,230,800
Number Under Insured for Flood	4	3
Foundation Types		
Piling	3	1
Pier and Wall	1	0
Slab	4	2
Enclosures		
None	4	2
299 sq. ft. or less	2	1
300 sq. ft. or more	2	0
Vacant Lots	1	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

22nd Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

22ND AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	23	6
With Flood Insurance	13	4
Value of Structures	$1,488,200	$327,900
Number Under Insured for Flood	10	2
Foundation Types		
Piling	11	1
Pier and Wall	5	0
Slab	7	5
Enclosures		
None	11	5
299 sq. ft. or less	5	0
300 sq. ft. or more	7	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

23rd Avenue N RL Area

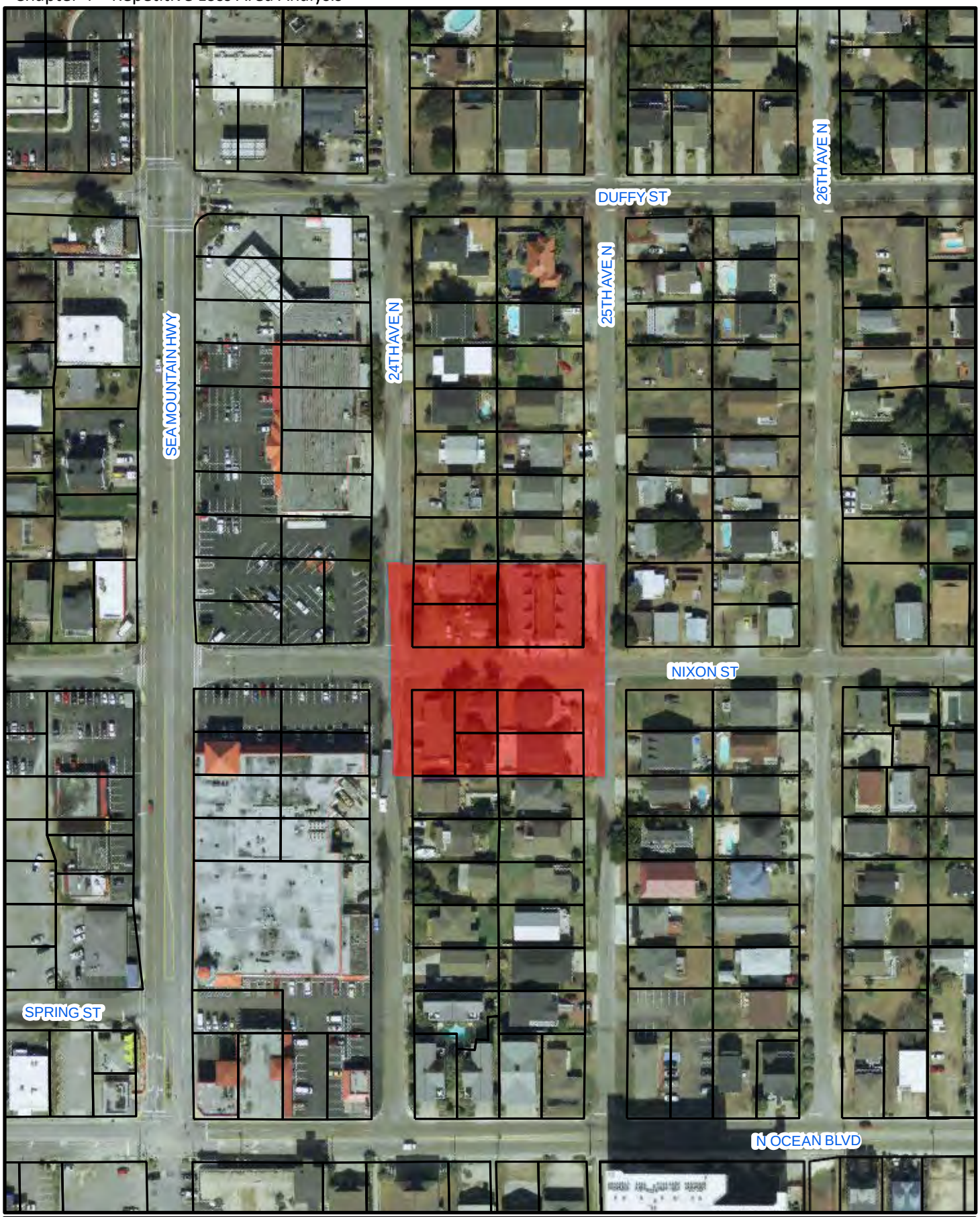
0 100 200 400 Feet

Legend

Repetitive Loss Area

23RD AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	7	1
With Flood Insurance	0	0
Value of Structures	$543,300	$94,500
Number Under Insured for Flood	7	1
Foundation Types		
Piling	5	0
Pier and Wall	1	0
Slab	1	1
Enclosures		
None	1	1
299 sq. ft. or less	1	0
300 sq. ft. or more	5	0
Vacant Lots	1	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

Nixion & 24th Avenue N RL Area

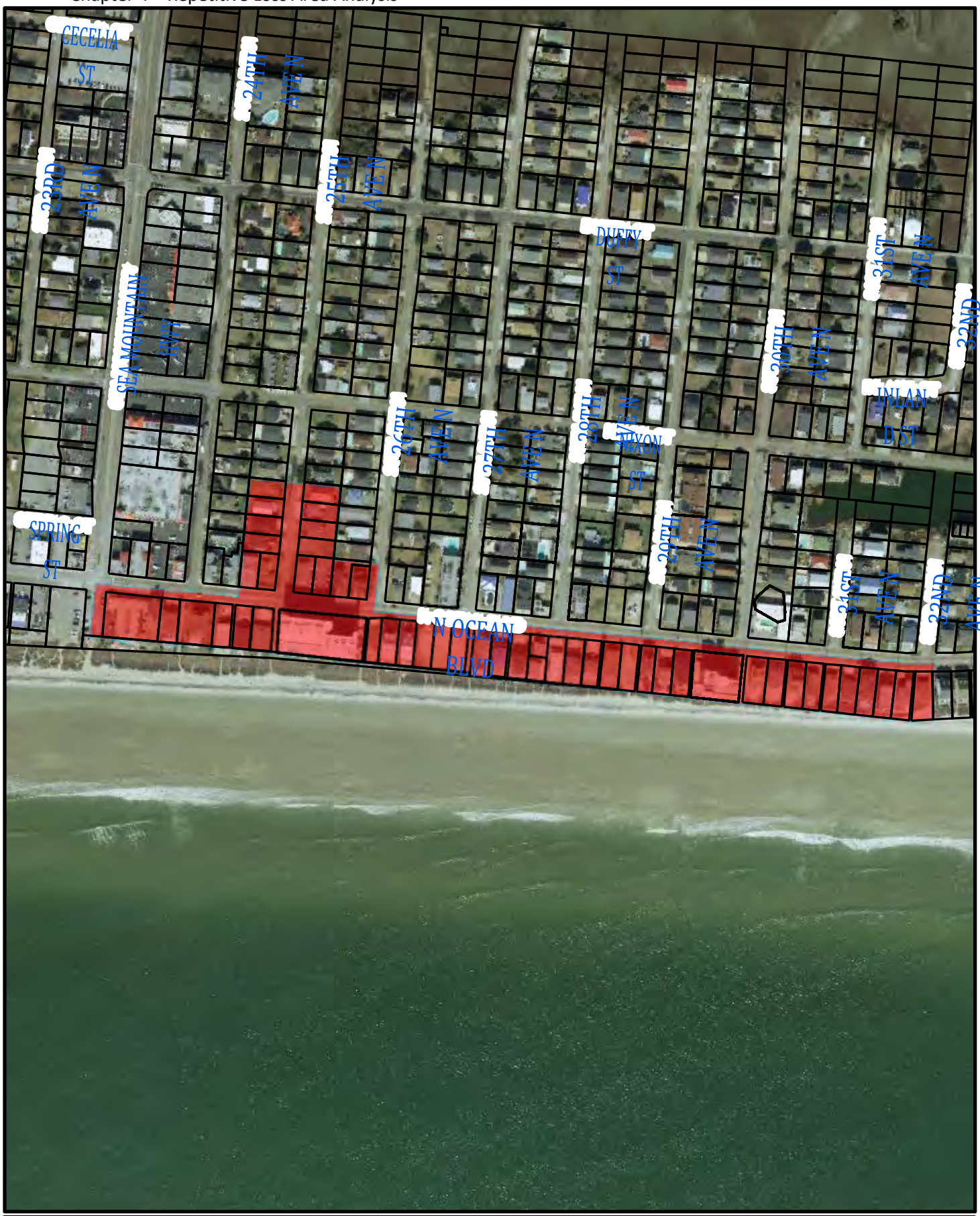
Legend

Repetitive Loss Area

0 100 200 400
Feet

NIXON & 24TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	7	1
With Flood Insurance	2	0
Value of Structures	$906,300	$43,100
Number Under Insured for Flood	5	1
Foundation Types		
Piling	2	0
Pier and Wall	1	0
Slab	4	1
Enclosures		
None	5	1
299 sq. ft. or less	1	0
300 sq. ft. or more	1	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH

OB & 25th Avenue N RL Area

Legend

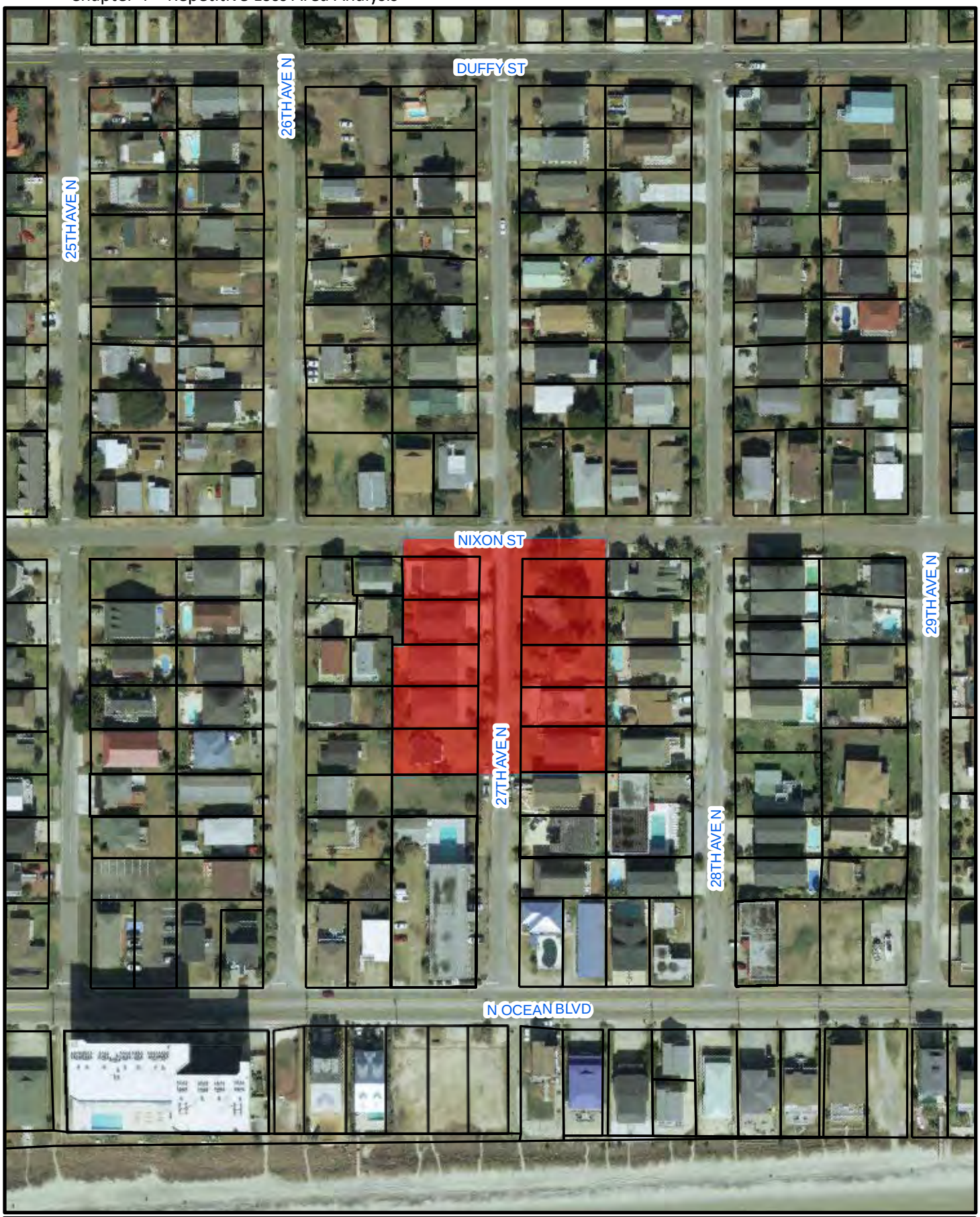
Repetitive Loss Area

0 100 200 400

Feet

OB & 25TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	49	18
With Flood Insurance	33	13
Value of Structures	$24,324,400	$19,012,300
Number Under Insured for Flood	20	5
Foundation Types		
Piling	40	16
Pier and Wall	3	0
Slab	6	2
Enclosures		
None	12	3
299 sq. ft. or less	31	13
300 sq. ft. or more	6	2
Vacant Lots	4	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

27th Avenue N RL Area

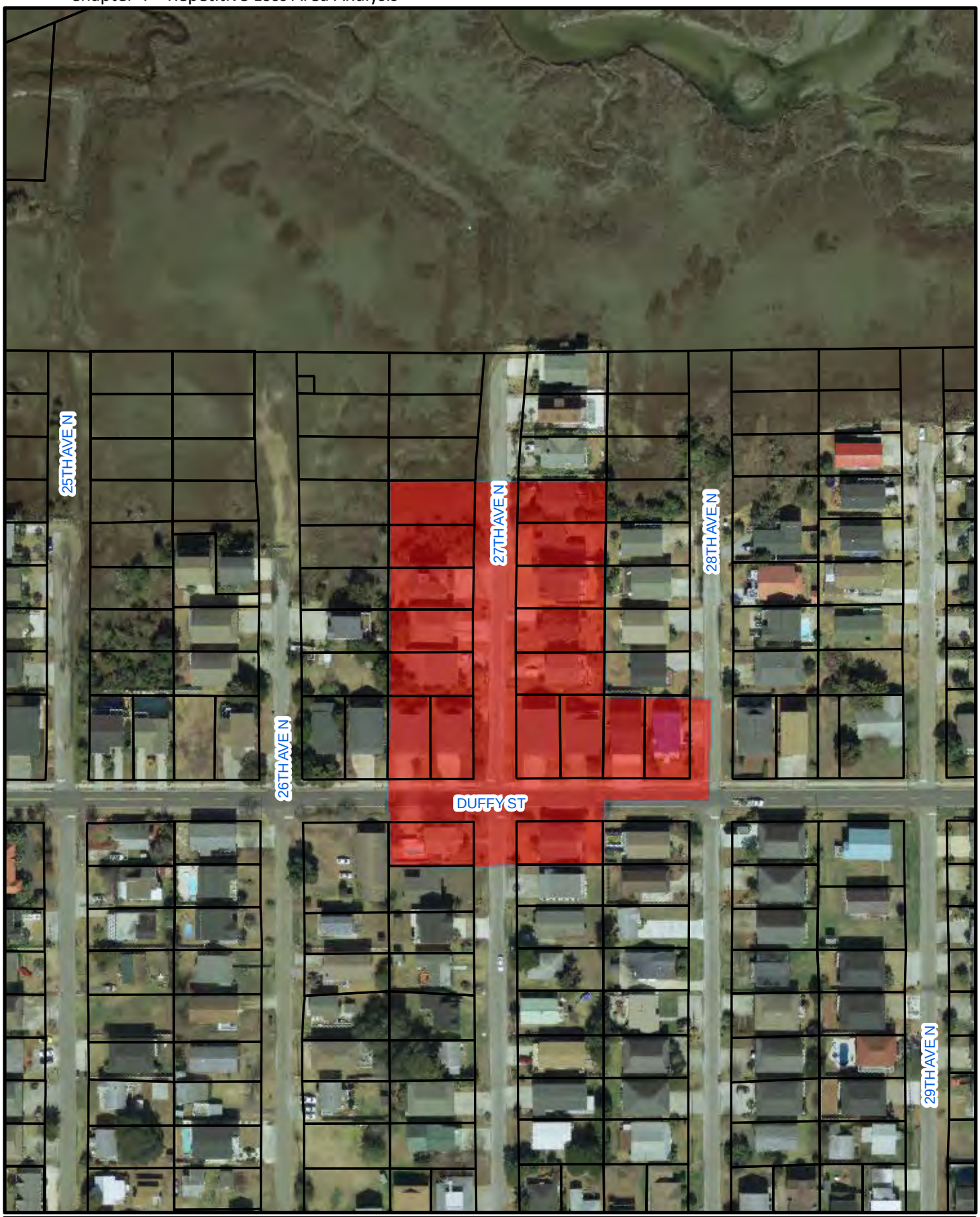
0 100 200 400 Feet

Legend

Repetitive Loss Area

27TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	9	1
With Flood Insurance	6	0
Value of Structures	$608,400	$31,300
Number Under Insured for Flood	3	1
Foundation Types		
Piling	4	0
Pier and Wall	1	0
Slab	4	1
Enclosures		
None	5	1
299 sq. ft. or less	3	0
300 sq. ft. or more	1	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

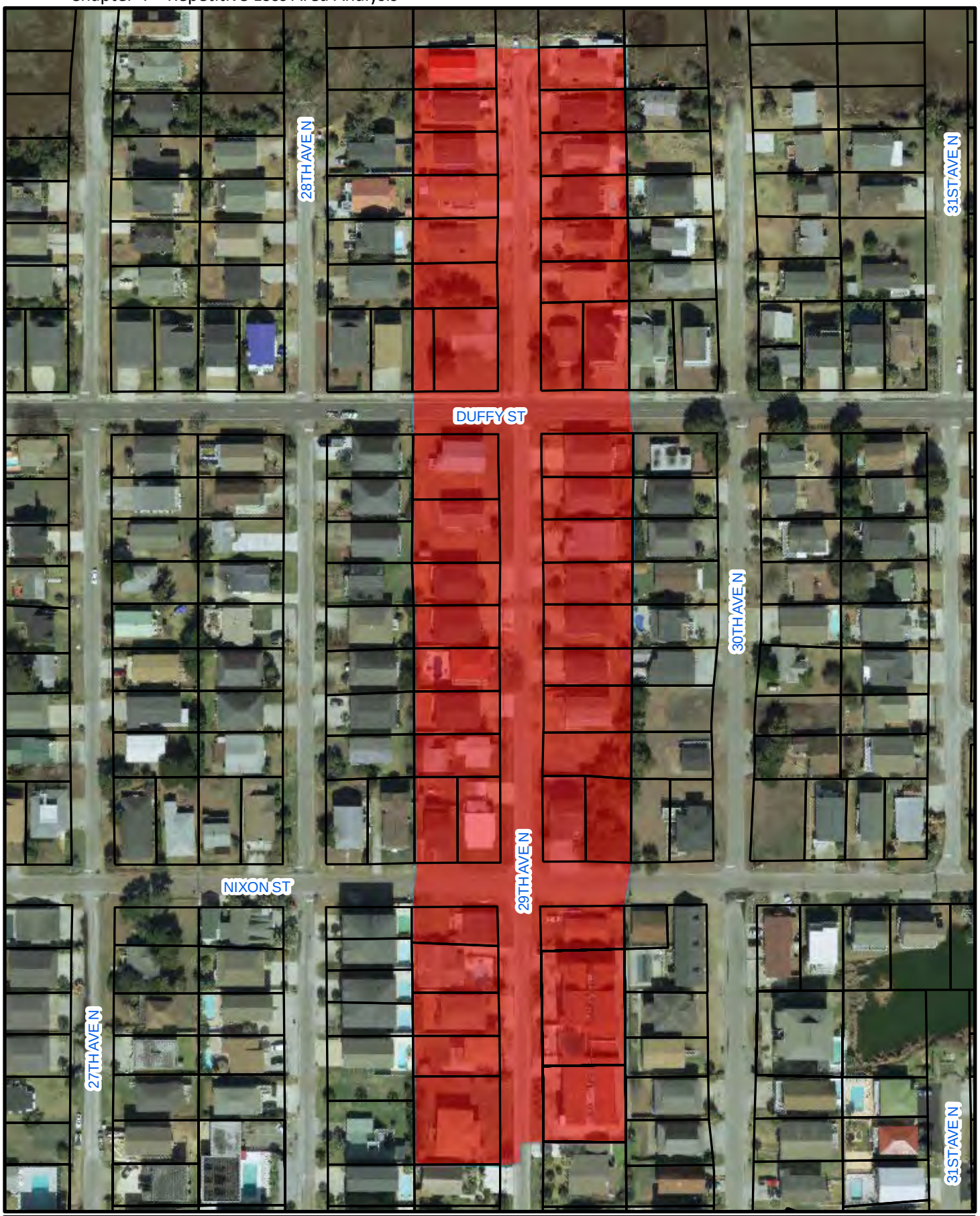
Duffy Street & 27th Avenue N RL Area

Legend

Repetitive Loss Area

DUFFY & 27TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	15	5
With Flood Insurance	8	3
Value of Structures	$1,580,600	$679,700
Number Under Insured for Flood	8	2
Foundation Types		
Piling	10	3
Pier and Wall	4	2
Slab	1	0
Enclosures		
None	2	0
299 sq. ft. or less	9	4
300 sq. ft. or more	4	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

29th Avenue N RL Area

Legend

Repetitive Loss Area

29TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	38	6
With Flood Insurance	26	5
Value of Structures	$4,723,100	$537,300
Number Under Insured for Flood	13	1
Foundation Types		
Piling	22	1
Pier and Wall	9	1
Slab	7	4
Enclosures		
None	7	4
299 sq. ft. or less	20	1
300 sq. ft. or more	11	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

31st Avenue N RL Area

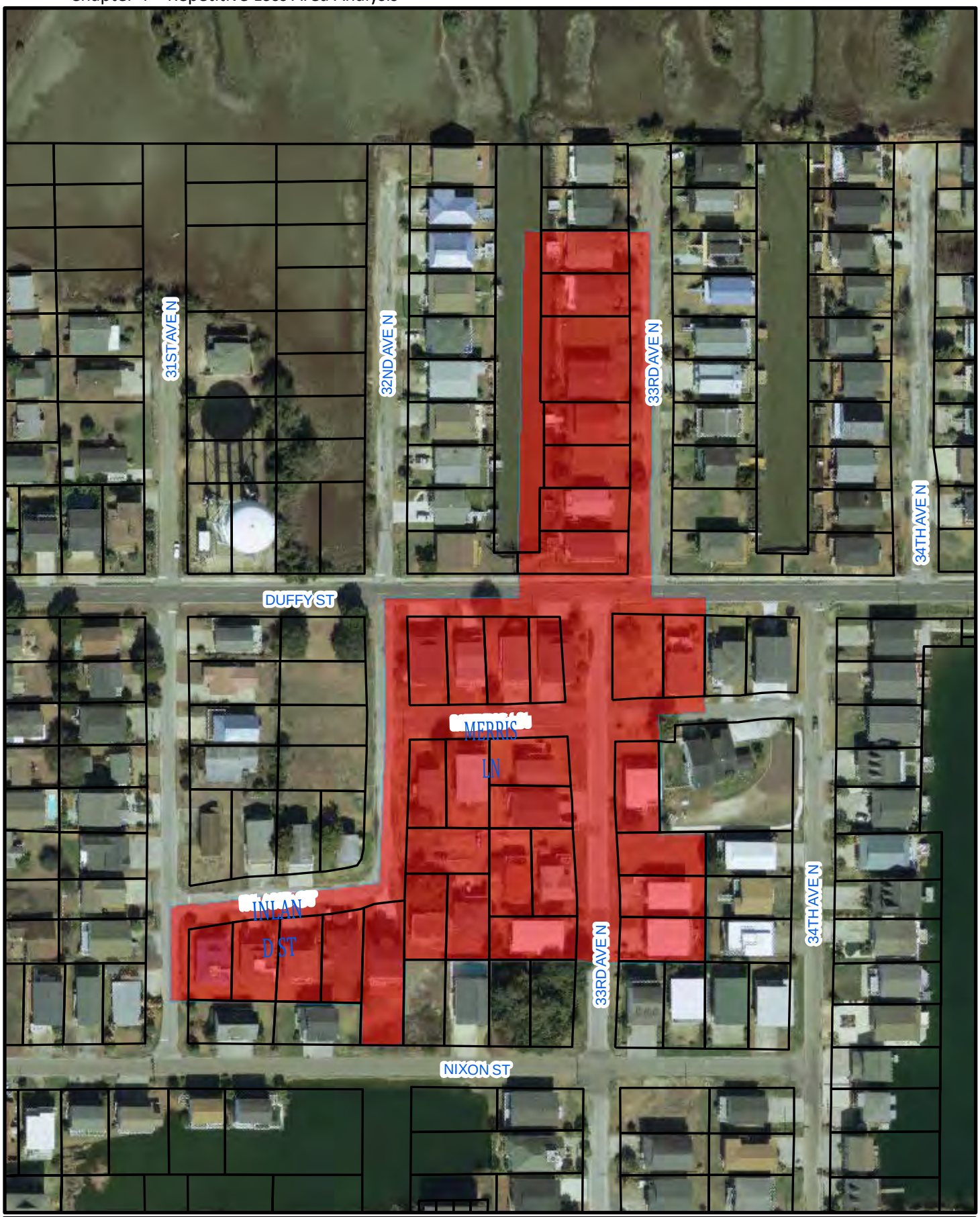
0 100 200 400 Feet

Legend

Repetitive Loss Area

31ST AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	12	2
With Flood Insurance	9	2
Value of Structures	$1,621,100	$171,800
Number Under Insured for Flood	4	0
Foundation Types		
Piling	5	0
Pier and Wall	1	0
Slab	6	2
Enclosures		
None	6	2
299 sq. ft. or less	3	0
300 sq. ft. or more	3	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

Inland & Merris RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

INLAND ST and MERRIS LANE REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	32	7
With Flood Insurance	22	4
Value of Structures	$2,625,800	$559,500
Number Under Insured for Flood	10	3
Foundation Types		
Piling	29	5
Pier and Wall	1	1
Slab	2	1
Enclosures		
None	2	1
299 sq. ft. or less	21	2
300 sq. ft. or more	8	4
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

34th Avenue N RL Area

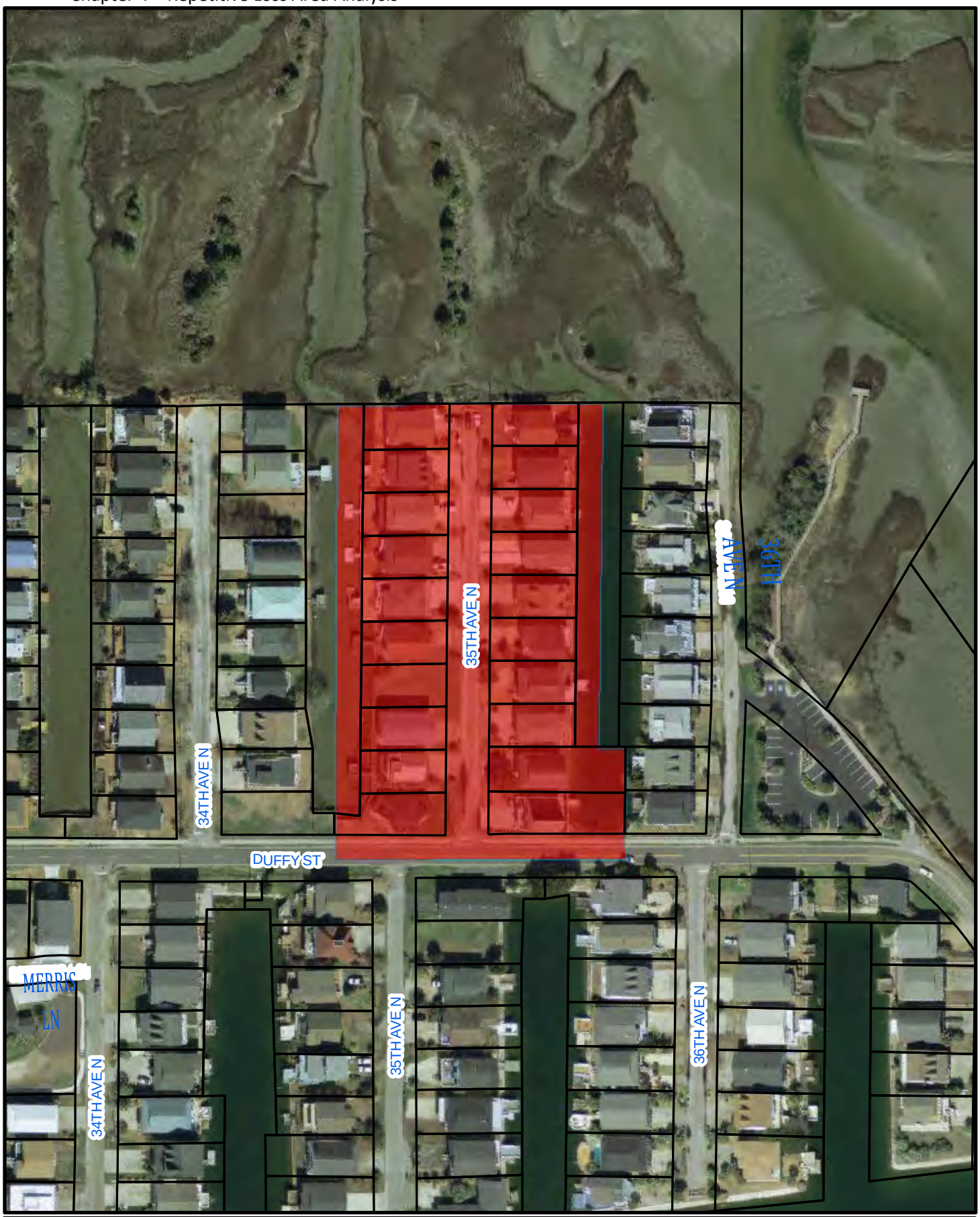
0 100 200 400 Feet

Legend

Repetitive Loss Area

34TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	8	3
With Flood Insurance	5	2
Value of Structures	$872,700	$439,200
Number Under Insured for Flood	3	1
Foundation Types		
Piling	6	1
Pier and Wall	1	1
Slab	1	1
Enclosures		
None	1	1
299 sq. ft. or less	3	1
300 sq. ft. or more	4	2
Vacant Lots	1	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

Duffy & 35th Avenue N RL Area

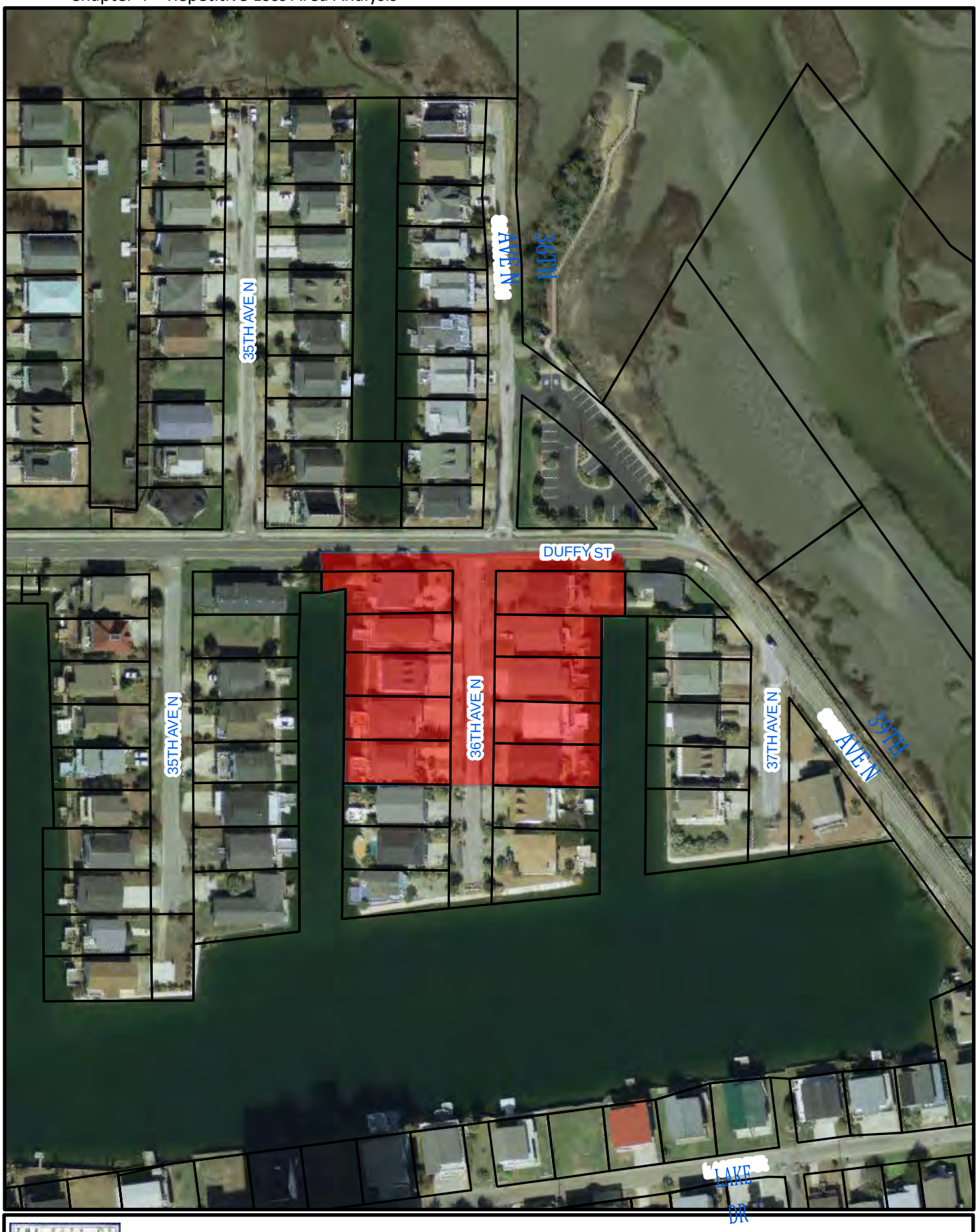
0 100 200 400

Legend

Repetitive Loss Area

DUFFY & 35TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	14	3
With Flood Insurance	12	3
Value of Structures	$1,395,900	$239,400
Number Under Insured for Flood	2	0
Foundation Types		
Piling	13	2
Pier and Wall	0	0
Slab	1	1
Enclosures		
None	1	1
299 sq. ft. or less	12	2
300 sq. ft. or more	1	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

36th Avenue N RL Area

0 100 200 400
Feet

Legend

Repetitive Loss Area

36TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	10	2
With Flood Insurance	6	2
Value of Structures	$1,151,500	$207,500
Number Under Insured for Flood	4	0
Foundation Types		
Piling	10	2
Pier and Wall	0	0
Slab	0	0
Enclosures		
None	0	0
299 sq. ft. or less	9	2
300 sq. ft. or more	1	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

OB &
38th Avenue N RL Area

Legend

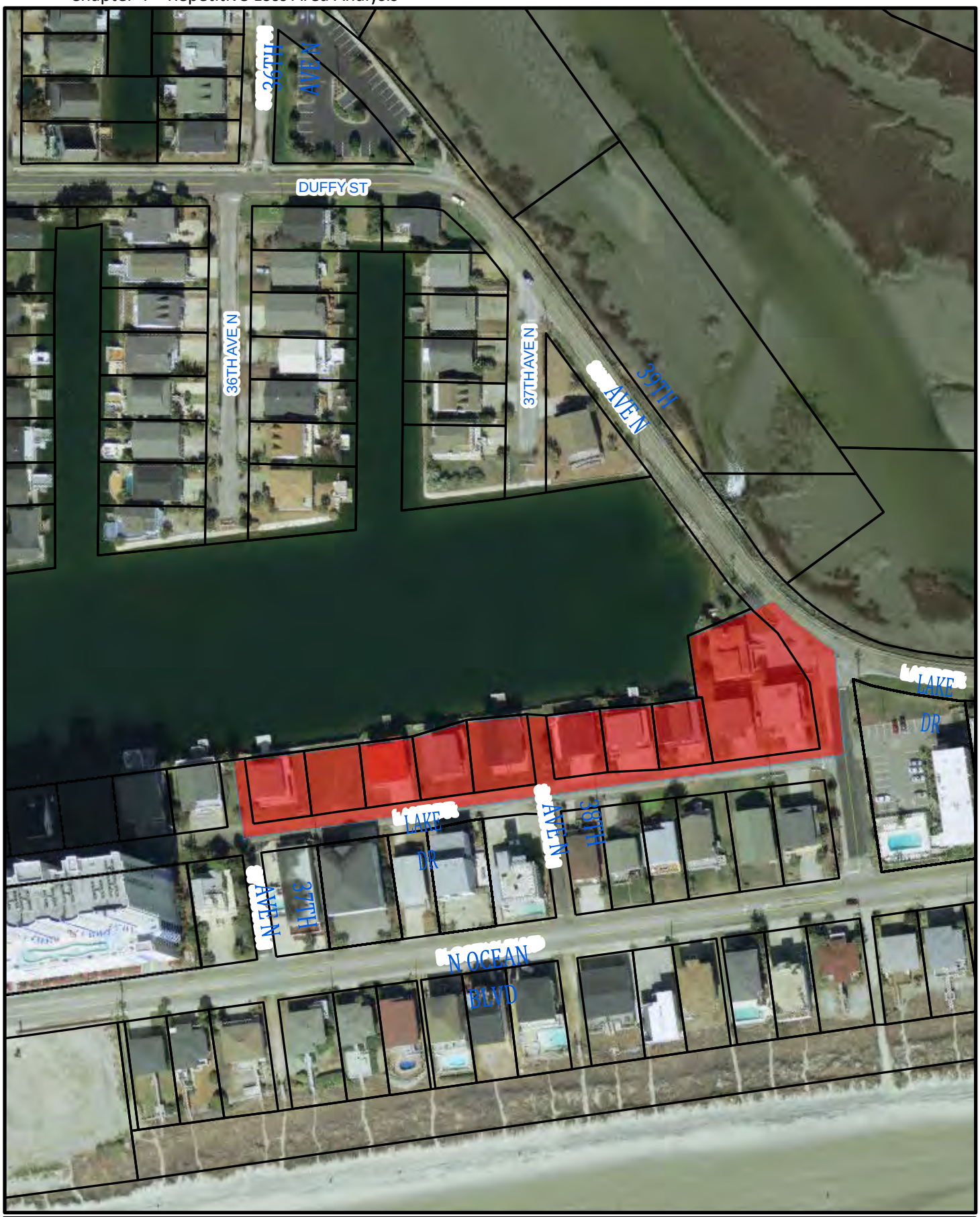
Repetitive Loss Area

0 100 200 400

Feet

OB & 38TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	19	5
With Flood Insurance	17	5
Value of Structures	$14,456,100	$12,686,600
Number Under Insured for Flood	3	0
Foundation Types		
Piling	15	3
Pier and Wall	0	0
Slab	4	2
Enclosures		
None	4	2
299 sq. ft. or less	11	0
300 sq. ft. or more	4	3
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

Lake Street N RL Area

0 100 200 400
Feet

Legend

Repetitive Loss Area

LAKE STREET NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	9	2
With Flood Insurance	5	2
Value of Structures	$1,773,300	$634,900
Number Under Insured for Flood	3	1
Foundation Types		
Piling	8	2
Pier and Wall	0	0
Slab	1	0
Enclosures		
None	1	0
299 sq. ft. or less	6	1
300 sq. ft. or more	2	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

42nd Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

42ND AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	10	2
With Flood Insurance	4	0
Value of Structures	$921,700	$159,400
Number Under Insured for Flood	6	2
Foundation Types		
Piling	10	2
Pier and Wall	0	0
Slab	0	0
Enclosures		
None	1	1
299 sq. ft. or less	9	1
300 sq. ft. or more	0	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

OB & 42nd Avenue N RL Area

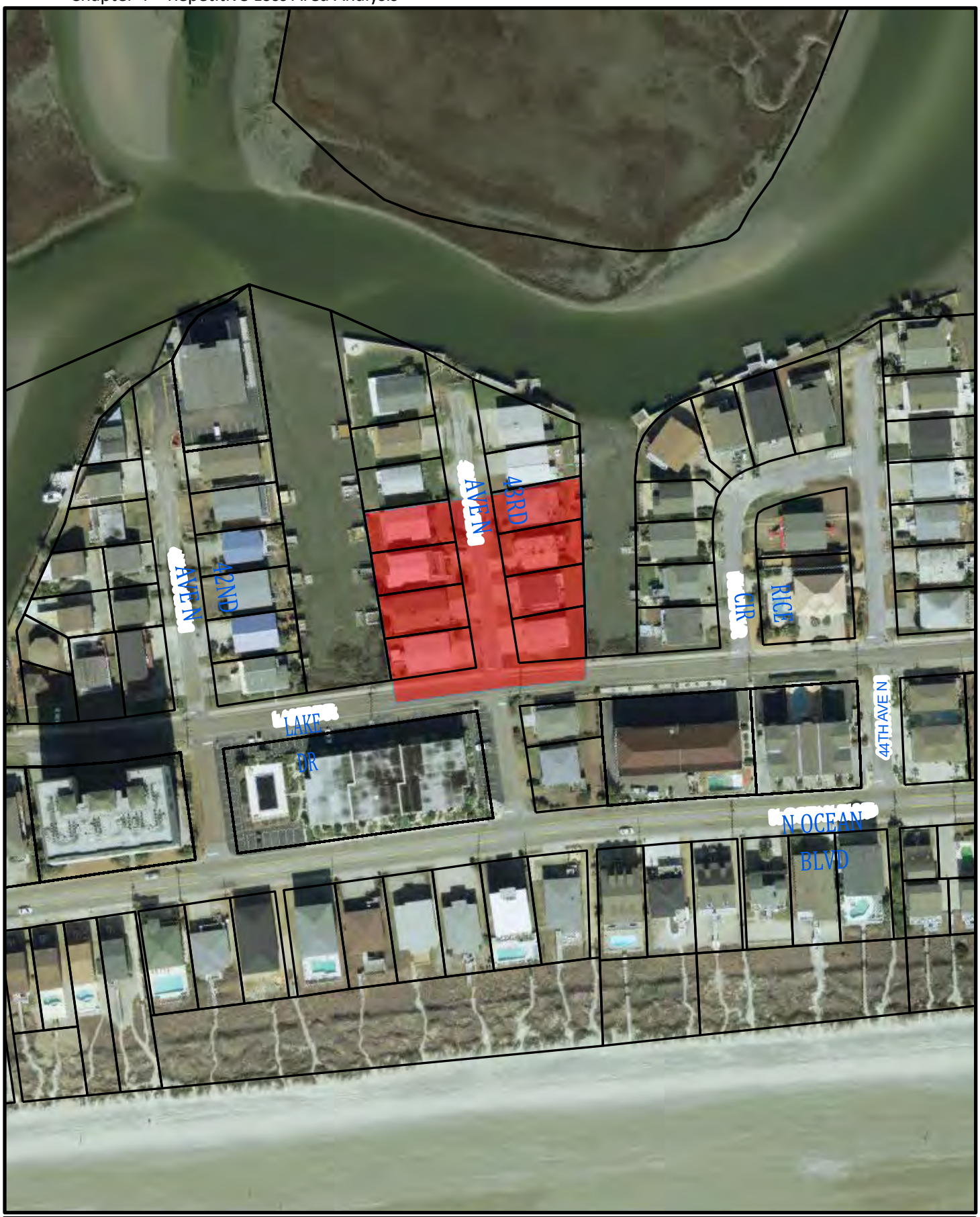
Legend

Repetitive Loss Area

0 100 200 400

OB & 42TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	6	1
With Flood Insurance	4	1
Value of Structures	$1,069,100	$57,100
Number Under Insured for Flood	2	0
Foundation Types		
Piling	5	0
Pier and Wall	1	1
Slab	0	0
Enclosures		
None	0	0
299 sq. ft. or less	3	0
300 sq. ft. or more	3	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

43rd Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

43RD AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	8	2
With Flood Insurance	7	2
Value of Structures	$762,200	$230,800
Number Under Insured for Flood	2	0
Foundation Types		
Piling	6	2
Pier and Wall	1	0
Slab	1	0
Enclosures		
None	0	0
299 sq. ft. or less	4	1
300 sq. ft. or more	4	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

Rice Street RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

RICE STREET REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	8	4
With Flood Insurance	6	3
Value of Structures	$1,014,500	$549,100
Number Under Insured for Flood	2	2
Foundation Types		
Piling	7	4
Pier and Wall	0	0
Slab	1	0
Enclosures		
None	0	0
299 sq. ft. or less	5	2
300 sq. ft. or more	3	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

OB & 44th Avenue N RL Area

Legend

Repetitive Loss Area

0 100 200 400

OB & 44TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	13	3
With Flood Insurance	11	2
Value of Structures	$6,344,200	$2,268,000
Number Under Insured for Flood	6	2
Foundation Types		
Piling	8	2
Pier and Wall	2	1
Slab	3	0
Enclosures		
None	3	0
299 sq. ft. or less	7	1
300 sq. ft. or more	3	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

45th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

45TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	14	4
With Flood Insurance	11	4
Value of Structures	$1,508,100	$472,800
Number Under Insured for Flood	3	0
Foundation Types		
Piling	11	1
Pier and Wall	0	0
Slab	3	3
Enclosures		
None	3	3
299 sq. ft. or less	8	1
300 sq. ft. or more	3	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

46th Avenue N RL Area

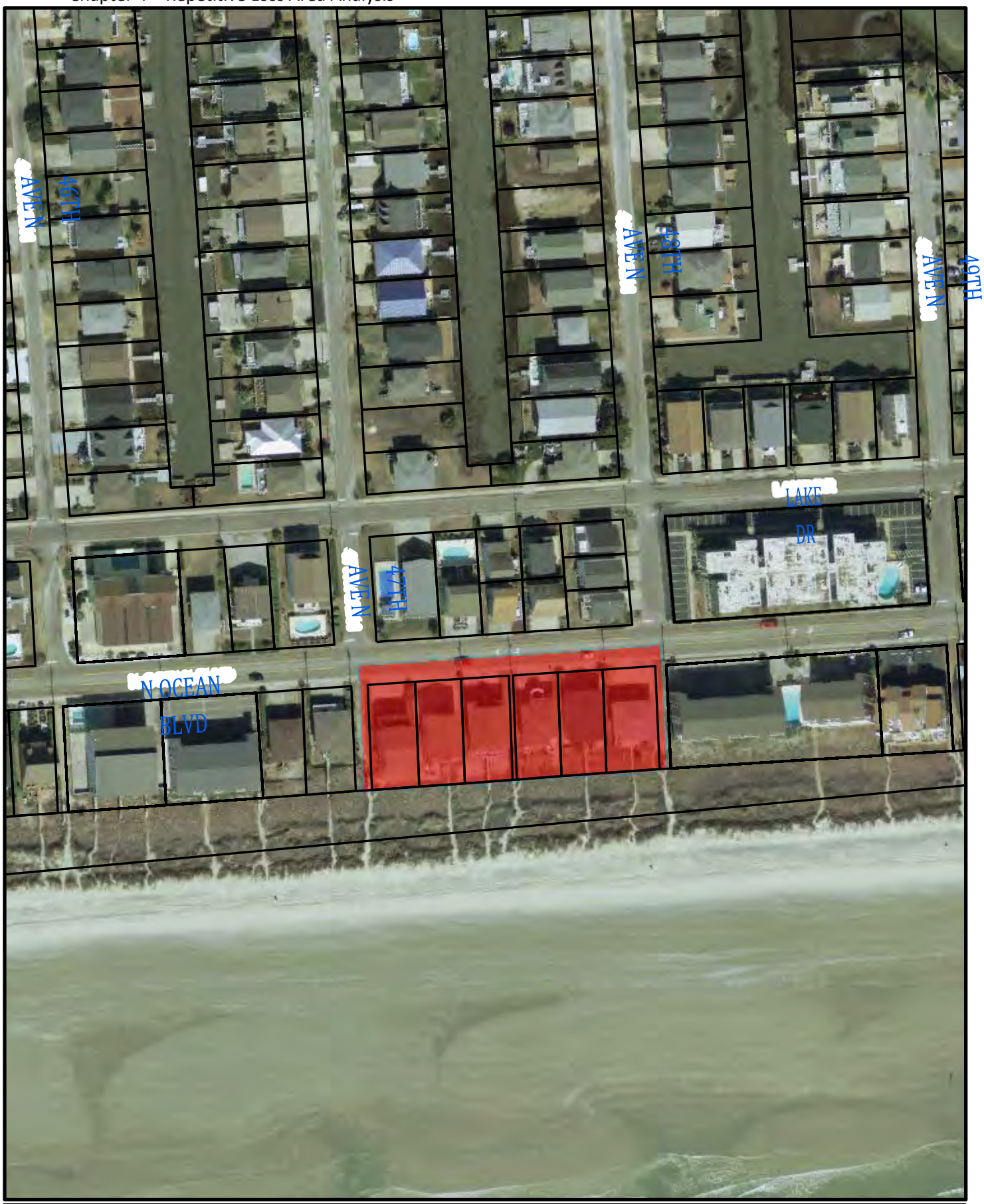
0 100 200 400 Feet

Legend

Repetitive Loss Area

46TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	11	2
With Flood Insurance	6	1
Value of Structures	$1,365,700	$229,200
Number Under Insured for Flood	5	1
Foundation Types		
Piling	7	0
Pier and Wall	0	0
Slab	4	2
Enclosures		
None	5	2
299 sq. ft. or less	4	0
300 sq. ft. or more	2	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

OB & 47th Avenue N RL Area

Legend

Repetitive Loss Area

0 100 200 400

OB & 47TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	6	2
With Flood Insurance	5	1
Value of Structures	$1,028,400	$458,900
Number Under Insured for Flood	1	1
Foundation Types		
Piling	5	2
Pier and Wall	1	0
Slab	0	0
Enclosures		
None	1	1
299 sq. ft. or less	2	0
300 sq. ft. or more	3	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

47th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

47TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	15	6
With Flood Insurance	10	5
Value of Structures	$2,176,400	$875,200
Number Under Insured for Flood	6	2
Foundation Types		
Piling	10	3
Pier and Wall	1	1
Slab	4	2
Enclosures		
None	4	2
299 sq. ft. or less	7	2
300 sq. ft. or more	4	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

Lake & 47th Avenue N RL Area

Legend

Repetitive Loss Area

0 100 200 400

LAKE & 47TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	15	3
With Flood Insurance	7	2
Value of Structures	$1,594,900	$335,300
Number Under Insured for Flood	8	1
Foundation Types		
Piling	11	2
Pier and Wall	0	0
Slab	3	1
Enclosures		
None	4	2
299 sq. ft. or less	9	1
300 sq. ft. or more	2	0
Vacant Lots	1	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

48th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

48TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	6	3
With Flood Insurance	4	2
Value of Structures	$518,900	$202,700
Number Under Insured for Flood	2	1
Foundation Types		
Piling	2	0
Pier and Wall	0	0
Slab	4	3
Enclosures		
None	4	3
299 sq. ft. or less	2	0
300 sq. ft. or more	0	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

49th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

49TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	9	2
With Flood Insurance	9	2
Value of Structures	$1,197,400	$186,700
Number Under Insured for Flood	0	0
Foundation Types		
Piling	9	2
Pier and Wall	0	0
Slab	0	0
Enclosures		
None	0	0
299 sq. ft. or less	6	1
300 sq. ft. or more	3	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

OB & 50th Avenue N RL Area

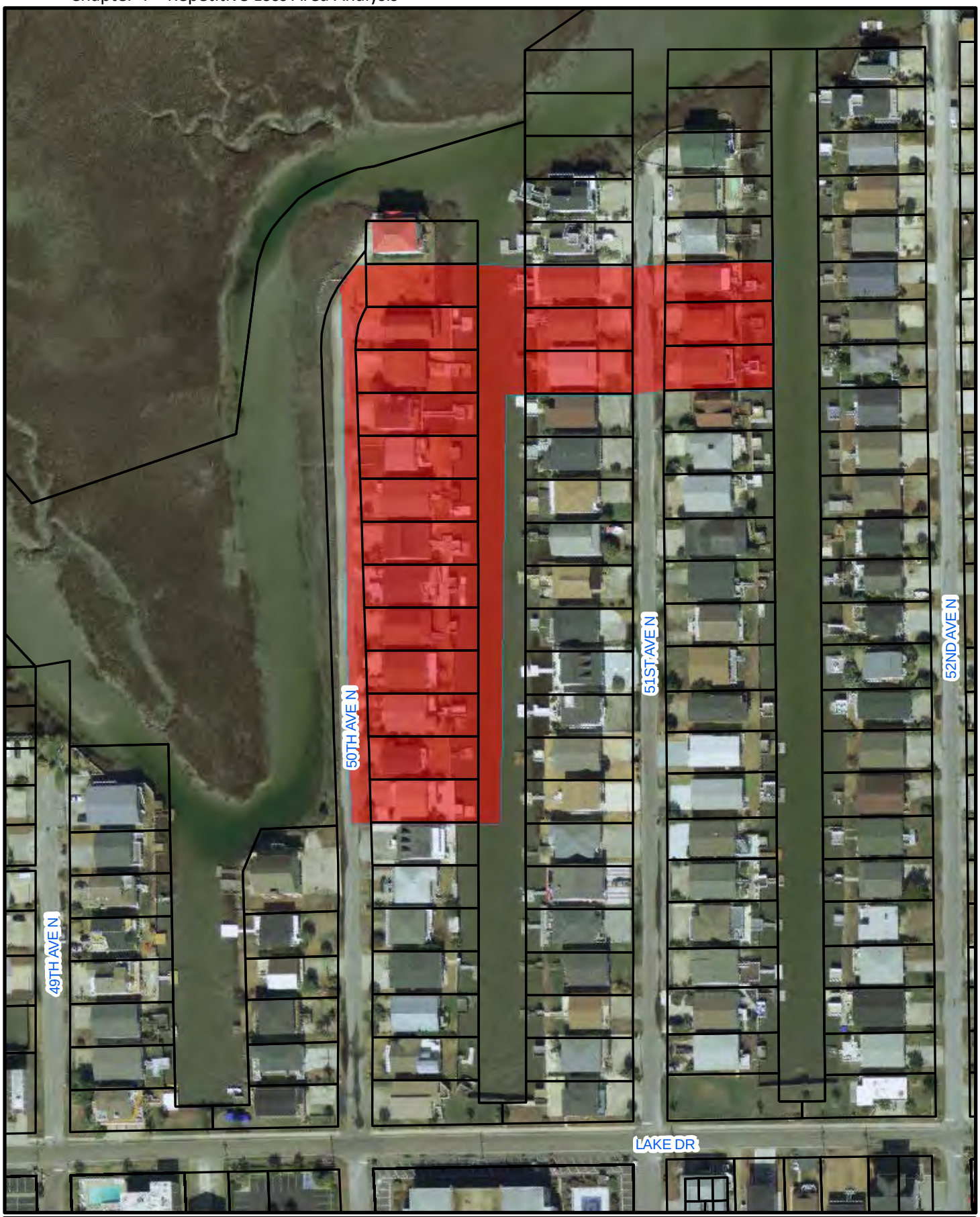
0 100 200 400 Feet

Legend

Repetitive Loss Area

OB & 50TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	19	3
With Flood Insurance	13	3
Value of Structures	$12,125,700	$7,226,100
Number Under Insured for Flood	7	1
Foundation Types		
Piling	13	2
Pier and Wall	0	0
Slab	6	1
Enclosures		
None	8	2
299 sq. ft. or less	7	0
300 sq. ft. or more	4	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

50th Avenue N RL Area

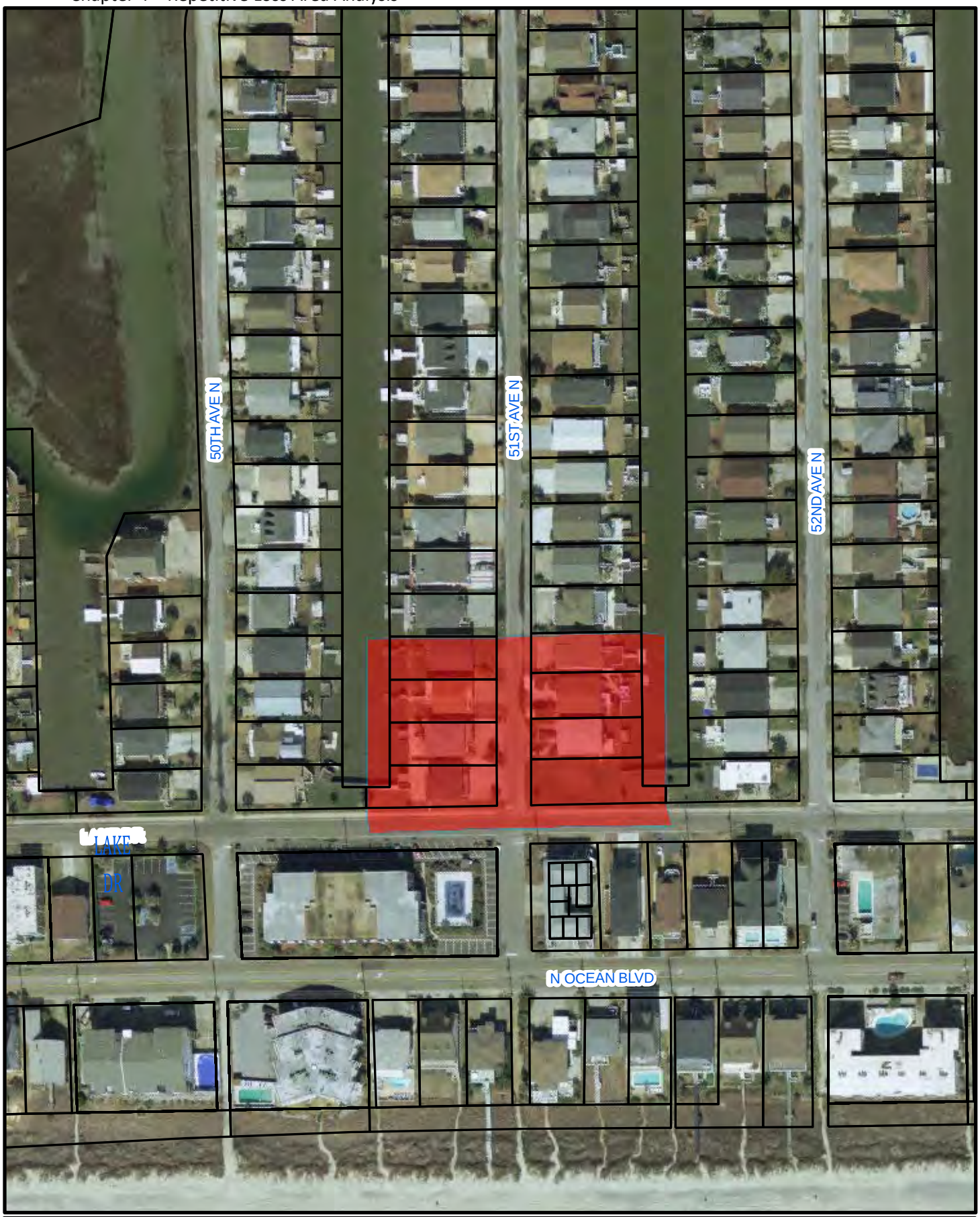
0 100 200 400 Feet

Legend

Repetitive Loss Area

50TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	18	5
With Flood Insurance	13	4
Value of Structures	$1,655,795	$477,800
Number Under Insured for Flood	5	2
Foundation Types		
Piling	15	3
Pier and Wall	0	0
Slab	3	2
Enclosures		
None	3	2
299 sq. ft. or less	12	3
300 sq. ft. or more	3	0
Vacant Lots	1	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

51st Avenue N RL Area

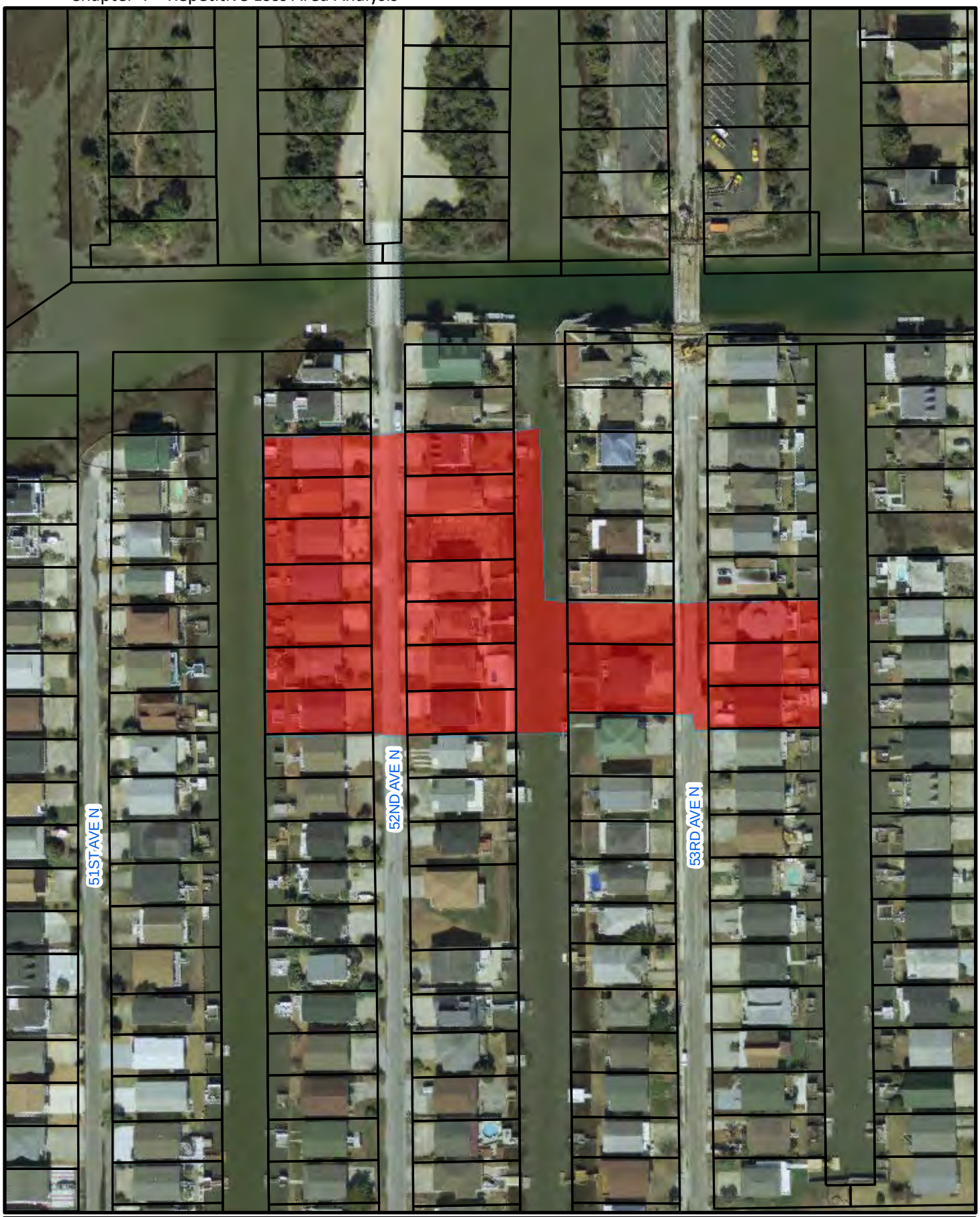
0 100 200 400 Feet

Legend

Repetitive Loss Area

51TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	7	3
With Flood Insurance	6	3
Value of Structures	$776,600	$323,400
Number Under Insured for Flood	1	0
Foundation Types		
Piling	7	3
Pier and Wall	0	0
Slab	0	0
Enclosures		
None	0	0
299 sq. ft. or less	6	2
300 sq. ft. or more	1	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

52nd Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

52ND AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	16	4
With Flood Insurance	9	3
Value of Structures	$1,643,200	$457,600
Number Under Insured for Flood	7	1
Foundation Types		
Piling	15	3
Pier and Wall	0	0
Slab	1	1
Enclosures		
None	1	1
299 sq. ft. or less	8	0
300 sq. ft. or more	7	3
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

53rd Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

53RD AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	21	6
With Flood Insurance	13	5
Value of Structures	$1,875,600	$709,700
Number Under Insured for Flood	8	1
Foundation Types		
Piling	17	4
Pier and Wall	0	0
Slab	4	2
Enclosures		
None	4	2
299 sq. ft. or less	11	3
300 sq. ft. or more	6	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015


54TH AVE N
55TH AVE N
54TH AVE N
55TH AVE N
53RD AVE N
NIXON ST
NORTH MYRTLE BEACH
54th Avenue N RL Area
Legend
Repetitive Loss Area
0
100
200
400
Feet

54TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	25	2
With Flood Insurance	15	1
Value of Structures	$3,103,100	$337,600
Number Under Insured for Flood	10	1
Foundation Types		
Piling	21	0
Pier and Wall	1	0
Slab	3	2
Enclosures		
None	4	2
299 sq. ft. or less	17	0
300 sq. ft. or more	4	0
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

55th Avenue N RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

55TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	40	11
With Flood Insurance	33	10
Value of Structures	$6,095,100	$1,747,800
Number Under Insured for Flood	7	1
Foundation Types		
Piling	38	9
Pier and Wall	0	0
Slab	2	2
Enclosures		
None	2	2
299 sq. ft. or less	31	7
300 sq. ft. or more	7	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

56th Avenue N RL Area

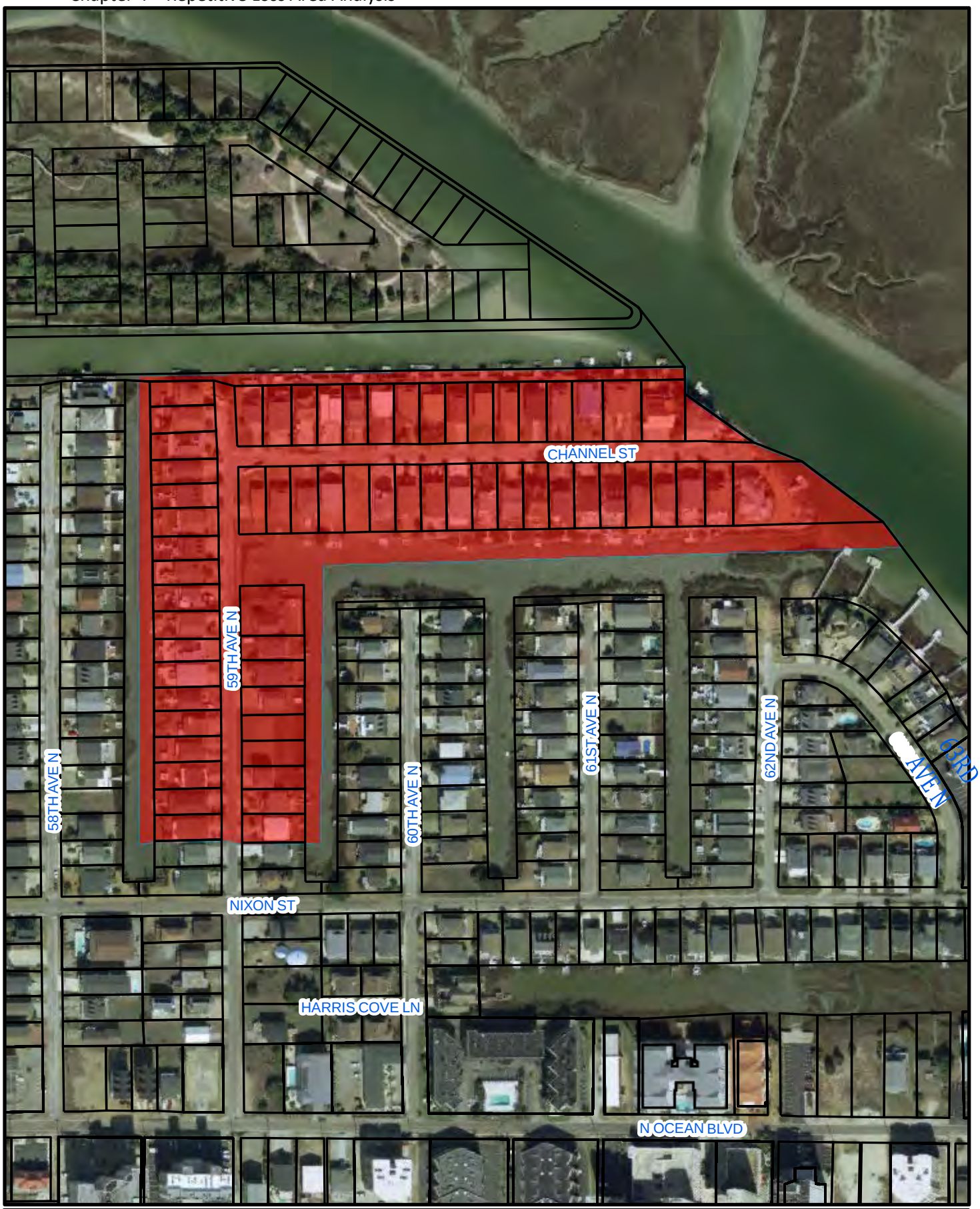
Legend

Repetitive Loss Area

0 100 200 400
Feet

56TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	28	7
With Flood Insurance	15	2
Value of Structures	$5,379,300	$873,700
Number Under Insured for Flood	19	5
Foundation Types		
Piling	20	3
Pier and Wall	1	1
Slab	7	3
Enclosures		
None	7	3
299 sq. ft. or less	17	3
300 sq. ft. or more	4	1
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015



NORTH MYRTLE BEACH
SOUTH CAROLINA

Channel Street RL Area

0 100 200 400 Feet

Legend

Repetitive Loss Area

CHANNEL STREET REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	62	9
With Flood Insurance	48	7
Value of Structures	$9,305,000	$1,622,300
Number Under Insured for Flood	18	2
Foundation Types		
Piling	55	6
Pier and Wall	4	2
Slab	3	1
Enclosures		
None	3	1
299 sq. ft. or less	28	2
300 sq. ft. or more	30	3
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

NORTH MYRTLE BEACH
SOUTH CAROLINA

OB &
60th Avenue N RL Area

Legend

Repetitive Loss Area

0 100 200 400

OB & 60TH AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	10	2
With Flood Insurance	5	1
Value of Structures	$55,009,900	$14,506,300
Number Under Insured for Flood	8	1
Foundation Types		
Piling	8	2
Pier and Wall	0	0
Slab	2	0
Enclosures		
None	4	0
299 sq. ft. or less	1	0
300 sq. ft. or more	5	2
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015


CHANNEL ST
61ST AVE N
62ND AVE N
63RD AVE N
NIXON ST
N OCEAN BLVD
NORTH MYRTLE BEACH
62nd Avenue N RL Area
0 100 200 400 Feet
Legend
Repetitive Loss Area

62ND AVENUE NORTH REPETITIVE LOSS AREA		
CHARACTERISTICS	**STRUCTURES**	**REPETITIVE LOSS STRUCTURES**
Total Number	16	4
With Flood Insurance	13	4
Value of Structures	$2,027,200	$497,600
Number Under Insured for Flood	4	0
Foundation Types		
Piling	15	4
Pier and Wall	0	0
Slab	1	0
Enclosures		
None	1	0
299 sq. ft. or less	9	1
300 sq. ft. or more	6	3
Vacant Lots	0	

SOURCES: Field Surveys November and December 2014 with update August 2015
Horry County Property Records July and August 2015
NFIP Insurance Policy data
Repetitive Loss Property Owner Questionnaire July 2015

Chapter 5. Goals, Strategies and Possible Mitigation Actions

This portion of the Mitigation Plan outlines North Myrtle Beach's overall basic mitigation goals from which the proposed hazard mitigation strategies, programs, and actions shall be drawn. The focus of these goals is to reduce the City's vulnerability to the effects of hazard events. This Chapter will address:

- *Mitigation Goals*
- *Mitigation Strategies and Measures*
- *Mitigation Actions*

5.1 Mitigation Goals

Hazard mitigation goals are broad in scope and far-reaching in application. This part of the plan presents the vision of the government for mitigation in the community. The goals also serve to set the community's priorities.

In the previous version of this plan (2016), the City of North Myrtle Beach had identified a number of mitigation objectives that were associated with each goal. When the plan was updated in 2021, the Hazard Mitigation Planning Committee determined that the objectives were specific enough that they should be converted into Mitigation Actions. Doing so also allows the City to actively track the implementation status of those actions and their impacts on risk reduction.

The City's Hazard Mitigation Goals are presented below.

Goal 1. Minimize future flood, wind and earthquake damage to buildings, critical facilities and infrastructure.

Goal 2. Protect the City's most vulnerable populations, buildings and critical facilities through the implementation of cost-effective and technically feasible mitigation projects.

Goal 3. Protect public health, safety and welfare by increasing the public awareness of existing hazards and by fostering both individual and public responsibility in mitigating risks due to those hazards.

Goal 4. Preserve and protect the natural ecology and environment, including beaches, marshes and the waterway.

Goal 5. Create a more disaster resistant community through cooperative efforts of the public, private and non-profit sectors.

As part of the development of the 2021 update of this plan, the goals found above were reviewed and discussed at the 11/16/20 meeting of the Hazard Mitigation Planning Committee. It was determined that the goals are still applicable for the City.

5.2 Mitigation Strategies and Measures

In formulating this Mitigation Strategy, a wide range of mitigation measures were considered in order to help achieve the goals of the community and to lessen the vulnerability of the City to the effects of natural hazards. In general, all of these measures fall into one of the following broad categories of mitigation strategies. These Mitigation Strategies and Measures are described in Chapter 6.

1. Prevention

Preventative activities are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative measures are described in Chapter 6 under the following topics:

Current Measures

A. Comprehensive Plan
B. Beach Management Plan
C. Zoning
D. Building Codes
E. Floodplain Construction Standards
F. Floodplain Mapping/Data Maintenance
G. Floodplain Open Space Preservation
H. Low-density Zoning
I. Planned Unit Development
J. Subdivision Regulations
K. Setback Regulations

Potential Measures

L. Coastal AE-Zone Regulations
M. Enclosure Regulations
N. Freeboard Regulations
O. Cumulative Substantial Improvement
P. Substantial Damage Regulations
Q. Critical Facility Regulations
R. Advanced Acquisition
S. Wildfire Protection
T. Regulations for Additions to Buildings

2. Property Protection
Property protection measures protect existing structures by modifying the building to withstand hazardous events, or removing structures from hazardous locations. Property protection measures are discussed in Chapter 6 under the following topics:

A. Acquisition and Demolition
B . Acquisition and Relocation
C . Building Elevation
D. Floodproofing
E. Lifeline protection
F. Flood insurance
G. Wind proofing
H. Safe Rooms
I. Seismic Retrofit

3. Natural Resource Protection
Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their mitigative functions. Such areas include floodplains, wetlands and dunes. Parks, recreation or conservation agencies and organizations often implement these measures. Natural resources protection measures are discussed in Chapter 6 under the following topics:

A. Wetland protection
B. Erosion and sediment control
C. Best management practices
D. Dumping regulations

4. Structural Projects
Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event. They are usually designed by engineers and managed or maintained by public works staff. Structural protection measures are discussed in Chapter 6 under the following topics:

A. Beach nourishment
B. Dune building
C. Sand scraping
D. Levees/floodwalls
E. Swales
F. Drainage Modifications
G. Channel and basin maintenance
H. Retention Ponds

5. Emergency Services
Although not typically considered a “mitigation technique,” emergency service measures do minimize the impact of a hazard event on people and property. Emergency service measures are discussed in Chapter 6 under the following topics:

A. Threat Recognition
B. Emergency Warning Dissemination
C. Response and Mitigation Operations
D. Post-disaster Recovery and Mitigation

6. Public Information and Awareness
Public Information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public are discussed in Chapter 6 under the following topics:

A. Map information
B. Outreach projects
C. Real estate disclosure
D. Library
E. Technical assistance
F. Educational programs

5.3 Mitigation Actions

Based on the Mitigation Strategies and Measures described in Chapter 6, the City has identified several Mitigation Actions. The Mitigation Actions are short- term, specific measures to be undertaken by the City in order to achieve the identified objectives. Most of these actions are also hazard-specific. Each action includes some general background information to justify the proposed action, and provides measures to assure successful and timely implementation.

Also important to note is that each Mitigation Action is designed to be performance-based, making it easier for the City to measure the Plan's progress over time and during the Plan's future evaluations. It is expected that while the Mitigation Goals may remain the same for an extended period of time, the actions included in this Mitigation Plan will be updated and/or revised through regular enhancements of the Plan.

A detailed list of Mitigation Actions is located in Chapter 8.

Chapter 6: Mitigation Measures

This section of the plan provides a comprehensive overview of the types of mitigation measures that are available to the City to consider. It can be evaluated as a toolkit for the Hazard Mitigation Planning Team and City staff and officials to consider as they work to reduce future damages from hazards. The primary categories of mitigation measures are:

- Preventive Measures
- Property Protection
- Natural Resource Protection
- Structural Projects and
- Emergency Services

Each primary category of mitigation measures contains a number of specific techniques that can be considered as part of an overall mitigation strategy. Each specific technique is defined in greater detail. The specific mitigation actions that have been selected for implementation by the City can be found in Section 8: Mitigation Action Plan.

Preventive Measures

Community officials recognize the importance of protecting their citizens from the devastation hurricanes, floods and other natural disasters can bring. For example, the City has recognized that meeting the minimum requirements for participation in the National Flood Insurance Program does not provide the level of protection its citizens need and deserve. Therefore, City Council has adopted enhancements to the City's floodplain management standards in order to decrease its vulnerability to floods.

To increase the level of protection from natural hazards the Mitigation Committee has examined additional approaches. These recommended safer standards are explained in detail in this section. The standards encourage prudent land use management and development, while promoting responsibility, fairness, community involvement, and planning.

Current Prevention Measures in North Myrtle Beach

6.1 Comprehensive Plan
6.2 Beach Management Plan
6.3 Zoning
6.4 Building Codes
6.5 Floodplain Construction Standards
6.6 Floodplain Mapping/Data Maintenance
6.7 Floodplain Open Space Preservation
6.8 Low-density Zoning
6.9 Planned Unit Development
6.10 Subdivision Regulations
6.11 Setback Regulations

6.1 Comprehensive Plan

The Local Government Comprehensive Planning Enabling Act of 1994 requires all counties and cities to establish comprehensive plans as a precondition of enacting a zoning ordinance and other land use controls, such as subdivision, landscape and historic preservation regulations. Local plans must cover seven elements, including community facilities and natural resources. While the latter may include floodplain information, there are no requirements that a plan address natural hazards.

Comprehensive plans identify how a community should be developed and where development should not occur. They govern the rate, intensity, form and quality of physical development. A thorough comprehensive plan will also address economic development, environmental, social and hazard mitigation concerns.

Hazard mitigation is often addressed through separate, stand-alone plans created in the wake of a disaster or under pre-disaster conditions. Some hazard experts believe integrating mitigation into comprehensive plans is preferable to developing independent hazard plans.

The typical elements of a comprehensive plan include land use, transportation, economic development, environmental protection, dedication of open space, provision of infrastructure and other municipal functions. Their main advantage as a hazard planning tool is that they guide other local measures, such as capital improvement programs, zoning ordinances, and subdivision ordinances.

Comprehensive plans are useful for creating a body of information about local hazard risks. They help identify hazard areas. The appropriate land uses and building (or retrofitting) standards can then be applied to those areas. They identify areas that are less vulnerable to hazards, where development should be directed.

Integrating mitigation into comprehensive planning can improve its effectiveness in four important ways. First, it institutionalizes the process of addressing hazards. This may help make mitigation a habit for community officials. Second, it can create a constituency for mitigation by making it a part of the public discussion of community goals that should be a part of any comprehensive planning process. Third, it allows communities to integrate mitigation with other community objectives. An example of this would be acquiring flood prone properties to achieve both mitigation and open space goals. Fourth, integrating mitigation planning makes it easier for communities to address multiple hazards at once, a process known as cross-mitigation.

Comprehensive planning requires local governments to collect and analyze information about land's suitability for development. This process helps policy makers and local residents understand the limitations to development in hazard- prone areas. In turn, land uses can be tailored to the hazard risk, typically by reserving dangerous areas for less intensive, hazard-compatible uses such as parks, golf courses, backyards, wildlife refuges or natural areas. Other elements of a plan can directly address hazard risk. For example, the capital improvements element should address the elevation or relocation of critical public facilities that could be incapacitated by natural hazards.

The objective of these plans is to preclude inefficient or hazardous land use by coordinating the development of adjacent properties. Developers have an incentive to submit proposals that meet the policies of the comprehensive plan since appropriate designs ensure a fast track for approval.

Current Practice in North Myrtle Beach:

So far, the city has maintained a reputation as a family beach—as a good place for family reunions without the noise, congestion, and expense of other beach resort areas.

With tourism as the mainstay, the city's growth has included a diversity of housing stock and price

ranges. Essentially the previous land use policies promoted high-density growth on the oceanfront and lower densities elsewhere, although the AICW has increasingly become a kind of second oceanfront attracting high-density resort development. General commercial activity was designated along U.S. 17, with beach-oriented business along the main routes into the city such as Sea Mountain Highway and Main Street. The zoning generally followed the land use plan, and subsequent requests for zoning changes were consistent with the land use plan in most cases.

Since 2005, most large tracts have been designated as Planned Development Districts. For example, the 173-acre former Robber's Roost golf course, zoned R- 1 Single-Family Residential Low-Density, became the 68-acre R-1 single-family detached Seabrook Plantation subdivision in 2007. In 2009, the remaining 100 acres were rezoned from R-1 to the Robber's Roost PDD; providing a mixed-use residential and village commercial community otherwise prohibited under the R-1 zoning district. Likewise, the Parkway Group PDD annexation and zoning of 1,363 acres occurred in 2008, creating another mixed-use and high-density residential community with access to and from Carolina Bays Parkway.

The City's current Comprehensive Plan was last updated in 2018. The plan addresses several mitigation topics including plant and animal habitats, wetlands areas, shoreline erosion, beach renourishment, open space preservation, stormwater management and fire suppression.

In recent years the city has given greater attention to the inherent relationships of demand, diversity, design, and distance when considering development alternatives. A good example is the two different land use scenarios prepared for a vacant property along Little River Neck Road.

The first development scenario represents conventional (i.e., business-as-usual) while the second development scenario represents a paradigm shift in planning philosophy that better integrates land use, urban form and transportation planning, so called conservation design or marina mixed-use. For double the density (2 - 4 dwelling units versus 1 - 2 dwelling units) the development:

- doubles in open space,
- creates a very pedestrian friendly neighborhood,
- interconnects the street system reducing traffic congestion,
- provides a small amount of commercial appropriate to a marina mixed-use community, and
- reduces both the number of trips (-4.3%) and vehicle miles traveled (-3.3%) compared to the business-as-usual scenario.

FIGURE 6-1 MIXED-USE WITH CONSERVATION PROTECTION

The City's Comprehensive Plan includes goals that are related to hazard mitigation including the following:

- Ensure a system of parks, trails and open spaces adequate for a wide variety of active and passive leisure pursuits, contributing to the quality of life within the City of North Myrtle Beach.
- Protect and preserve the city's natural resources to the greatest extent possible.

6.2 Beach Management Plan

South Carolina Code of Laws, Section 48-39-350, the South Carolina Coastal Zone Management Act, as amended July 1, 1990 required each coastal beachfront county and city to prepare a Local Comprehensive Beach-front Management Plan based on guidelines provided by the South Carolina Coastal Council (SCCC). The local comprehensive beach management plan, at a minimum, must contain all of the following:

1. an inventory of beach profile data and historic erosion rate data provided by the department for each standard erosion zone and inlet erosion zone under the local jurisdiction;
2. an inventory of public beach access and attendant parking along with a plan for enhancing public access and parking;
3. an inventory of all structures located in the area seaward of the setback line;
4. an inventory of turtle nesting and important habitats of the beach/dune system and a protection and restoration plan if necessary;

5. a conventional zoning and land use plan consistent with the purposes of this chapter for the area seaward of the setback line;
6. an analysis of beach erosion control alternatives, including renourishment for the beach under the local government's jurisdiction;
7. a drainage plan for the area seaward of the setback zone;
8. a post disaster plan including plans for cleanup, maintaining essential services, protecting public health, emergency building ordinances, and the establishment of priorities,
9. a detailed strategy for achieving the goals of the Coastal Zone Management Act by the end of the forty-year retreat period. Consideration must be given to relocating buildings, removal of erosion control structures, and relocation of utilities;
10. a detailed strategy for achieving the goals of preservation of existing public access and the enhancement of public access to assure full enjoyment of the beach by all residents of this State. The plan must be updated at least every five years.

Since the original legislation was passed, SCCC was dissolved, and beachfront management planning is now under the auspices of the Department of Health and Environmental Control (DHEC) Office of Ocean & Coastal Resource Management (OCRM).

Current Practice in North Myrtle Beach:
The City has developed a strategy for responding to beach erosion within the framework of the Beach Management Act. City policies call for:

1. Maintaining existing shore protection structures until other measures can be implemented to rebuild the beach dune system.
2. Maintain a dry sand beach for recreational use and storm surge protection through the beach nourishment project in accordance with the agreement with the U S Army Corps of Engineers.
3. Enforcing shoreline setback regulation in conformance with South Carolina State Law.
4. Ensuring full public access to the beach through the provision of safe, comfortable public access walkways to the beach with parking facilities.

Updates to the plan occur every five years with the next updated scheduled to begin in 2021.

6.3 Zoning

A zoning ordinance regulates development and existing uses by dividing the community into zones or districts and setting development criteria for each district. The floodplain can be designated as one or more separate zoning districts that prohibit development or allow only development that is not susceptible to damage by flooding. For example, new commercial development can reasonably be precluded or dissuaded from hazardous areas in the interest of protecting these major contributors to the tax base.

Appropriate zoning districts include public use, conservation, and cluster or planned unit developments that keep buildings out of the floodplain, wetlands, and other areas that are not suitable for intensive development.

Current Practice in North Myrtle Beach:
Most of North Myrtle Beach's zoning districts are traditional residential and commercial zones. There is also a "conservation/preservation" district. Two large marsh areas in the City are zoned

Conservation Preservation (CP). The largest is located in the northern end of the City and is known as the Cherry Grove Marsh. The other is located in the Windy Hill section and is a large marsh that borders US 17 in the vicinity of 46th Avenue South. The CP zoning limits the potential use of these sites to recreational activities such as fishing piers and nature walks.

Elsewhere, the floodplains in the City are zoned as follows:

R-1	Single-family Residential, Low Density	W-1	Waterfront-Pleasure
R-2	Medium Density Residential	R-4	Resort Residential
CPO	Coastal Protection Overlay	RC	Resort Commercial
PUD	Planned Unit Development		

6.4 Building Codes

Building codes are laws, ordinances, or governmental regulations that set forth standards and requirements for the construction, maintenance, operation, occupancy, use or appearance of buildings, premises, and dwelling units. North Myrtle Beach has adopted the International Building and Residential Codes. These building codes regulate for seismic, flooding and high wind resilience in addition to fire resistance.

One way to require non-conforming structures to come up to code is to establish passive or active code triggers, such as a change in use. In order to qualify for a change in use, the building must meet or approach current code. A different kind of code trigger requires that buildings that have suffered a certain degree of damage be renovated to a higher level of natural hazards resilience. Another approach to code enforcement is to establish financial incentive or voluntary compliance programs.

Current Practices in North Myrtle Beach:

Enforcement at the local level extends beyond construction inspections to the advance review of plans. An applicant for a building permit must submit plans for approval. The local building department reviews the plans and elects to approve or reject them or to require revisions. Construction cannot begin until local officials confirm that the plans are in accordance with the code.

A building inspector must then visually monitor the construction of the building. The inspector's duty is to make sure that the project follows the plans as approved. Inspectors are empowered to stop work on projects that fail to conform to the plans. Any observed errors must be fixed before work can continue. The inspector must perform a final review before an occupancy permit is issued.

Adherence to existing codes and standards is essential to maintaining public safety and promoting an effective local mitigation program—so much so that the insurance industry has moved to rate communities according to their ability to enforce the building code and by the qualifications and training of their staff. North Myrtle Beach currently has a 3/3 rating under the Building Code Effectiveness Grading Schedule.

6.5 Floodplain Construction Standards

Zoning and open space preservation work to keep damage-prone development *out* of the hazardous or sensitive areas. Building construction and special use regulations impose

construction standards on what is allowed to be built *in* the floodplain.

The NFIP operates through a partnership between the Federal Government, the states, and individual communities. Participation in the NFIP is voluntary. In participating communities, affordable, federally backed flood insurance is made available to property owners and renters. In return, each community adopts and enforces a floodplain management ordinance or law, which it uses to define regulatory floodplains and control floodplain development, including new construction, substantial improvement of existing buildings, and repairs of substantially damaged buildings.

FEMA's National Flood Insurance Program (NFIP) sets minimum requirements for participating communities' building construction regulations. The NFIP minimum requirements are summarized in the box on the next page.

Current Practice in North Myrtle Beach

North Myrtle Beach's ordinance meets the minimum NFIP requirements spelled out in the box on the next page. It exceeds the minimum standards for elevation in that it requires new, substantially improved and substantially damaged buildings to be protected to a level one foot above the base flood elevation shown on the FIRM.

Floodplain regulations are enforced as part of the City's inspection program by the Building Department. The Department reviews permit applications and site plans, conducts field inspections, and reviews elevation certificates, engineering certifications and other documentation to determine compliance with federal, state and local regulations.

In 1990, to provide incentives for communities to adopt more stringent requirements, FEMA established the NFIP Community Rating System (CRS), a program through which FEMA encourages and recognizes community floodplain management activities that exceed the minimum NFIP requirements. Under the CRS, flood insurance premium rates within participating communities are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS: (1) reducing flood losses, (2) facilitating accurate insurance rating, and (3) promoting the awareness of flood insurance.

North Myrtle Beach participates in the Community Rating System and is a Class 6 community. As a result, most property owners with a flood insurance policy receive a 20 percent adjustment in their annual flood insurance premium.

Minimum Regulatory Requirements Imposed by Newly Constructed, Substantially Damaged, and Substantially Improved Buildings in the SFHA

- Building sites must be reasonably safe from flooding.
- Buildings must be:
  - designed (or modified) and anchored to prevent flotation, collapse, and lateral movement of the building resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy,
  - constructed with materials resistant to damage from immersion in flood waters,
  - constructed with methods and practices that minimize flood damage, and
  - constructed with electrical, heating, ventilation, plumbing, and air conditioning

equipment and other service facilities that are designed and/or located so as to prevent flood water from entering or accumulating within their components.

Subdivisions and Other New Development in the SFHA

- All proposals for subdivisions and other new development in the SFHA must be consistent with the need to minimize flood damage within the floodprone area.
- All public utilities and facilities must be located and constructed to minimize or eliminate flood damage.
- Adequate drainage must be provided for all such subdivisions and new developments in order to reduce exposure to flood hazards.

Additional Minimum Requirements for Buildings in A Zones

Building Elevation in Zones AE and A1-A30. The top of the lowest floor, including the basement floor, of all newly constructed, substantially damaged, and substantially improved buildings must be at or above the BFE.

Enclosures Below the Lowest Floor in Zones AE, A1-A30, AO, and A. Enclosed space below the lowest floors of newly constructed, substantially damaged, and substantially improved buildings may be used only for parking of vehicles, access to the building, or storage. The walls of such areas must be equipped with openings designed to allow the automatic entry and exit of flood waters.

Additional Minimum Requirements for Buildings in V Zones

The additional minimum requirements regarding newly constructed, substantially damaged, and substantially improved buildings in Zones VE, V1-V30, and V pertain to
Siting : All newly constructed buildings must be located landward of the reach of mean high tide. **Building Elevation:** All newly constructed, substantially damaged, and substantially improved buildings must be elevated on pilings, posts, piers, or columns
so that the bottom of the lowest horizontal structural member of the lowest floor is at or above the BFE. **Foundation Design:** A registered engineer or architect must develop
or review the structural design, construction specifications, and plans for construction and must certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the building elevation and foundation design standards described above. **Use of Fill:** Fill may not be used for the structural support of any building within Zones VE, V1-V30, and V.

6.6 Floodplain Mapping/Data Maintenance

Identifying the floodplain is the first step in preventing flood problems. Most of the preventive and public information mitigation measures rely on a map to designate the areas affected and to help set appropriate protection standards.

The term “mapping” includes both a spatial display that shows the properties affected by flooding and the background data, such as discharges and flood elevations that are used as the basis for the map.

One important data source for riverine flooding is the flood profile. Because water runs downhill, the flood elevation is not constant. A profile is a graph that relates flood elevations to horizontal points along a channel as it flows downstream. Seventh Avenue Stream in North Myrtle Beach is mapped with a floodway.

The nation's primary floodplain mapping program is conducted by the Department of Homeland Security - FEMA for the National Flood Insurance Program. Flood Insurance Rate Maps (FIRMs) and their accompanying Flood Insurance Studies provide data on the areas affected by the base or 100-year flood, the 500-year flood, and the regulatory floodway.

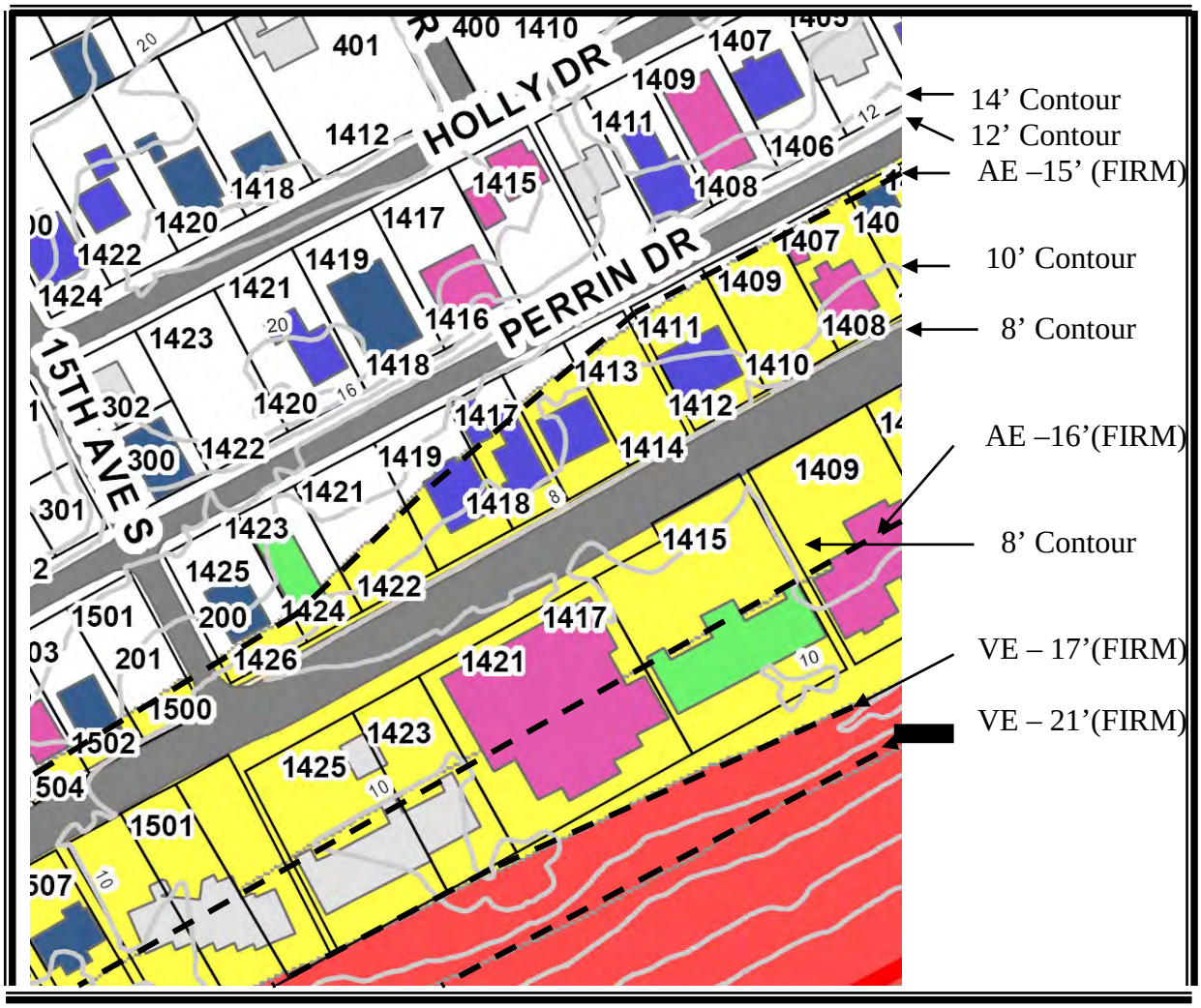
North Myrtle Beach was provided its first FIRM in 1977. This was last revised when a county-wide map was published in August 1999 although new, updated maps have been produced and are scheduled to be available for adoption in late 2021. The current map comes in several panels that show the floodplain and the floodway. The Flood Insurance Study includes the background data, such as the study techniques, discharges and profiles. The City provided planimetric data based on 1990 aerial photography for the latest flood study.

Current Practice in North Myrtle Beach:

The City maintains the flood insurance study data (100- and 500-year flood zones, V-zones and floodway boundaries) in its Geographic Information System (GIS) as overlay layers (See **Figure 6-2** on the next page). The flood hazard data can be combined with topographic contours, buildings with parcel boundaries and street address, building use classification and building footprint. The GIS also includes corporate limits and streets and is linked to tax parcel information and zoning designation. Repetitive flood loss properties identified by FEMA are included in the GIS as an overlay with restricted access. Finally, to aid surveyors, engineers and City staff, North Myrtle Beach maintains elevation reference marks, checking them at least every two years.

Data available from the system makes administration of the community's regulations more effective and efficient. Additionally, the City receives 153 CRS credit points towards its classification and increases the flood insurance premium adjustment for policy holders.

FIGURE 6-2 LAND USE, TOPOGRAPHY AND FLOOD HAZARDS MAP



When FEMA prepared the 1999 Flood Insurance Study for North Myrtle Beach, the most recent USGS topographic data was used as a base for delineating the flood zone boundaries. The City has better topographic data based on a 2002 survey and is available at two-foot contour intervals.

As illustrated in the example in Figure 6-2, the accuracy of the flood risk on the current maps could be improved by using the latest topographic data. In this example the current flood zones have been overlaid on the City's Land Use Map. The red area is the current VE-Zones and the yellow represents the current AE- Zones. In both cases the current flood zone boundaries do not match the risks as depicted by the City's topographic maps.

Recommendation

The State and DHS FEMA have entered into a mapping partnership and are in the process of conducting a restudy of flood hazards within the city. The preliminary maps have been reviewed and the City submitted appeals that were reviewed and addressed where necessary. The new maps should be ready for adoption later in 2021. The city should prepare a fact sheet on map

changes to help the public understand how the changes will affect their construction, reconstruction and repair decisions. Another fact sheet should address how the map changes will affect flood insurance purchase decisions and pricing.

6.7 Floodplain Open Space Preservation

Keeping the floodplain free from development is the best approach to preventing flood damage. Preserving vacant natural areas also has recreational benefits and preserves these areas' natural and beneficial functions. These functions include:

- storage of flood waters
- lowering peak flood flows by slowly releasing storm water over time
- absorbing overland flood flow through infiltration
- recharging aquifers through infiltration
- filtration of hazardous materials and excessive nutrients
- habitat for riparian species

Open space can be preserved through a variety of methods, including:

- establishing parks in the floodplain
- acquiring vacant floodprone land
- requiring buffers or setbacks from a waterway
- purchasing or dedicating easements

The simplest method is to acquire lands and preserve them as parks. There are several alternatives to public acquisition and ownership of open space lands. One is a public-private partnership that shares the load of purchasing, developing and managing the property. Often the financial and legal responsibility can be easier to manage through a public entity and the management is conducted by private non-profit or volunteer organizations.

Easements are another alternative to preserving open space. There are various types, including:

- conservation (the owner agrees to keep it in a natural state)
- public access (the owner agrees to allow public access across the land)
- drainage (the owner agrees to keep the area open for flood flows)

In all of these, the owner keeps possession of the land but benefits by a reduction in property taxes. The community benefits by increasing the amount of open space that can be preserved without paying for the full property value and being responsible for maintaining the land. Often a local land trust legally "holds" the easement and is responsible for the annual oversight.

Open space lands and easements do not always have to be purchased. Developers can be required to dedicate park land and flood flow, drainage, or maintenance easements. Maintenance easements also can be donated by existing streamside property owners in return for a community channel maintenance program.

Current Practice in North Myrtle Beach:

The City has six recreational sites in floodprone areas:

Name	Location	Facilities
City Park	1st Avenue South on Oceanfront	Restrooms, Parking, Concessions, Benches
Hill Street Park	Hill Street and 24th Avenue N.	Playground, Picnic Area and Tennis Court
Russell Burgess Coastal Preserve	Lake Drive in Cherry Grove	Access to Natural Resource Areas and Parking
Cherry Grove Oceanfront Park	22nd Avenue North	Handicap beach access, restrooms, beach showers, picnic tables
Heritage Shores Preserve	Heritage Drive	40 interpretive stations along a Nature primitive walk path, picnic shelters and a boat dock.
Cherry Grove Park and Boat Ramp	53rd Avenue	Boat launch, fishing pier, floating boat picnic shelter, restrooms

Recreation Areas Added Since the 2004 Hazard Mitigation Plan

Heritage Shores Nature Preserve

Heritage Shores Nature Preserve is one of the newest and most unique parks in the city. As part of a land exchange with developers of the Heritage Shores single-family subdivision, the City acquired approximately seven acres of property on the north end of an island located on Williams Creek and the Cherry Grove Marsh, off 53rd Avenue North. At the southern end of the island lies the Cherry Grove Park and Boat Ramp, and a subdivision is located directly adjacent. This land exchange allowed the creation of the Heritage Shore Nature Preserve, which was dedicated in January 2007. This preserve has a walking path with elevated boardwalks and observation platforms. Additionally, the preserve has fifty-three (53) interpretive signs listing information on forty-eight (48) different marine and terrestrial animals, insects, and plants.

Russell R. Burgess, Jr. Coastal Preserve

In 2004, the acquisition of the property known as "The Spit," located on Lake Drive in Cherry Grove, occurred. That same year, the area was renamed the "Russell Burgess Jr. Coastal Preserve", in honor of local resident and past City Council member Russell Burgess Jr. Long used as a local fishing spot, and identified in the *Parks and Open Space Master Plan*, the preserve provides paved parking and a new boardwalk providing access to the water. The Preserve is a scenic overview of the picturesque Cherry Grove Marsh. The Preserve also protects and maintains important marsh habitat.

Russell R. Burgess, Jr. Coastal Preserve boardwalk completed in 2009

Table 6-1 shows many of the areas of open space protected by either conservation regulations and/or deed restrictions. Column three shows the total acres of the parcel. The last column shows the acreage in the SFHA that is protected by either conservation regulations and/or deed restrictions. The acres identified in this column are the net free open space acres. To determine this number the City subtracted from the total acres the following:

- ✓ Area not in the SFHA.
- ✓ Areas that include more than 10 acres of water.
- ✓ All building, streets, parking lots with impervious surfaces and walkways.
- ✓ Hard surface areas of boat ramps and walkways over dunes.

TABLE 6-1 PROTECTED OPEN SPACE AREAS IN NORTH MYRTLE BEACH

NAME OF PROTECTED AREA	METHOD OF PROTECTION	TOTAL ACRES	NET OPEN SPACE
Barefoot Resort Golf Course	OSP	82.80	8.51
Ocean Front Erosion Setback Area	Coastal Setback Regulations	286.92	283.30
Boy Scout of America Pee Dee Area	Deed	1.45	1.07
Central Park	Deed	12.27	0.08
Charleston Landing Subdivision Open Space	OSP	5.91	3.76
Cherry Grove Beach	OSP	4.76	4.76
Cherry Grove Boat Ramps	Deeds	6.70	4.61
Cherry Grove Marsh	OSP	453.02	322.27
Cherry Grove Lots	OSP	0.56	0.55
City of North Myrtle Beach Ocean Parcel	Deed	6.65	6.57
Crescent Beach Walkways	Deeds	0.09	0.08
Half Moon Lake	OSP	6.05	4.34
Heritage Shores Nature Preserve	Deed	9.42	8.03
Hillside Drainage Project	Deed and OSP	21.13	15.29
Mary A Lewis Property	OSP	0.53	0.37

NAME OF PROTECTED AREA	METHOD OF PROTECTION	TOTAL ACRES	NET OPEN SPACE
McClean Park	Deed	7.56	1.00
Ocean Drive Walkways	Deeds	0.05	0.05
Ocean Hill Common Area	OSP	0.69	0.64
Ocean Marsh Multi-family Common Land	OSP	0.29	0.28
Ocean Park	Deed - LWCF	0.31	0.16
Pointe Marsh Subdivision Common Area	OSP	1.22	1.22
Pond	OSP	7.72	7.67
Russell Burgess Coastal Preserve	Deed	40.82	26.97
Seaside Plantation Subdivision Common Area	OSP	13.90	12.04
Street ends	Deed - LWCF	2.45	1.45
Sunset Harbour Subdivision Common Area	OSP	5.71	3.54
Surf Golf Course	OSP	172.63	14.88
Tidewater Plantation Common Area	OSP	216.85	77.47
Waters Edge Open Space	OSP	0.96	0.78
Wetland located Cottages on 9th	OSP	1.98	1.55
White Point Swash	OSP	41.55	39.02
Widgeon Lake	OSP	1.18	0.53
Willow Creek Common Area	OSP	0.75	0.73
		1414.88	853.57

6.8 Low-Density Zoning

Density ordinances can be applied within floodplains, in the surcharge area along the coast, or any other area that can be demonstrated as a high-risk zone. Local governments lower the allowable intensity of development in hazardous areas to prevent intense private development within areas delineated as high-hazard.

There are two primary ways to regulate residential development density: set maximum housing density or set minimum lot size. In terms of floodplain development, both approaches are complemented by limits on the percentage of impervious surface within parcels.

Current Practice in North Myrtle Beach:

Most of North Myrtle Beach's zoning districts are traditional residential and commercial zones that do not require lots larger than 10,000 square feet for single-family residential use. There is a "conservation/preservation" district that has a minimum lot size requirement of 5 acres. Two large marsh areas in the City are zoned Conservation Preservation (CP). The largest is located in the northern end of the City and is known as the Cherry Grove Marsh. The other is located in the Windy Hill section and is a large marsh that borders US 17 in the vicinity of46th Avenue South. The CP zoning limits the potential use of these sites to recreational activities such as fishing piers and nature walks.

Cherry Grove Marsh Looking North

6.9 Planned Unit Development

These types of regulations allow the flexible design of large- or small-scale developments that are constructed as a unit. While the actual design is a matter of negotiation, the basic premise is that some areas are developed more intensively than would normally be allowed and others are used less. The average density of the site remains at or near the allowable limit.

Planned unit development (PUD) places regulations on an area rather than on individual lots and allows for mixed use. Since PUDs are typically negotiated between the developer and city officials on a project-by-project basis, this approach allows for flexibility in meeting subdivision regulations. Clustering typically refers to the concentration of housing on a portion of a site. Clustering can be integrated into a zoning code instead of being negotiated.

Shifting density away from hazard-prone areas is a good way to limit development in these areas without instigating a 'taking.' In shorefront areas, PUDs are generally used to encourage property owners to cluster buildings on the inland portions of their parcels, while reserving areas adjacent to the beach for recreational open space and parking.

Current Practice in North Myrtle Beach:

The City's Zoning Ordinance includes a PUD District. One of the stated purposes of the district is "to preserve the natural and scenic features of open areas. The minimum lot size for a PUD designation is two (2) acres. At least fifteen (15) percent of this area must be developed into common open space. Most of the land between the Intercostal Waterway and the ocean has already been developed or subdivided. Thus, in this area little floodplain land is expected to be preserved as open space as a result of the PUD regulations. As the City expands across the Waterway this situation is expected to change. Recently the City annexed an area west of the Waterway called Barefoot Resort. This 2,300 acre development is being developed under the City's PUD regulations. As a result, a significant number of acres will be developed as common open space; however, a detailed flood hazard analysis has not been completed in this area so it is not known how many acres are located in the floodplain.

6.10 Subdivision Regulations

Subdivision regulations govern the division of land for development or sale. In addition to controlling the configuration of parcels, they set standards for developer-built infrastructure. Many communities include developer exactions and impact fees/system development charges in their

subdivision regulations. Subdivision regulations can be used for mitigation purposes in several ways. They primarily prohibit the subdivision of land subject to flooding. When hazard zones can be identified on a map of the parcel, communities may require minimum distances between those zones and development. If land dedications are required as part of the subdivision regulation, they can be used to reserve hazard-prone land for non-intensive uses.

Subdivision regulations may also set a standard for public infrastructure that ensures it is adequate for the assessed risk. For example, the installation of adequate drainage and stormwater management facilities should be required in flood-prone areas. If local governments are responsible for managing of developer-built infrastructure, they should require that all improvements be built to hazard-resilient standards. This may help reduce the public cost of post- disaster reconstruction.

Subdivision regulations can require that developments be built in a hazard- resilient manner. In order to reduce fire risk, for example, subdivision ordinances may require wide building spacing, fire breaks, on-site water storage, and multiple access points. They should require “deep” lots in shorefront areas. These lots allow homes to be moved inland on the same parcel in the case of shoreline erosion.

The site plan review stage is another time at which it is possible to require developers to site buildings away from hazard-prone portions of the area. Local governments may require mitigation actions, such as the protection or creation of wetlands, dunes or natural vegetation, as a condition of subdivision approval.

Some experts recommend establishing land use restrictions for each property before it is subdivided. After a property is subdivided, the various owners may demand compensation for the loss of use of their property. As a result, the city might have to acquire land that it could have otherwise regulated without a purchase.

Subdivision regulations are not as broad as zoning and only indirectly affect the quality and type of development that occurs on subdivided land. Since these regulations apply only when land is subdivided and sold, they do not address development of small or undivided parcels of land.

Current Practice in North Myrtle Beach:
The North Myrtle Beach Subdivision Regulation establishes procedures and rules to provide for the timely provision of required streets, utilities and stormwater management facilities; and for the separation of buildings for fire safety and open space. Section 20-23 (b) (13) requires the areas subject to inundation by a 100-year flood to be shown on the final plat. Subdivision regulations also require that wetland areas be delineated upon preliminary subdivision plats. However, use of wetland areas remains within the regulatory realm of the United States Army Corps of Engineers and the Office of Coastal Resource Management.

6.11 Setback Regulations

The borders of natural hazard areas are often “fuzzy,” or difficult to define. Setbacks provide a margin for error in assessing where damage is likely to occur. The length of the required setback varies with the type and degree of hazard, as well as the type of development.

Current Practice in North Myrtle Beach:
Along the oceanfront the building location is determined by a setback line, which is established

by using a mathematical formula based on the 40-year erosion rate in that area. New habitable structures must be built as far landward as possible and are limited to a maximum of 5,000 square feet. Special permits must be obtained to build seaward of the baseline. To qualify, the structure (usually a house) must be built as far landward as possible and have no impact on the primary sand dune or active beach area. If the beach erodes and the permitted structure becomes situated on the active beach, the property owner, at his or her own expense, must agree to remove the structure if so ordered by Office of Ocean and Coastal Resource Management (OCRM).

Additions located wholly or partially in the setback area are allowed, provided that the addition and the existing structure together do not exceed 5,000 square feet of heated space. The additions must also be located no farther seaward than the existing structure. The linear footage of the structure, parallel to the coast, cannot be increased. Additions made totally landward of the setback area do not require any notice to OCRM.

Proposed Prevention Measures in North Myrtle Beach

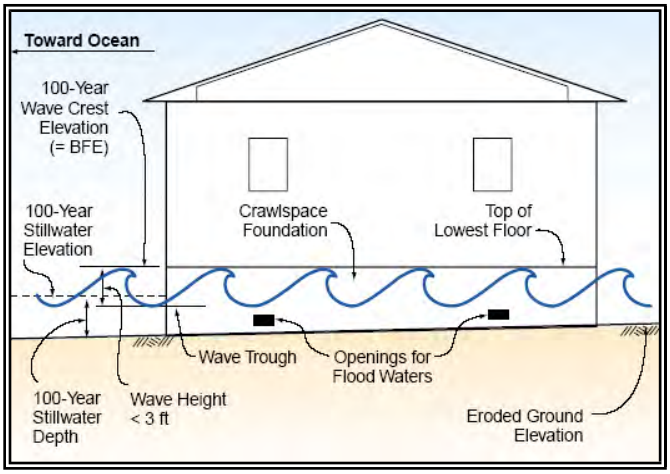
As indicated in Chapter 2 current programs and regulations do not address all of the issues that can cause property losses and business interruption. These additional measures address some of the remaining property loss issues.

6.12 Coastal AE-Zone Regulations
6.13 Enclosure Regulations
6.14 Freeboard Regulations
6.15 Cumulative Substantial Improvement and Substantial Damage Regulations
6.16 Critical Facility Regulations
6.17 Regulations for Additions to Buildings

6.12 Coastal AE-Zone Regulations

The NFIP regulations do not differentiate between coastal and non-coastal A zones. Because coastal A zones may be subject to the types of hazards present in V zones, such as wave effects, velocity flows, erosion, scour, and high winds, **this proposal recommends that buildings in coastal A zones meet the NFIP regulatory requirements for V-zone buildings.**

FIGURE 6-3: CURRENT A-ZONE ELEVATION REFERENCE POINT

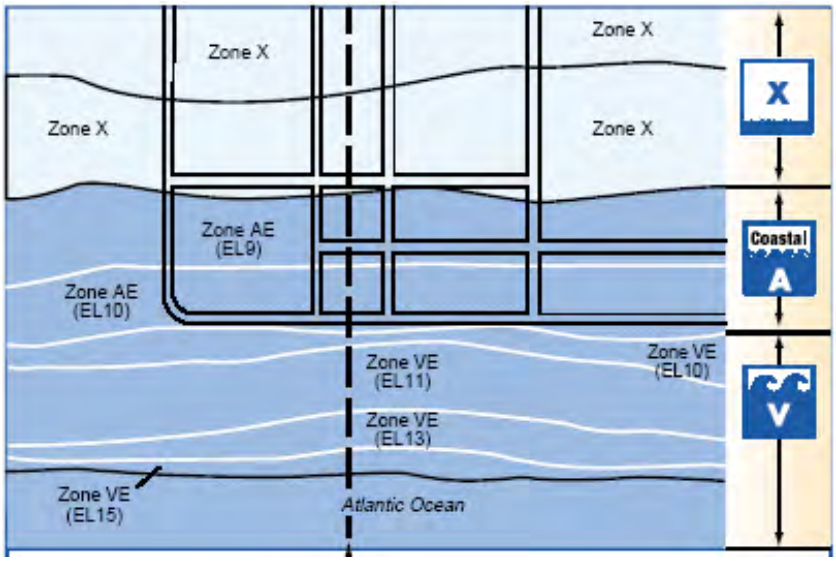


The criteria for construction in A Zones do not provide adequate protection in coastal AE Zones subject to wave effects, velocity flows, erosion, scour, or combinations of these forces. Wave tank studies conducted by FEMA show that breaking waves less than the 3-foot criteria used to designate VE Zones can cause considerable damage. Post-disaster evaluations and insurance claims data also support this conclusion, particularly for those buildings with enclosures below the elevated floor. FEMA's current regulations do not adequately address this situation and contribute to communities like North Myrtle Beach having a high number of repetitive loss properties.

Section 431.p.2.(a) of the *CRS Coordinator's Manual* provides up to 500 points for local governments that adopt and enforce NFIP requirements for V Zones in areas it identifies as its coastal AE Zone. Up to 150 additional points are available under Section 431.p.2. (b) if the community adopts higher standards that prohibit or regulate the size of enclosures under elevated buildings in the coastal AE Zone.

At this point it is not clear where the boundaries for a new coastal A-Zone would be drawn. A new flood study is underway and the coastal A-Zone should be set based on the results of the study to be released in 2010. The city should consider amending the current code to require new construction, substantially damaged and substantially improved structures within this area to meet the following standards:

FIGURE 6-4: TYPICAL COASTAL FIRM



a. Foundation Design

For buildings in the designated coastal AE-zone the piling or column foundations for all newly constructed, substantially damaged, and substantially improved buildings, as well as the buildings attached to the foundations, must be anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all components of the building. A registered engineer or architect must develop or review the structural design, construction specifications, and plans for construction and must certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the building elevation and foundation design standards described above.

In addition, erosion control structures and other structures such as bulkheads, seawalls and retaining walls may not be attached to the building or its foundation. Fill may not be used for the structural support of any building within the designated coastal AE-zone. Fill may be used in the designated coastal AE-zone for minor landscaping and site drainage purposes.

The NFIP's Community Rating System provides substantial insurance credits when local governments apply these standards within its coastal AE-zone. The following CRS credits, subject to the impact adjustment described in Chapter 1, are available to North Myrtle Beach upon adoption of the proposed regulations.

Foundation. (225 Points.)
Meets all of the following:

A. New construction and substantial improvements are elevated on piles and columns (60.3(e)(4)
B. The pile or column foundation and the structure attached are anchored to resist floatation, collapse, and lateral movement due to the effects of wind and water loads (60.3(e) (4) (ii)).
C. New construction and substantial improvements have the space below the lowest floor free of obstruction or enclosed with non-supporting breakaway walls, open wood lattice work, or insect screening (60.3(e)(5)) and have openings (60.3(c)(5)).
D. Use of fill for structural support is prohibited (60.3(6).

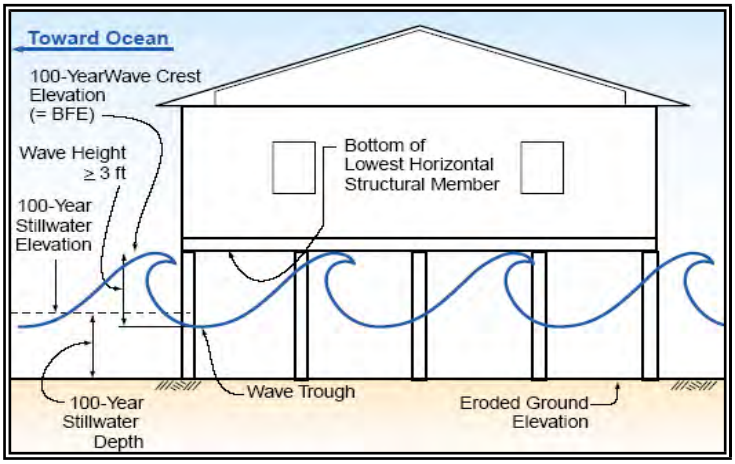
[Note: If the requirements of paragraph C. are not met, foundation credit will be reduced.]

Structural Design, Specifications and Plans. (125 points.)
A registered professional engineer or architect shall develop or review the structural design, specifications, and plans and certify the designs and methods of construction to be used meet accepted standards of practice for meeting the provisions of (60.3(e)(4)(ii) and breakaway walls (60.3(e)(5)).

b. Reference Elevation

All newly constructed, substantially damaged, and substantially improved buildings must be elevated on pilings, posts, piers, or columns so that the bottom of the lowest horizontal structural member of the lowest floor (excluding the vertical foundation members) is at or above the BFE.

FIGURE 6-5 PROPOSED ELEVATION REFERENCE POINT



The NFIP's Community Rating System provides substantial insurance credits when local governments use the bottom of the lowest horizontal member as the reference point for elevation requirement within its coastal AE-zone. The following CRS credits, subject to the impact adjustment based on the percentage of the floodplain affected by the regulation, are available to North Myrtle Beach upon adoption of the proposed regulations.

Reference Elevation. (100 points.)
The bottom of the lowest horizontal structural member, and electrical and mechanical equipment servicing the building must be elevated to or above the BFE. (60.3(e)(4)(i).

[Note: These points can be approved when the community regulations require two or more feet of freeboard in the coastal A zone area, but use the top of the lowest floor as the reference point; however, a community cannot earn both Freeboard (FRB) and CAZ reference elevation credit for the same two feet of freeboard. To earn freeboard credit the community would need to prorate the credit for freeboard greater than two feet.]

c. Siting

Along the oceanfront all newly constructed buildings must be located landward of the reach of mean high tide (i.e., the mean high water line). In addition, manmade alterations of sand dunes are prohibited if those alterations would increase potential flood damage. Removing sand or vegetation from, or otherwise altering, a sand dune may increase potential flood damage; therefore, such actions must not be carried out without the prior approval of a local official.

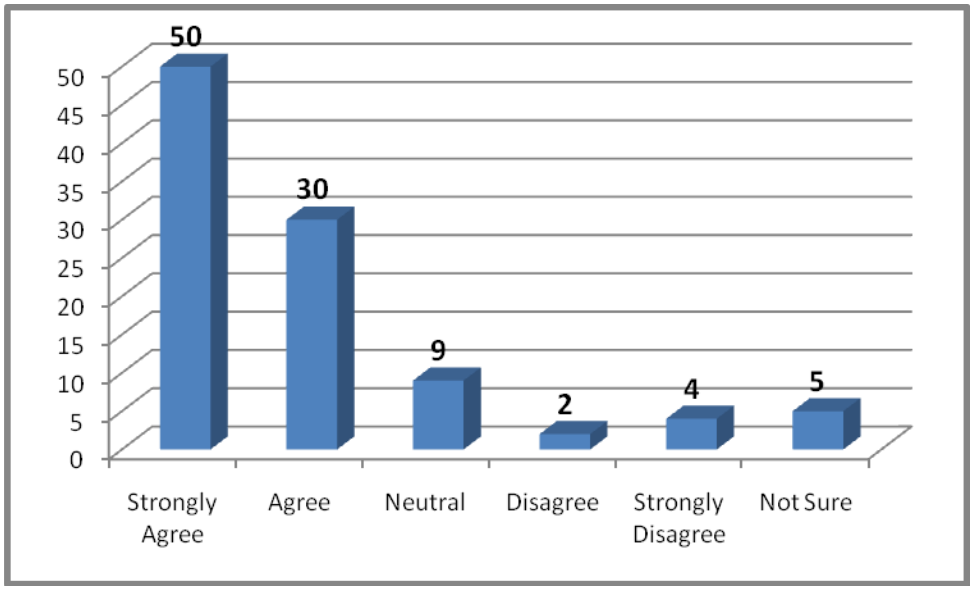
When local governments regulate the siting of buildings in accordance with these standards within its coastal AE-zone the NFIP's Community Rating System provides insurance credits. Subject to the impact adjustment described earlier, CRS insurance credits (up to 25 points) are available to North Myrtle Beach for requiring all new construction to be located landward of the reach of mean high tide.

Along the oceanfront the building location is determined by a setback line, which is established by using a mathematical formula based on the 40-year erosion rate in that area. New habitable structures must be built as far landward as possible and are limited to a maximum of 5,000 square feet. Special permits must be obtained to build seaward of the baseline. To qualify, the structure (usually a house) must be built as far landward as possible and have no impact on the primary sand dune or active beach area. To receive this credit the City should ensure that the Office of Ocean and Coastal Resource Management (OCRM) do not issue any variances to the setback regulation.

Public Opinion Survey

In the public opinion survey conducted during the previous update of the plan, 80% of the respondents said they would support the City's adoption of higher construction and foundation standards for new and substantially improved building in coastal areas subject to waves. This included the 1.5 foot wave that results from hurricanes.

FIGURE 6-6 SUPPORT HIGHER STANDARDS FOR BUILDINGS SUBJECT TO WAVES IN COASTAL A ZONES (PERCENTAGE)



Recommendation

At this point it is not clear where the boundaries for a new coastal A-Zone would be drawn. A new flood study is underway and the coastal A-Zone should be set based on the results of the study to be released later in 2021. The city should consider amending the current code to require new construction, substantially damaged and substantially improved structures within this area to meet coastal A zone constructions standards.

Local governments that adopt all of the V Zone standards in the coastal A Zone area identified by FEMA receive up to 500 points under the Community Rating System. Due to an impact adjustment based on the percentage of the floodplain where the regulations are applied communities do not receive the full 500 points. Additional points are earned when a local government extends the area where the V Zone regulations are enforced.

The City should evaluate adopting a coastal AE-Zone regulation that requires buildings to be elevated on pile or column foundations, with the structure attached and anchored to resist floatation, collapse, and lateral movement due to the effects of wind and water loads, and without the support of fill. The regulation should require the space below the lowest floor to be free of obstruction or enclosed with non-supporting breakaway walls, open wood lattice work or insect screening and have openings.

The rule should require a registered professional engineer or architect to develop or review the structural design, specifications, and plans and certify the designs and methods of construction to be used meet accepted standards of practice for meeting the provisions of V-Zone construction including, if used, breakaway walls for enclosures. Additionally, the reference elevation in this zone should be measured at the bottom of the lowest horizontal structural member.

6.13 Enclosure Regulations

There are no NFIP restrictions on the size of the area that may be enclosed. However, V-zone buildings with lower area enclosures (constructed with breakaway walls) of 300 square feet or greater may be subject to higher insurance premiums due to the potential for increased loadings on the foundation system caused by the enclosure.

The area beneath the elevated superstructure of a V-zone building may be enclosed only with non- load bearing breakaway walls. Open lattice and insect screening may also be used in lower areas.

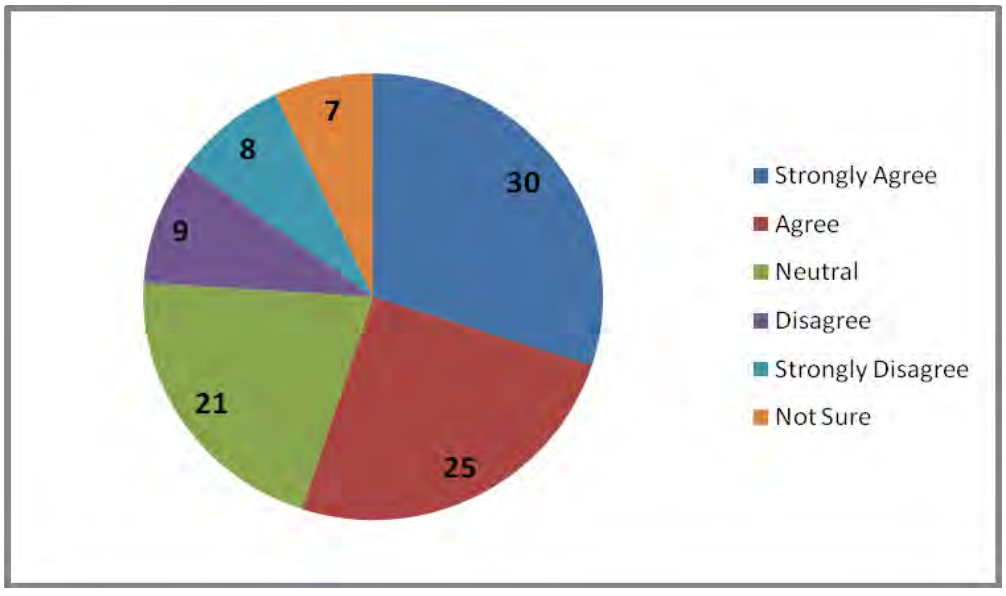
Uses of the area beneath an elevated building are restricted to parking, access, and storage; lower areas must not be finished or used for recreational or habitable purposes. No mechanical, electrical, or plumbing equipment is to be installed below the BFE.

Damage to enclosed area.

Public Opinion Survey

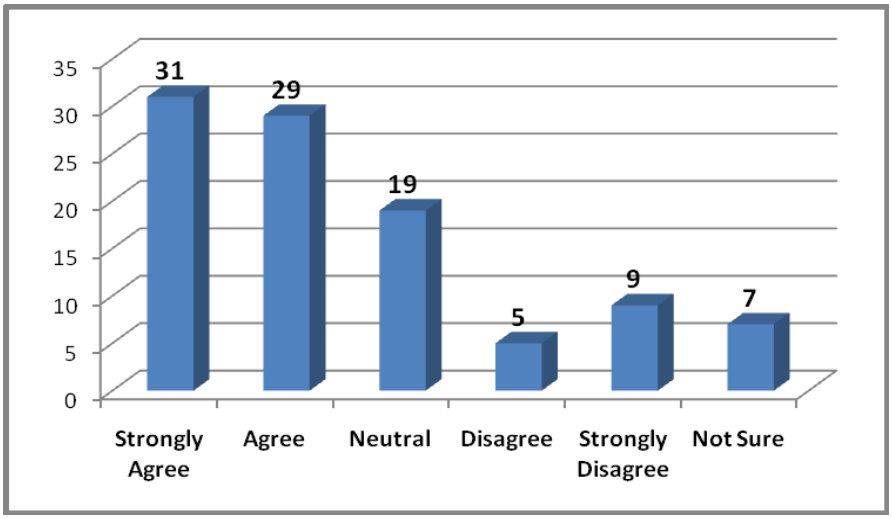
In the public opinion survey conducted under the previous plan update, 55% of the respondents said they would support the City prohibit enclosures below the base flood elevation. Seventeen percent (17%) of the respondents opposed prohibiting enclosures. Twenty-eight percent (28%) were not sure or had no opinion about limiting enclosures.

FIGURE 6-7 SUPPORT FOR PROHIBITING ENCLOSURES BELOW ELEVATED BUILDINGS (PERCENTAGE)



When asked about limiting the size of enclosures, sixty percent (60%) of the respondents said they would support regulation that limit the size of enclosures to no more than 299 square feet (approximately 16 feet x 18 feet) in areas subject to flooding.

FIGURE 6-8 SUPPORT LIMITING THE SIZE OF ENCLOSURES (PERCENTAGE)



Recommendation

The City should limit the size of enclosures in the Special Flood Hazard Area identified on the Flood Insurance Rate Map to no more than 299 square feet.

Disadvantages – The proposal to limit the size of enclosures would mean property owners with full enclosures below the base flood elevation would be limited to 299 square feet of enclosure size if their building was substantially damaged.

Benefits – Adoption of this higher standard will reduce property losses flood events. Property owners will be discouraged from converting enclosed areas to living space. This higher standard will also reduce potential damage to foundation walls and the superstructure from hydrostatic and hydrodynamic pressures.

In addition, adoption of the standard will provide CRS credits as a 430 Series activity as well as Federal flood insurance cost reduction for both below BFE enclosure sizes and a possible CRS discount. When local governments enforce enclosure limits within the coastal AE-zone they are eligible for flood insurance credits as described below.

Coastal AE-Zone Enclosure Limits. (Up to 150 points.)

150	Prohibit all Enclosures
50	Limit Enclosures to 299 Square feet or less.

The enclosure points were added because FEMA was concerned that encouraging elevated structures would also encourage enclosures below the elevated building. Communities are eligible for these additional enclosure points only if they receive CAZ foundation credit. These points are in addition to the 300 points provided for in Section 430h of the *CRS Coordinator's Manual*.

Section 430h Enclosure limits (ENL) (Maximum credit: 300 points)

ENL is EITHER:

1. 300, if regulations prohibit ANY building enclosures, including breakaway walls, below the base flood elevation; OR

2. The total of the following points:

    a. 100, if regulations prohibit enclosures of areas greater than 300 square feet, including breakaway walls, below the base flood elevation. The area enclosed must still meet all NFIP requirements for openings, anchoring, and flood-resistant materials.
    b. 50, if regulations require that the owner of a building sign a nonconversion agreement, promising not to improve, finish, or otherwise convert the area below the lowest floor and granting the community the right to inspect the enclosed area.

Based on the above recommendation 200 CRS credit points would be awarded to North Myrtle Beach.

Recommendation

The city should consider adopting an ordinance that requires applicants for new construction to sign a non-conversion agreement. The regulation should apply to all new buildings in the mapped special flood hazard area identified on the City's Flood Insurance Rate Maps. The agreement should be recorded with the deed.

Benefits – This will make sure future buyers are aware of the city's rules on the use of enclosed areas below elevated buildings. It will assist the Building Inspection Division with enforcement of the enclosure requirements in the current code.

6.14 Design/Regulatory Flood Elevation (Freeboard)

The NFIP requires "all new construction and substantial improvements of residential structures within AE zones on the community's FIRM, have the lowest floor (including the basement) elevated to or above the base (1% annual chance) flood level" (44 CFR 60.3I(2)). Within riverine special flood hazard areas, commercial structures may be floodproofed in lieu of elevation.

In coastal areas, the NFIP regulations require that "all new construction and substantial improvements in Zones V1-30 and VE on the community's FIRM are elevated on pilings and columns so that (i) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is above the base flood level" (elevated to or 44 CFR 60.3(e)(4)).

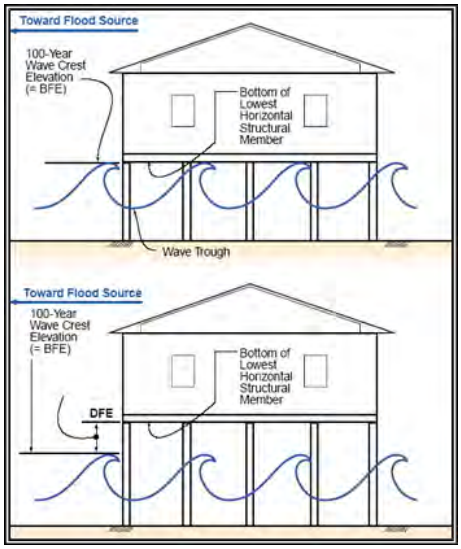


Figure 6-9 Top Figure Illustrates NFIP Minimum V- Zone Standard. The Lower Figure Illustrates Additional Protection with Freeboard

For CRS credit, freeboard must be applied not just to the elevation of the lowest floor of the building or to the elevation to which a non-residential building is dry floodproofed, but also to the level of protection provided to all components of the building. All building utilities, including ductwork, must be elevated or protected to the freeboard level and all portions of the building below the freeboard level must be constructed using materials resistant to flood damage.

North Myrtle Beach requires new construction and substantial improvement of all structures to have the reference floor elevation at least one foot above the 1% annual chance flood elevation. This vertical distance from the 1% annual chance water-surface elevation to the regulatory flood elevation is known as "freeboard." This freeboard is a buffer zone to provide added protection for the structure to help prevent the entrance of floodwaters during a flood event.

The amount of freeboard a community adopts depends on local considerations. Factors that may contribute to the selection of freeboard include the desired level of additional protection, the potential rise in flood water due to sea-level rise, the amount of insurance rate reduction that is available through the NFIP's CRS program, and economic impacts on development.

Background of the Higher Standard –

Some structures that are built to the minimum NFIP standards will be partially inundated during a 1% annual chance flood. With the reference floor elevated at the BFE, floodwater will be literally at door level under ideal conditions during a base flood. Any conditions that could increase flood levels such as debris accumulation at bridges and culverts, sea- level rise, channel sedimentation, or wave action will cause further flood damage of the structure. Many communities discovered this in recent hurricanes, especially in areas that have shown high development since their current FIRM was actually published. The impervious surface areas added by these new developments increased runoff, possibly causing structures to be flooded even though they were constructed in compliance with minimum NFIP standards.

Recommendation

Assuming the City adopts the proposed coastal AE-Zone regulation the freeboard requirement should be increased to two feet.

Benefits – Adoption of the standard may prevent loss of life and property because elevated construction is safer during flood events. The reference floor elevation has a direct impact on the Federal flood insurance rates. For a one- floor, no basement/no enclosure structure, for example, the annual flood insurance policy costs for $250,000 coverage on a home with $100,000 coverage on contents, are shown below in the Table **6-2** (April 1, 2015, rates).

The increased freeboard will result in safer construction as well as direct reduction in flood insurance costs as shown above. Also, if a community enforces freeboard, disaster recovery efforts and costs will be reduced and the community could receive recognition for this regulation as part of the 430 Series of the CRS, which in turn would further reduce the rates listed above. Each foot of freeboard provides up to 100 credits for a maximum of 300 points. As indicated in Chapter 1 the rate reductions under CRS are made in 5% increments related to 500- point credits.

TABLE 6-2 ANNUAL FLOOD INSURANCE COST AND SAVINGS WITH FREEBOARD

Reference Elevation	AE Zone	Savings	VE Zone	Savings
One foot below the BFE*	3,456.00	N/A	10,325.00	N/A
Equal to the BFE	1,520.00	0	8,085.00	0
One foot above the BFE	774.00	776.00	6,355.00	1,730.00
Two feet above the BFE	523.00	997.00	4,635.00	3,450.00
Three feet above the BFE	445.00	1,075.00	3,360.00	4,425.00

*Reference floor elevation two feet or more below the BFE must be "Submit to Rate" in Washington, D.C.

Cost Impacts –Requiring freeboard will increase the initial construction costs for structures in the regulated floodplain. The floor level can be raised by increasing the height of the foundation. Raising the footprint of a 1,400 square foot house by 1 foot would cost approximately $1,500 at the time of initial construction. Elevating the same house by 1 foot after initial construction would cost approximately $30,000.

6.15 Cumulative Substantial Improvement and Substantial Damage Regulations

The NFIP allows improvements valued at up to 50% of the building's pre- improvement value to be permitted without meeting the flood protection requirements. Over the years, a community may issue a succession of permits for different repairs or improvements to the same structures. This can greatly increase the overall flood damage potential within a community as well as the insurance liability to the Federal Insurance Administration.

This proposed requirement has the effect of requiring more structures to come into compliance after a disaster because damage repair is included in "improvements" under the NFIP rules. Since the City participates in the NFIP it already has a substantial improvement threshold; therefore, it is only necessary to change the number of years specified in its ordinance that are to be used to calculate substantial improvements.

Increased Cost of Compliance

On June 1, 1997, the NFIP began offering "Increased Cost of Compliance" (ICC) coverage for buildings covered under the Standard Flood Insurance Policy (SFIP). ICC coverage provides for the payment of a claim to help pay for the cost to comply with community floodplain management ordinances after a flood event in which a building has been declared substantially damaged or repetitively damaged.

When an insured building is damaged by a flood and the community declares the building to be substantially or repetitively damaged, ICC will help pay for the cost to elevate, floodproof, demolish, or relocate the building up to a maximum of $30,000. This coverage is in addition to the building coverage for the repair of actual physical damage from flood under the SFIP. An ICC claim can be filed whether or not a community has received a Presidential disaster declaration. **The following conditions must be met for a substantially damaged building to be eligible for an ICC claim:** A building is eligible for an ICC claim payment if it is in a Special Flood Hazard Area and if the community determines it has been damaged by a flood whereby the cost of restoring the building to its before-damaged condition would equal or exceed 50% of the market value of the building before the damage occurred, as determined by the community. All NFIP communities must have, at a minimum, a substantial damage provision in their floodplain management ordinance in accordance with the NFIP criteria.

CRS NOTE: *By statute, an ICC claim can only be paid upon a substantial damage determination based*

on the NFIP's 50% damage criteria. An ICC claim will not be paid if the damage is less than 50% of the market value, even if the local ordinance declares the building substantially damaged. Communities receiving LSI credit for lower substantial improvement thresholds need to be aware that there may be times when their higher regulatory standard will not trigger an ICC claim payment for their residents.

The following conditions must be met for a repetitively damaged building to be eligible for an ICC claim payment: A building is eligible for an ICC claim payment if it is in a Special Flood Hazard Area and is a repetitive loss structure and is subject to a community floodplain management ordinance. Two conditions must be met for an ICC claim to be paid under the SFIP for a repetitive loss structure:

1. The state or community must have adopted and be currently enforcing a repetitive loss provision or a cumulative substantial damage provision requiring action by the property owner to comply with the community's floodplain management ordinance, and

2. The building must have a history of NFIP claim payments that satisfies the statute's definition of "repetitive loss structure". A repetitive loss structure means "a building covered by a contract for flood insurance that has incurred flood-related damage on 2 occasions during a 10-year period ending on the date of the event for which a second claim is made, in which the cost of repairing the flood damage, on the average, equaled or exceeded 25% of the market value of the building at the time of each such flood event." *Note that this statutory ICC definition is not the same as the CRS definition of a repetitive loss property.*

The date on which the first loss occurred, even if the loss occurred before June 1, 1997, is immaterial to eligibility for an ICC claim payment, as long as the state or community enforced a repetitive loss or cumulative substantial damage requirement on the building and the insured building satisfies the definition of the "repetitive loss structure" defined above.

CRS NOTE: *Communities receiving CSI credit for a cumulative substantial improvement regulation must be aware that there may be instances in which the community's criteria may require compliance with its floodplain management ordinance, but the building may not qualify for an ICC claim payment (e.g., if a building is damaged three times, with each flood averaging 20% damage).*
Source: DHS – FEMA CRS Coordinator's Manual, 2007

This Community Rating System provides credit to a community that ensures that the total value of all improvements or repairs permitted over the years does not exceed 50% of the value of the structure. When the total value does exceed 50%, the original building must be protected according to the ordinance requirements for new buildings.

Under some circumstances the NFIP flood insurance policy may pay part of the cost of bringing a substantially flood-damaged building into compliance with the community's floodplain management ordinance. This Increased Cost of Compliance coverage is described in the above Figure.

6.16 Critical Facilities Regulations

Current Minimum Standard – The NFIP regulations only require elevation of structures located in SFHAs to the BFE, regardless of the function they serve. Facilities belonging to agencies of the Federal Government are subject to Executive Order 11988, which requires rigorous alternative site evaluations before funding, leasing, or building any facility in the 100-year floodplain. The guidelines for implementing Executive Order 11988 set the 500-year flood as the standard for protecting "critical actions."

Background of the Higher Standard – Many public and commercial facilities serve vital functions for communities, which, if interrupted due to flooding, would severely impact citizens. Also, some facilities house large numbers of people who would experience difficulty if required to evacuate before or during a severe flood. Special consideration should be given to requiring a higher level of protection from flooding for such facilities. Since flooding can prevent access to a critical facility even if the facility is elevated or floodproofed above the flood level, primary consideration should be given to locating critical facilities where the risk of flooding is minimal.

Statistically, a facility located in a SFHA stands a 26% chance of experiencing the 100-year flood in a 30-year period. On the other hand, a facility located outside a 500-year floodplain (i.e., in a C Zone or "unshaded X Zone" as shown on the FIRM) stands less than a 6% chance of being flooded over a 30-year period.

Recommendation

The City could prohibit siting of critical facilities in areas subject to flooding by the 1% annual chance flood (SFHAs) and should discourage siting of critical facilities in areas subject to flooding by the 0.2% annual chance (500-year recurrence interval) flood.

If no feasible alternative site is available for a newly constructed facility, or if an existing critical facility located in a SFHA or 500-year floodplain is substantially damaged or improved, it should be elevated to at least the 0.2% annual chance flood elevation and be accessible by road during a 0.2% annual chance flood event.

If a proposed critical facility site is in or near a SFHA for which the 0.2% annual chance flood elevation is not determined and the 500-year floodplain has not been delineated, a flood study should be performed to determine this information before the facility is sited.

If locating critical facilities outside of 500-year or even 100-year floodplains is not an option, elevation to the level of the 0.2% annual chance flood offers almost the same level of protection from flooding for the facility and its contents. Requiring elevation above the 500-year flood level provides an additional level of protection if floodwaters rise higher than predicted 500-year levels due to debris accumulation or other factors.

For some facilities, floodproofing to the same elevation will provide a similar level of protection. However, since all-weather access is generally necessary either to maintain operations or to evacuate the occupants, it will be necessary to provide an elevated access road to facilities located inside the 100-year or 500-year floodplain. When evaluating where to locate a critical facility, the additional cost to elevate or floodproof and to provide all-weather access if the facility is located in a floodplain should be fully considered.

The City should consider requiring that the following categories of facilities be subject to these requirements:

i Emergency response facilities, including rescue/emergency medical services, police departments, fire departments, hospitals, health clinics, emergency shelters, emergency management operations, and communication facilities.

ii Facilities housing vulnerable occupants, such as nursing homes, prisons, jails, centers and group homes for the mentally and physically handicapped, and day-care centers.

iii Public utilities, including power generating plants and transfer stations, public water

supply plants, solid waste incinerators and waste transfer stations, and wastewater treatment plants.

iv Facilities housing irreplaceable public documents, such as libraries, museums, courthouses, colleges, and schools.

v Hazardous material facilities, such as liquid and gas fuel tanks, petrochemical facilities, chemical manufacturing and storage facilities, research laboratories testing infectious biological agents, explosive manufacturing and warehousing, toxic waste facilities, and landfills.

Benefits – Adoption of this higher standard may prevent loss of life and property during flood events by ensuring that services provided by critical facilities are not interrupted during and after major flood events. In addition, adoption of the standard will provide CRS credit points as a 430 Series activity. Communities that prohibit siting critical facilities in the 500-year floodplain receive 100 CRS credit points; communities that only require protection from damage (i.e., elevation or floodproofing) and loss of access as a result of the 500-year flood or the flood of record, whichever is higher, receive 50 CRS credit points.

Cost Impacts – Restricting critical facility sites to locations outside of SFHAs and 500-year floodplains may increase costs if land prices are higher in non- floodprone areas. Requiring elevation or floodproofing and all-weather access for new and substantially improved structures built in SFHAs and 500-year floodplains may significantly increase facility costs.

6.17 Regulations for Additions to Buildings

Additions are improvements that increase the square footage of a structure. Commonly, this includes the structural attachment of a bedroom, den, recreational room garage or other type of addition to an existing structure. All additions to a post-FIRM building must be elevated at least as high as the BFE in effect when the building was built. A compliant building must not be allowed to become noncompliant by allowing additions at grade. If a new, higher BFE has been adopted since the building was built, additions that are substantial improvements must be elevated to the new BFE.

There has been some confusion about how additions should be regulated. The current code should be examined for possible clarification.

Recommendation

Prepare regulations that govern the flood protection requirements for additions (other than enclosures described above) to existing buildings. Consideration should be given to the adoption of regulations that specify where the addition is within the footprint of the original building the addition must be to a floor at or above the regulatory flood elevation. And, where additions are outside the footprint of the original building they would be required to be elevated at or above the regulatory flood elevation.

Property Protection

Property protection measures are used to modify buildings or other facilities subject to flood damage rather than to keep floodwaters away. Often, they are implemented by (or cost-shared with) property owners. There are a variety of flood protection measures that can be implemented to protect individual buildings from flooding: They include

6.18 Acquisition and Demolition

Acquiring a property in fee simple means buying the land outright. It provides a local government with the greatest level of control over the use and disposition of a parcel.

Fee simple acquisition can be used to meet several community objectives at once. One example would be the purchase of beachfront properties to ensure recreational access and reduce hazard risk. Acquisition can also be used where general land-use regulations are not sufficient or where environmental objectives are sought. Acquiring properties in the floodplain and reverting them to open space can restore the natural function of the floodplain or wetlands. Similar gains can be made if parks and recreation areas replace flood-prone buildings. Acquisition policies could also target beachfront properties where redevelopment would be permitted under current regulations but would impact the beach and dune system.

Implementation Policies

1. The power of acquisition can be a useful tool for pursuing mitigation goals. The City may find the most effective method for completely hazard- proofing a particular piece of property is to remove it from the private market, thereby eliminating or reducing the possibility of inappropriate development. Given its cost, this technique should be used only for property in the most hazardous areas, where property and life is subject to repeated damage or extreme risk.
2. Acquisition, followed by demolition, is most appropriate for buildings that are too expensive to move -- such as larger, slab foundation, or masonry structures -- and for dilapidated structures that are not worth protecting.
3. Properties subject to repeated damage or extreme risk should not be returned to the marketplace.
4. The City should look for acquisition opportunities where it may not need to pay full price for damaged structures acquired in the wake of a disaster. Sometimes a property can be purchased for the difference in value between its full price and payments already made to the landowner, such as insurance settlements and Small Business Administration loans.
5. Checkerboard purchases should be avoided whenever possible since dispersed properties are more costly and difficult to maintain.

Financial Approaches to Implementation

1. The City should apply for funding to pay for 75% of the fair market value of the substantially damaged buildings and their lots. Funds may be available from the Flood Mitigation Assistance (FMA) and Hazard Mitigation Grant Programs (HMGP).
2. If the funding is received, a property appraiser would prepare a formal appraisal of the pre-flood value of each lot and building. Those without flood insurance would be offered 75% of this appraised amount. For example: if a property is appraised at

$100,000, the owner would be offered $75,000. The owner in effect absorbs the difference which is credited to the project as the non-federal share.

3. Those who did have flood insurance will have the amount of the flood insurance claim payment subtracted from the property value. The offer would be 75% of the balance. For example: If the property is valued at $100,000 and the owner received a claim payment for $60,000, the offer would be 75% of $40,000 or $30,000. In the end, the owner would have received a total of $90,000.
4. The property owners can decide if they need more than 75% of the appraised value. Whether they were insured or not, they can apply for an SBA loan. This can help pay the costs for a new property. For example: a property was appraised for $100,000 and the owner receives $75,000 for it. There is still a $50,000 mortgage payment. The owner pays off the mortgage and uses the remaining $25,000 plus a low interest SBA loan to purchase a new place. The loan can also help pay for new furniture, etc.

Acquisition Disadvantages

Fee-simple purchase is usually the most expensive method of land acquisition. In addition to the cost of buying the property, a local government must delete the property from its property tax rolls and assume its maintenance costs.

Acquisition Advantages

Acquisition ensures that buildings in a floodprone area will cease to be subject to damage. Acquisition is undertaken by a government agency, so the cost is generally not borne by the property owner, and the land is converted to public use, such as a park. Acquiring and clearing buildings from the floodplain is not only the best flood protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Recommendation

The City should develop a post-disaster recovery program that establishes policies and procedures that will be used to administer acquisition and demolition grants. Priority for the allocation of these funds should go first to acquire and demolish the most severe repetitive loss buildings in the highest flood hazard areas. The second priority should be buildings that suffer substantial damage and are in high hazard areas. The policy should identify the criteria to be used to determine the remaining priority categories for the use of these funds.

Some grant programs require a reuse plan for the vacant land to be submitted with the grant application. Programs like FEMA's Hazard Mitigation Grant Program require floodprone land acquired through the grant program to remain as open space. The City should consider how these acquisitions can assist in achieving other City objectives such as additions to parks, expanding natural areas, developing walking trails, and providing parking and access to the beach.

6.19 Acquisition and Relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost goes up for heavier or rigid structures, such as those made of brick, and for large or irregularly shaped buildings.

Mobile homes and manufactured housing have been shown to be highly vulnerable to floods and should not be located in the floodplain. Where such housing can be relocated, this step

should be taken.

Implementation Policies

Issues that need to be addressed in the planning stage include: cost-benefit comparisons of relocating structures intact or rebuilding; and whether buildings can be relocated on the same property or if new property must be acquired.

While relocation and acquisition work against any type of flood hazard, it is more cost-effective in areas subject to storm surge, flash flooding, deep waters, or other severe flood hazards where other property protection measures are not feasible. They are also often justified for properties that repetitively flood, are substantially damaged and/or where the occupants are kept out of the building for extended periods.
Relocation is also preferred for large lots with portions outside the floodplain or where the owner has a new flood-free lot available.

Financial Approaches to Implementation

See the discussion under Acquisition and Demolition above.

Relocation and Acquisition Disadvantages

The costs of a new lot, a new foundation, new utility connections, landscaping, moving fees and mitigation of the former site (including the removal of foundations, utility connections, concrete and asphalt) may outweigh the value of the structure. Adding to these costs is the fact that prices for lots outside the floodplain are often more expensive.

In addition to the cost of buying the building lot, a local government must delete the property from its property tax rolls and assume its maintenance costs.

Relocation and Acquisition Advantages

Relocation allows the City to remove a building from a hazard area, place it on a safer site and keep the building on the property tax rolls. The vacant lot may be converted to public use, such as a park. Like acquisition and demolition projects, acquiring and relocating buildings from the floodplain or other hazard areas is one of the most effective protection measures available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Recommendation

The City should develop a post-disaster recovery program that establishes policies and procedures that will be used to administer acquisition and relocation grants. Priority for the allocation of these funds should go first to acquire and demolish the most severe repetitive loss buildings in the highest flood hazard areas. The second priority should be buildings that suffer substantial damage and are in high hazard areas. The policy should identify the criteria to be used to determine the remaining priority categories for the use of these funds.

6.20 Building Elevation

Raising a house above the flood level is the best property protection method short of getting the building entirely out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Another alternative is to raise the building and place fill under it before the building is lowered back down, although sometimes buildings on fill look safe and people may feel encouraged to stay in them during a flood.

Elevating a structure will change its appearance. If the house is raised two feet, the front door would be three steps higher than before. If the house is raised eight feet, codes will usually allow the lower area to be wet floodproofed for use as a garage and for limited storage of items not subject to flood damage.

Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. This protection technique is required by law for new and substantially damaged residences located in a floodplain if the lowest floor is below the base flood elevation. Commonly practiced in flood-prone areas nationwide, house-moving contractors know the techniques to elevate a building.

Elevated buildings are not new to North Myrtle Beach. Construction practices in the area favor the "elevated look" especially near the shoreline. Therefore, the method is tried and true and appearance is not a major problem.

Inland from the oceanfront the standard practice has been to build single-family homes on crawlspace foundations with the first floor two to three feet above grade or in some cases slab-on-grade construction is used.

Implementation Policies

FEMA has developed a set of criteria that may be used to evaluate whether a building can be elevated. It must be accessible below the first floor for placement of jacks and beams, it must be light enough to be lifted, it must be small enough

to be elevated in one piece, and it must be strong enough to survive the elevation process.

Elevation of a building increases its vulnerability to high winds and earthquakes. Thus there is a need to incorporate wind and seismic protection measures to ensure that the flood protection project does not increase the building's vulnerability to other hazards.

Financial Approaches to Implementation

See the discussion under Acquisition and Demolition above.

Elevation Disadvantages

Some think regulatory restrictions, such as the Americans with Disabilities Act (ADA) pose a problem for elevating structures. However, the regulatory requirements of the Americans with Disabilities Act and historic preservation programs do not affect single-family homes, the type of buildings that comprise approximately 90% of North Myrtle Beach's floodprone structures. While the City's building code does require wind and seismic protection standards, they do not add significantly to the cost of elevation.

Elevation Advantages

Elevation is one of the best techniques for protecting buildings that are, or for some reason must be, located in areas prone to flooding. Elevation is cheaper than relocation and is less disruptive to the neighborhood.

Where funds are not available to elevate a building, one less expensive way to reduce flood damage is to elevate only a structure's heating, ventilating, and cooling (HVAC) equipment, such as furnaces and hot water heaters. This equipment can often be moved to an upper floor or attic. However, relocating HVAC systems is likely to involve plumbing and electrical changes. A less

desirable method of floodproofing this equipment is to build a concrete or masonry block floodwall around it in its existing location. This kind of floodwall must be strong enough and high enough to protect the equipment.

Electrical system components, including service panels (fuse and circuit breaker boxes), meters, switches, and outlets should also be elevated at least 1 foot above the 100-year flood. These components suffer water damage easily and could short and cause fires. By elevating electrical and mechanical equipment, buildings should be able to recover more quickly and less expensively.

Financial Approaches to Implementation

Several of the financial assistance programs, including FEMA's Home Repair Program and SBA loans can help fund these measures. FEMA's program aims to get people back in their homes quickly rather than pay for housing elsewhere. It covers items deemed necessary for "habitability" of a residence. People who qualify can receive additional funds for mitigation items, such as

- relocating the main electrical panel to a higher floor
- elevating the furnace or water heater to 1 foot above the experienced flood elevation within the crawlspace or basement but not to another floor.

Recommendation

The City should develop a post-disaster recovery program that establishes policies and procedures that will be used to administer elevation grants. Priority for the allocation of these funds should go first to elevate the most severe repetitive loss buildings in the highest flood hazard areas. The second priority should be buildings that suffer substantial damage and are in high hazard areas. The policy should identify the criteria to be used to determine the remaining priority categories for the use of these funds.

The city should prepare an application for FEMA Flood Mitigation Assistance Grants to assist property owners with the cost of elevating their homes.

Some of the flooded buildings in North Myrtle Beach are houses on crawlspaces. Most of these had water under the flooring and were not substantially damaged. However, their heating, air conditioning and duct systems were often a total loss. Electrical circuits that were underwater were also in need of replacement.

Residents and businesses should be encouraged to include retrofitting measures in their building repairs. These could include:

- Moving the electrical box to a level above the high water mark.
- Moving the furnace, air conditioner and ductwork to a higher level. If there's no more room in the crawlspace, the system could be replaced with one in the attic where it will be high and dry.

6.21 Floodproofing

If a building cannot be removed from harm's way, it can be protected on site. In areas of low flood threat, such as infrequent low velocity shallow flooding, barriers and dry and wet floodproofing can be efficient approaches. These approaches can also be less disruptive to a neighborhood.

However, floodproofing a residential building does not qualify for an insurance premium reduction and is not allowed if the project is a substantial improvement or repair of substantial damage.

Barriers
Levees, floodwalls and berms keep floodwaters from reaching a building. They are useful only in areas subject to shallow flooding. They can surround the entire building, tie into high ground, or be as small as a low floodwall built around a stairwell to protect a basement or split-level home. Care must be taken in locating barriers. They must be placed so as not to create flooding or drainage problems on neighboring properties. All barriers must be kept out of the floodway.

Dry floodproofing
Through dry floodproofing, a building on a slab foundation is sealed against floodwaters. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows, sewer lines and vents, are closed, either permanently with removable shields or with sandbags.

The flood protection level should be no more than 2 or 3 feet above the top of the slab because the building's walls and floors may not withstand the pressure of deeper water. If a nonresidential building is dry floodproofed to one foot above the base flood elevation, there is a flood insurance rate reduction.

Wet floodproofing
This term means intentionally letting floodwaters into an area, but modifying the area to eliminate or minimize water damage. Wet floodproofing techniques can be as simple as moving a few valuable items or as involved as rebuilding the floodable area.

This is the preferred approach for crawlspaces and garages. If damageable items, such as furnaces, air conditioning units and ductwork are removed or elevated above the flood level, a crawlspace can be flooded and be damage free.

For other areas, wet floodproofing is usually considered a measure of last resort, because the modifications needed severely limit use of an inhabited area.

Implementation Policies
Barriers or dry floodproofing are more appropriate for buildings on slab foundations subject to shallow flooding. There are several commercial buildings on Main Street that would benefit from these approaches. They could also be useful for the slab buildings and small enclosed areas subject to local drainage problems. However, for this approach to be effective the property owners must receive adequate warning.

Floodproofing Disadvantages
Floodproofed buildings in the flood zone are still subject to damage from floating debris and may not provide shelter during flood events. Floodproofing a residential building does not qualify for an insurance premium reduction.

Dry floodproofing cannot extend more than two or three feet above the foundation of the building because the pressure exerted by deeper water would collapse most walls and floors.

It must be remembered that during a flood, the building may be isolated and without utilities, and therefore unusable. The streets, utilities and other infrastructure that serve the property will still

be exposed to flood damage. This is also a risk to the occupants who may try to get in and out of the building during a flood.

Floodproofing Advantages

Although floodproofing raises construction costs, it is an effective mitigation tool and provides a high level of protection from water damage. Simply moving utilities, contents and electrical appliances out of the floodprone area can prevent thousands of dollars in damage.

Recommendation

Due to its disadvantages, floodproofing should be used as a last resort.

6.22 Lifeline protection

"Lifelines" include roads, railroads, pipelines, power lines, and other utility systems that are used for transportation or communication. They are vital to an area's economic base and, depending on the situation, can be vital for public health and safety.

In most cases, well-constructed lifelines can resist the effects of high winds, and flooding, especially shallow, slow moving floodwaters. Protection measures vary according to the facility and flood conditions. Well-known engineering practices, such as proper siting and deeper foundations, can protect a new or existing facility, provided there is recognition of the full potential of the natural hazards.

As discussed in Chapter 1, lifelines affected by previous hurricanes and floods included streets and sewers, power, and phone lines.

Sewers

Commonly situated at low elevations, sewage lift stations often fall victim to flooding. Simple telemetry equipment offers early detection of high water levels at the lift, and timely response can keep the station operational.

The electronics of the lift stations have been raised above base flood elevation to protect the vital and costly switchboard. If the lift becomes disconnected from the City's electrical grid, yet the onsite electronics remain dry and functional, service personnel can safely use a "quick connect" hook-up installed in the station to access power from an emergency generator.

Sandbagging has been determined not to be a feasible option by the City. When a hurricane is expected to make landfall or approach the beach so that lift stations may be flooded, one pump in the station is taken off-line for protection purposes. All lift stations have been wired to accept standby generators. Standby generators are stationed in reserve for deployment as needed.

Recommendation

Additional emergency generators should be purchased as funding becomes available. This will help maintain operations of the sewer system, permit earlier return of residents and visitors to the beach following a hurricane, and protect the environment.

Traffic lights and other traffic controls

Protect traffic lights and other traffic controls, and/or install resilient street signs for navigation in an emergency to avoid traffic signal malfunction, which can produce backups and accidents at intersections and subsequently impede evacuation or emergency response.

Housing for electronics should be watertight, and traffic lights securely connected to suspension wires. Arching or "trunk-and-branch" metal poles used to suspend traffic lights are more expensive; however, they are also more durable than wooden poles in the face of strong wind and water forces. For earthquake hazards, traffic hardware should be resistant to malfunction associated with jarring.

Finally, signs with street names should be resilient: emergency service crews from neighboring towns might join the rescue effort; presuming that personnel from outside the locality are unfamiliar with the road network, the survival of street signs could promote a timely response.

Recommendation
Continue the policy of protecting traffic lights from high winds to prevent them from becoming airborne.

Electric, telephone, and cable lines
Nationwide, falling trees and swinging tree limbs are the greatest source of power outages. In addition, tree limbs entangled in a frayed and sparking electrical wire create the perfect conditions for an uncontrolled fire. The force of tornadoes and hurricane winds is strong enough to torque high-tension wires from their connections on utility poles. Even if the wind does not break the wires, objects lifted by the high winds can catch upon and tear utility wires.

Recommendation
Continue the program to bury electric, telephone, and cable lines, and/or reinforces the connections on existing utility lines to avoid line damage resulting from high winds. Routinely clear tree limbs hanging in the right-of-way to prevent trees from damaging utility wires during high wind events. Take care not to trim more than is necessary to avoid denying citizens the shade and beauty that a full tree offers.

When ground is broken to bury lines, there is an opportunity to install high- speed Internet lines that are attractive to both business and the current generation of homebuyers.

Strips of easement land above buried wires are available as pedestrian or cyclist pathways, and this may also be seen as an opportunity for streetscape beautification by eliminating industrial-looking poles and overhead lines.

6.23 Flood Insurance

Increased Cost of Compliance Coverage and Regulations

The requirement for non-compliant buildings to achieve compliance after substantial damage is sustained has been part of the NFIP regulations since 1974. Standard NFIP flood insurance policies issued or renewed since May 1997 include coverage called Increased Cost of Compliance. This coverage is intended to help bear at least a substantial part of the cost of bringing a flood damaged building into compliance with the flood resistant provisions of the community's codes and regulations.

Most buildings insured under the NFIP that are declared "substantially damaged" by the community will qualify for an additional insurance claim payment of up to an amount stated in the flood insurance policy. This additional claim payment may also be used as part of the non-federal cost-share for certain federally funded flood mitigation grants.

Increased Cost of Compliance claim payments may also be available for insured buildings that sustain "repetitive flood losses", but only if the community has adopted a specific cumulative substantial damage provision that either meets or exceeds the definition in the standard flood insurance policy.

If eligible, a flood insurance policy holder can collect up to $30,000 to help cover the cost of bringing their home or business into compliance with floodplain ordinances. For a policy holder to be eligible to file for ICC the City's floodplain administrator must determine one of the following:

- The property is "substantially damaged." This means the cost to repair the flooded building is 50% or more of its pre-disaster market value.

- The property sustained "repetitive damage." This term applies to homes or businesses that were damaged by flooding twice in the past 10 years, where the cost of repairing the flood damage, on average, equaled or exceeded 25% of the property market value at the time of each flood. Also, there must have been flood insurance claim payments for each of the two flood losses. To access the ICC flood policy benefit using this provision the City's floodplain management ordinance must have a repetitive loss provision.

To help property owners comply with these provisions in the City's building codes and floodplain ordinances, ICC can be used to help pay for any of these mitigation solutions:

- Elevating above the flood protection level required by the City code.
- Relocating to a new site.
- Demolishing the building.
- Floodproofing (non-residential properties only).

Recommendation
The City should undertake a study to see how many property owners would potentially benefit from the addition of a repetitive loss provision in the ordinance.

6.24 Windproofing

Windproofing is the modification of the design and construction of buildings to withstand wind damage. It typically involves improvements to the aerodynamics of a structure, the materials used in its construction, or the addition of features such as storm shutters. Windproofing can also help protect a building's occupants and their possessions from broken glass and flying objects.

Implementation
Several structural measures can significantly increase a buildings' wind resistance without raising the cost of construction by more than a few percent. These include:

- using larger than usual timbers;
- using bolts instead of nails;
- strengthening wood frames with braces;
- anchoring the structure to the foundation;
- make sure there is a continuous load path;
- secure roof sheathing with screws instead of nails; and

- make sure roof shingles meet the wind code standards for the area.

Property owners should properly prepare the exterior of their homes. Garage doors should be reinforced to prevent them from blowing open. Roof-mounted structures should be securely attached to buildings. Residents should reduce the number of potential airborne objects around their homes, since such items can puncture a home and render it vulnerable to the elements. Doors and windows should be strengthened to resist flying debris. In the case of a severe storm warning, home and business owners should cover their windows with plywood boards or storm shutters. Other techniques include securing fan and light fixtures to ceilings and strapping or bolting generators to walls.

Manufactured housing has also been shown to be very susceptible to wind damage. These structures should be securely anchored to their foundations. Mobile homes should be tied down to their pads to prevent them from being blown apart. Windblown debris from mobile or manufactured housing can be a hazard to structures located nearby.

6.25 "Safe Rooms"

Windproofing will not protect structures from tornadoes. As a result, tornado shelters should be provided in areas with high tornado likelihood, or where structures lack basements and underground protection (such as mobile home parks). Manufactured housing has proved to be especially vulnerable to damage from tornadoes.

The shelter has the potential to be an attractive building that functions as a community meeting room and gives a greater sense of permanence to the mobile home park. As a result, it may increase lot values.

Recommendation

Encourage construction of a "safe room" in new schools, daycares, and rest homes to provide a room, or adequate space, that is capable of withstanding extreme wind forces and the force of collapsing or propelled materials.

The room should be large enough to hold the anticipated number of daily occupants of the building. Existing schools, daycares, and rest homes could potentially receive government subsidy to reinforce a room or hallway to function as a safe room.

Encourage mobile home parks to build a storm shelter for their residents, whose housing is susceptible to destruction by relatively minor high-wind events.

6.26 Seismic retrofitting

Seismic retrofitting means preparing existing and new buildings to withstand the shaking force of an earthquake. Preparedness also includes non-structural improvements to reduce earthquake damage within a structure.

Structural improvements typically include adding braces and removing overhangs. Bridges, water towers and other non-occupied structures should also be retrofit with earthquake-resilient materials. Sources of secondary damage, such as sprinkler pipes, water and gas service lines should be secured or fitted with shutoff valves. Fuel tanks and their supply lines should be securely anchored so that they are not dislodged by earthquakes. Unanchored basement tanks can tear free of their supply lines. Fuel storage tanks need to be inspected and, if necessary,

repaired or reconstructed following hazard events.

Recommendation
Nearly every structure, both public and private, is a candidate for seismic retrofitting of some sort. Public buildings, especially those that also serve as shelters, should be made earthquake resilient.

Homeowners should be encouraged to undertake relatively simple but effective non-structural mitigation actions. These might include: securing bookcases, light fixtures and computer monitors; covering high-hazard windows with shatter- resistant film; and locating hazardous materials where they are unlikely to be spilled in an earthquake.

Government and public buildings should be inspected for equivalent mitigation opportunities. Education and awareness programs can help raise public interest in mitigation activities. Brace generators, elevators and other vital equipment in critical facilities such as hospitals to ensure that the usual operations of hospitals are not disturbed by the jarring associated with an earthquake.

Natural Resource Protection

The coastal areas of South Carolina are often referred to as the “Low Country” due to the larger areas of marsh and wetlands “swamps” that are found here. North Myrtle Beach is no exception to this distinction. A report prepared in 1989 by the South Carolina Land Resources Commission states that approximately 321,567 acres or 45% of all land within Horry County is considered to be wetlands. A conservative estimate puts the total wetland acreage at 1,636 acres or 19% of the City in wetlands.

Preserving or restoring natural areas or the natural functions of floodplain and watershed areas produce flood loss reduction benefits as well as improve water quality and habitats. These activities are usually implemented by parks, recreation, or conservation agencies or organizations. In addition to the four measures listed here, other measures, such as zoning and preservation of open space (covered in Chapter 5) can also protect natural resources.

The tidelands and coastal waters of the South Carolina coast are a very dynamic ecosystem and a valuable natural resource for the people of the State. The tides regularly ebb and flood through the coastal inlets, bays and marshes which constitute a fragile area, vulnerable to the impacts of many human activities. Tidelands and coastal waters are identified as "critical areas" over which the Department has direct permitting authority.

The saline marshes are highly productive components of the marine food web of coastal waters and estuaries. Decaying organic material, called detritus, serves as the basis of the food web and is the major biological contribution of the saline marshes. Many commercially and recreationally important fish and shellfish species depend on the marshlands and estuaries for all or part of their life cycle. In addition, many birds and other forms of wildlife utilize wetlands as habitat as well as a source of food. Tidelands and coastal waters also have become increasingly important in recent years for the purposes of aquaculture.

Among the important functions of the salt and brackish marshes is their role in protecting adjacent highlands from erosion and storm damage. Marsh vegetation absorbs and dissipates wave energy and establishes a root system, which stabilizes the soils. Its effectiveness as a buffer

depends on the surface area available which, combined with the composition of the underlying substrate, allows tidelands to act as "sponges," absorbing and releasing waters during storms or times of heavy riverine discharge.

Marshes also perform a valuable waste treatment function since the dense vegetation acts as a filter, trapping sediments and pollutants, which enter as run- off from the upland areas. The trapping of sediments helps maintain water clarity, a factor important to clam, oyster, and phytoplankton productivity. The marshes also assimilate pollutants and recycle nutrients through various biochemical processes.

Coastal waters and the adjacent marshes are also significant as aesthetic, recreational and educational resources. Much of the expenditure for recreation and tourism in the South Carolina coastal zone is for purposes of enjoying outdoor activities and the aesthetic pleasures of undisturbed tideland areas. These natural areas lend themselves to important academic pursuits such as wildlife population and nutrient recycling studies.

These same unique natural resource areas face increasing land development pressure and negative impacts from human activities in and around them. The marshes constitute a fragile ecosystem; consequently, indiscriminate dredging and filling, degradation of water quality or unsound building and development practices can have long-term detrimental effects.

Natural resource protection measures include:

6.27 Wetlands protection

The natural environment is directly affected by the built environment. Our community depends on clean water and a healthy ecosystem. The dynamic natural processes that characterize land and water boundaries create beautiful landscapes that are essential to both the local ecology and economy. Freshwater and tidal creeks, marshes, dunes, estuaries, and beaches intermix to support complex ecological systems that provide invaluable services. Wetlands provide critical habitat, mitigate flooding, and capture and retain sediments, reducing pollution downstream. Estuaries provide essential commercial and recreational fish nurseries. Beach and dune systems protect the shoreline against the natural hazards of erosion, storms, and sea-level rise. Because our local economy is so dependent upon economies fueled by tourism, recreation, as well as a retiree community, protecting our natural assets is paramount.

Protecting the strength and health of this coastal community's natural resources requires balancing the needs of the built environment with those of the natural one. Green infrastructure planning can help North Myrtle Beach achieve this balance. Through green infrastructure planning, a community or region can identify and prioritize natural areas that should be preserved or restored to protect long-term ecological health and build community resilience[4]. It is anticipated that the process of assessing the City's most important environmental assets will continue; identifying the natural and working lands and water bodies that need to be protected or restored. Humans, animals, and plants all share this ecosystem; and our health is absolutely critical to the health of the natural world as well. Conserving our natural environment not only ensures the protection of attractive surroundings or plants and animal survival, it also ensures our survival as well. North Myrtle Beach residents share the responsibility of maintaining and

improving this delicate ecosystem.

Wetlands are often found in floodplains or depression areas in the watershed. Many can store large amounts of floodwaters, slowing and reducing downstream flows. They also filter water and provide habitats for fish and wildlife. Most development projects in wetlands are regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. Corps "404" permits are required for projects that will place fill or dredged materials in a wetland. Before a permit is issued, the plans are reviewed by several agencies, including the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency.

Generally, these agencies want to protect wetlands by preventing development that will adversely affect them. However, sometimes the negative impact can be mitigated by preserving or developing an equivalent or larger wetland on another site, although it takes many years for a new wetland to approach the same quality as an existing one. Another drawback is that a new wetland in a different location (especially if it's in a different drainage basin) will not have the same flood protection benefits as the original one did.

Implementation in North Myrtle Beach:

Waites Island

Waites Island is only three miles long and 0.31 miles wide, but is one of the few remaining undeveloped barrier islands in South Carolina. The island was named after William Waites, who was one of the first to trade with the Native Americans in the area. Over the years, historians and archaeologists have discovered broken pieces of pottery, burial mounds, and arrowheads left behind by Native Americans on the island.

Threatened Piping Povers are found on Waites Island

In 1992, Anne Boyce donated 1,049 acres of undeveloped land to Coastal Education Foundation, Inc. Since the donation, Coastal Carolina University's Marine Biology Department has turned the area into an outdoor classroom that allows students to explore and monitor the unique wildlife and plants in an almost untouched coastal environment.

Part of the charm of this island is that it is essentially a wildlife sanctuary for a number of threatened and endangered plant and animal species. A few examples of the wildlife include the Piping Plover, Bald Eagle, Loggerhead Sea Turtle and the Wood Stork.

The United States Fish and Wildlife Service has established numerous critical habitat areas along the Atlantic Ocean in order to protect the threatened Piping Plover population. One of the sites extends from the eastern most tip of Cherry Grove point to the southern tip of Waites Island. These sites were designed to protect and encourage the breeding of this small shoreline bird. In addition to the endangered wildlife, this island is the home of Seabeach Amaranth, which is a federally threatened plant that can only be found on sandy beaches.

Access to Waites Island is gated and requires permission from Coastal Carolina University, which

uses the island for research purposes. With so few undeveloped barrier islands remaining in the region, an alternative to developing the island is to designate it as a conservation area. A land conservation organization, such as The Nature Conservancy, could purchase the property and preserve the barrier island in its natural state by keeping it closed to the public. The property could also be purchased by the State of South Carolina with grant money and be designated as a state park. Because the Tilghman Point is both historically and environmentally significant, sensitive areas could be blocked off to visitors while other sections would be open to the public to learn more about the history of South Carolina and our coastal environment.

White Pointe Estuary

According to the consultant Davey Resources Group, White Pointe Estuary "swash" is a coastal estuary ecosystem located toward the southeast end of the City. This area is relatively open and

White Point "Swash" Looking North

is dominated by the smooth cord grass (*Spartina* alternatiflora) grass. Recognized on maps from the National Wetlands Inventory, this type of ecosystem is extremely valuable as a nursery for many species of marine fish, including many that have commercial and recreational value. Some examples of important Atlantic Ocean fish species dependent upon the estuary in the early part of their lives, where food is plentiful and protective habitat exists, are flounder, spot, drum, croaker, menhaden, mullet, and kingfish.

Because the estuary is nearly surrounded by residential or commercial development, the ecological value of the swash may be somewhat limited. Ironically, this estuary undoubtedly absorbs large amounts of pollutants from nearby runoff and developed areas. These environments are particularly sensitive to alteration in the landscape that affects hydrology. Increasing impervious surfaces can lead to increased runoff that can erode soils. Runoff can also carry pollutants that eventually harm susceptible fish and aquatic life.

Cherry Grove Marsh

Cherry Grove Marsh serves as another nursery and breeding ground for a variety of plants and animals. Birds, including herons and egrets, live in the salt-water marsh and feed on fish and shrimp that live in the marsh. Smooth cord grass is present here, too. Most of the marine life is

dependent on decomposing detritus from the salt marsh for their food supply. In 2002, the Pew Oceans Commission published *Marine Reserves*, explaining that coastal development and the loss of such estuary nurseries was a major threat to the world's oceans.

North and South Sea Mountain Swamps
Both North and South Sea Mountain Swamp are wooded sites and contain a mosaic of wetlands and uplands. Vernal pools are found throughout these areas and offer unique habitats for a variety of significant species. For example, many species of salamanders (*Ambystoma*) require these types of wooded wetlands as breeding sites. The older trees also provide habitat for nesting birds, as well as the federally endangered Indiana bat (*Myotis sodalis*).

These two swamps are threatened with adjacent residential development and contamination caused by stormwater run-off containing grease, oil, gasoline, debris, and anything else washing off from local roads. The water quality of these environments is particularly sensitive to the effects of urbanization and development including increased impervious surfaces, sedimentation and erosion, and deforestation. The natural resources present in these swamps are of a higher quality and provide habitat for a variety of local wildlife.

7th Avenue South Swamp
City Purchase. The City purchased roughly 80 acres of property from the McClean family in 2009 so the Public Works Department could plan a stormwater retention facility. The 7th Avenue South Swamp will continue to function as nature intended to help relieve downstream flooding on Hillside Drive. Within 1-2 years the project should be complete. Treated as a natural resource, installing a future public boardwalk with interpretive educational signage discussing the natural environment has been mentioned.

Photo of the South Sea Mountain Swamp.

South Carolina Land Resources Commission
According to the South Carolina Land Resources Commission, approximately 45% of all land in Horry County is considered to be wetlands. This represents a tremendous resource that can provide flood protection as well as be inappropriate land for development.

In 1998, a court ruling limited the Corps of Engineers' permit authority to wetlands that are within 800 feet of navigable streams, i.e., the Intracoastal Waterway. DHEC and DNR review and comment on development plans before the Corps issues a 404 permit. The state agencies have no authority to veto or alter a proposed permit. However, there are good relations and cooperation with the Corps' program and state recommendations are often accepted.

In the coastal counties, development in the remaining wetlands is subject to review by DHEC's Office of Ocean and Coastal Resources Management (OCRM). As with the Corps' program, OCRM does not stop development. It can only minimize the adverse impact development has on a wetland.

An alternative wetland protection measure is to purchase the land or otherwise pay the owner to prevent development on it. Since 1996, over 10,000 acres of wetlands have been enrolled in the state-wide Wetland Reserve Program. In most of the successful projects, additional agencies and private partners are part of the cooperative effort. Examples of partners could be:

State Department of Natural Resources, U.S. Fish and Wildlife Service, or the South Carolina Waterfowl Association.

Wetlands Restoration Program (WRP)

USDA Natural Resources Conservation Service (NRCS). Programs exist to continue wetland restoration efforts. For example, the USDA Natural Resources Conservation Service (NRCS) provides technical and financial assistance to help landowners with wetland restoration efforts. The goal with the program is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled.

WRP offers landowners an opportunity to establish long-term conservation, wildlife habitat and wetland protection. Landowners who choose to participate in WRP may sell a conservation easement or enter into a cost-share restoration agreement with USDA to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership.

With landowner input, NRCS develops a plan for the restoration and maintenance of the wetland. WRP offers landowners three options including permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration.

Landowners interested in participating in WRP should contact their local NRCS conservationist to begin the application process. WRP targets land which was formerly wetland and where planned restoration has the potential to maximize wildlife habitat, improve water quality, and aid in the recovery of special status species. NRCS ranks eligible projects according to both environmental benefits and cost-analysis. Environmental factors include assessments of future habitat diversity, benefits to special status animals, restoration of hydrology, the ability of the project to reduce habitat fragmentation, size of the offering, percent of eligible land, and improved water quality[12].

Implementation in North Myrtle Beach

The City currently has no staff involved with regulating wetlands or other environmentally sensitive areas. Subdivision regulations require that wetland areas be delineated upon preliminary subdivision plats and site-specific development plans. In the Zoning Ordinance, the newly revised Planned Development Districts require wetland delineation. However, determination of wetland areas remains within the regulatory realm of the United States Army Corps of Engineers and OCRM.

City Designates Over Three Miles of East Coast Greenway. A top priority for the city is to implement biking and walking throughout the city, and create an ocean trail. The proposed East Coast Greenway (ECG) route helps accomplish this priority by combining a long-distance route with the existing network of trails via a ‘main spine’ running along Ocean Boulevard for most of its length through the city.

Nationally, the ECG is a proposed 2,600-mile multi-use urban trail system that will extend from the northeast part of Maine to the southern tip of the Florida Keys. The system will consist of existing trails that will include greenways, bikeways, rail-trails, canal towpaths, and park pathways that will accommodate walking, cycling, and in-line skating. Of the 2,600-mile trail system, 90 miles will extend through Horry County and Georgetown counties; showcasing coastal South Carolina to visitors using the trail and will provide an alternate transportation

route as well.

The City has designated 3.6 miles of the total 13.8-mile ECG segment through North Myrtle Beach, including the ½ mile of trail installed along Windy Hill Road Extension in 2008.

In 2009, the City was awarded $208,000 of federal Transportation Enhancement (TE) money, sponsored by the Grand Strand Area Transportation Study (GSATS), to construct approximately 8,500 linear feet (over a 1.5 mile-long segment) of trail along Water Tower Road; extending the trail from Links Drive to the north side of the Highway 22 bridge. The new ECG trail will be designed and constructed by the City Public Works Department pending approval of the federal transportation bill. From the bridge, another 2.3 miles of ECG is anticipated to be constructed, following Water Tower Road and ending at a proposed future trailhead on publicly owned land as part of the Parkway Group PUD annexation and development agreement.

The ECG Master Plan shows the trail continuing south through the Lewis Ocean Bay Heritage Preserve to connect with existing ECG trails in Myrtle Beach.

Cherry Grove Marsh showing Cherry Grove Park and Boat Ramp

6.28 Erosion and sediment control

Because construction sites are usually bare, stormwater runoff can erode soil, sending sediment into downstream waterways. Sediment tends to settle where a river or stream slows down, such as when it enters a lake. Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. Not only are the drainage channels less able to do their job, but also the sediment in the water reduces light, oxygen and water quality, which affects water supply treatment, habitat and fishing.

The Sediment and Erosion Control Act of 1991 sets erosion and sediment control requirements for all construction projects greater than two acres. It is administered by DHEC, but communities can implement their own regulations if their standards meet or exceed DHEC's. As it excludes agriculture and forestry, its primary impact is on new construction sites.

Implementation in North Myrtle Beach:
The City relies on the DHEC regulations and its regulatory standards for erosion and sediment control on construction projects. These are explained in *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities*, August 1998. The City does ensure that the proper DHEC permits are obtained.

6.29 Best Management Practices

Point source pollutants come from clearly identified locations such as the outfall of a municipal

wastewater treatment plant. Nonpoint source pollutants come from non-specific locations. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry.

Best management practices ("BMPs") are measures that reduce nonpoint source pollutants that enter the waterways. Unlike erosion and sediment controls, which focus on problems created during construction, BMPs can also be implemented as part of a project's design to permanently address nonpoint source pollutants. There are two general categories of BMPs:

1. Those that prevent runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage, and
2. Those that stop pollutants after they are en route to a stream, such as grass drainage ways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

6.30 Stream Dumping Regulations

Floodplain regulations and building codes control major development projects. However, debris can be accidentally or intentionally dumped into the channels or wetlands, obstructing even low flows and reducing their ability to retain or clean stormwater.

Dumping regulations are one approach to preventing intentional placement of trash or debris in channels and other water bodies. Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Some prohibit the discharge of polluted waters into natural outlets or storm sewers. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. Similarly, they may not understand how regrading their yard, or discarding leaves or branches in a watercourse can cause a problem. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Regular inspections to catch violations also should be scheduled. Finding dumped materials is easy; locating the source of the refuse is hard. Usually the owner of property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points.

Implementation in North Myrtle Beach:
The City's Code of Ordinances specifies the City's authority to prevent obstructions to drainage and the penalty for violations. The ordinance clearly regulates drainage in streets and makes the City responsible for maintaining open ditches. The ordinance is enforced by the Department of Public Works.

Recommendations

1. The City should review its regulatory requirements for new development in wetlands and other natural areas to see if best management practices should be included. Development regulations should promote and reward developments that protect natural areas.
2. The City should continue to developing a walking trail system that links all parts of the City and incorporates natural areas in the corridor plan.
3. The City should incorporate preserving natural areas in its work to preserve open space (see Chapter 5's recommendations) and should utilize interest in and programs that protect natural areas to support the corridor plan.
4. The city should encourage property owners to participate in the Wetlands Restoration Program (WRP) operated by the USDA Natural Resources Conservation Service (NRCS). Educational materials should be made available to the public

Structural Projects

Structural flood control projects are used to prevent floodwaters from reaching properties. These measures are "structural" because they involve construction of man-made structures to control water flows. They can be grouped under five measures:

6.31	Beach nourishment	6.35	Swales
6.32	Dune building	6.36	Drainage Modifications
6.33	Sand scraping	6.37	Channel and basin maintenance
6.34	Levees/floodwalls	6.38	Retention Ponds

The 1977 Coastal Zone Management Act, as amended, rejects construction of new erosion control devices and adopts retreat and renourishment as the basic state policy towards preserving and restoring the beaches of our state. The State is implementing the forty-year retreat policy described in the statute by designating a baseline and setback line on all oceanfront properties of the State, developing a long-range comprehensive State plan for management of the beach/dune resource, and supporting the efforts of local governments in developing local long-range beach management plans.

Based on this policy North Myrtle Beach has not considered the placement of any additional hardened structures along the ocean shoreline. Therefore, this plan does not include a discussion of seawalls, revetments or similar structures.

6.31 Beach Nourishment

Ensuring the beach stays clean and healthy is critical to the success of North Myrtle Beach. The City first adopted a Beachfront Management Plan in 1991. Over the past twelve years, the City has used the plan to assist in making decisions regarding the location and placement of public facilities and development of oceanfront property.

In 1976, the South Carolina Legislature adopted the South Carolina Coastal Zone Management Act. This law established the South Carolina Coastal Council (SCCC) and charged it with coastal zone management and permitting activities for the State's coastal areas.

This law was amended in 1988 to increase beach management authority of the SCCC in the State's coastal zone, and required all coastal communities to prepare a Local Comprehensive Beach Management Plan. All coastal communities were required to prepare a Beachfront Management Plan based upon SCCC guidelines by July 1, 1991. The Beach Management Act was revised again in 1990. These revisions limited the number of shore-protection options. New seawalls are prohibited and existing structures cannot be upgraded to protect from higher wave/water-level events, rising sea level, or increased wave energy caused by continued erosion of the beach. The City developed a strategy for beach erosion control within the framework of the 1991 Beach Management Plan policies, primarily through beach renourishment.

In 1995, the City of North Myrtle Beach acquired 262 easement and right-of-ways in order to renourish, protect and maintain the City's public beaches. This project included distribution of sand, development of dunes and berms and the planting of vegetation on the dunes and public walkways. In addition to the renourishment project of 1996, these easements allow the city to continue to maintain these dunes and berms as part of the public beach. Each year the Public Works Department reviews erosion data and sand budgets from OCRM and other sources and determines if any change in the above strategy is warranted.

Beach renourishment, controlled by the U.S. Army Corps of Engineers, was last completed in 2019 providing 750,000 cubic yards of sand over 8.6 miles at a cost of $15 million dollars; $11,250,000 Federal, $1,876,000 State, and $1,876,000 City. The funding was largely due to the City's willingness to continue to implement the policies of the Beachfront Management Plan.

Beach nourishment is the artificial replacement or addition of sand to beaches to widen the backshore and move the high-water line offshore. This technique is expensive, temporary, and requires maintenance at great cost.

The effectiveness and longevity of a beach nourishment project depends on the type of imported sand, the slope of the beach, the strength of cross-shore currents, and the frequency of storms. The slope of the nourished beach should match as closely as possible the beach's original slope, and fill should resemble the original beach material, since finer fill will erode more quickly than the native beach.

Financial Approach to Implementation

The North Myrtle Beach Storm Damage Reduction Project was authorized for construction by Section 101 of the Water Resources Development Act of 1990, Public Law101-640. Section 934 of the Water Resources Development Act of 1986 (WRDA 1986), Public Law 99-662, authorized the Government to extend Federal participation in periodic beach nourishment until 2046.

The Beach Nourishment Fund was established in 1995 to account for the City's share of the $22.5 million Army Corps of Engineers Beach Nourishment Project. Funding for the project came from the issuance of General Obligation Bonds for a period of 10 years.

Each year the City appropriates $50,000 for emergency repairs and sand replacement.

Beach Nourishment Disadvantages

Nourishment programs may spur shorefront development, putting even more structures at risk. Most of the beachfront is developed; therefore, this is not a significant issue in North Myrtle Beach. Additionally, the City enforces the construction provisions of the International Building Codes, oceanfront setbacks, and windborne debris standards.

Beach Nourishment Advantages

Nourishment programs offer wider beaches for recreational use and they can provide a significant level of protection against building damage from severe storms and long-term shoreline erosion.

Recommendation:

The City should request the US Army Corp of Engineers to include sea-level rise in its next evaluation of the beach nourishment project.

6.32 Dune Building

The North Myrtle Beach shore protection project includes a program to construct and maintain a healthy dune system in the upper reach of the beach.

Dunes can be constructed artificially by trapping sand with fences or by piling sand into dunes with bulldozers. The most effective method of creating new dunes is to interrupt airflow with fences made of porous materials. This technique encourages sand to deposit where the airflow has been disrupted. It is important that the fences alter the airflow but do not halt it.

Dunes can also be built using vegetation. It is important to note the distinction between vegetation used for dune construction and for dune stabilization, as they are usually of different species. It is also important to note that such methods are less likely to work at restoring interior dunes, since buildings, lawns and roads cover much of the sand that would feed them. In these cases, it is necessary to create dunes by depositing sand manually. Sand used for this purpose should match the existing sand type. New dunes should resemble and be in line with existing dunes.

Advantages:

Dunes can provide a significant level of protection against building damage from severe storms and long-term shoreline erosion. They prevent overwash* flooding during storms and minimize the scouring that occurs when this water retreats to the sea. Dunes also shelter buildings from high winds. In the long-term, dunes help replenish beach sands and maintain beach width.

Disadvantages:

Dunes block the view of the ocean for those who reside in buildings that have not been elevated.

Recommendation:

The City should continue to include dune building as a part of its beach nourishment program.

6.33 Sand Scraping

Sand scraping is a technique for reinforcing the beach without adding new sand. The top foot of sand is scraped from the beach with bulldozers and deposited above the high-tide line. This may result in new sand drifting onto those parts of the beach that are below the high-tide line.

Scraping should dig no deeper than one foot below the existing surface to prevent the beach from becoming too steep. If the slope of the beach is increased it will erode more quickly than it would have at its natural slope.

Disadvantage:
While sand scraping is less expensive than beach nourishment, it is also only a temporary solution to beach erosion. Scraped beaches continue to erode, and may erode more quickly than natural beaches in storms. If so, this technique would not be well suited for mitigation. Some research has shown that beach scraping may actually help beaches recover after a storm event. However, since no new sand is added to the system, gains on scraped beaches amount to a net sand loss on downdrift beaches.

Recommendation:
The City should continue to maintain the beach nourishment and dune building projects. Sand scraping should only be used in a severe emergency.

6.34 Levees/floodwalls

Probably the best-known structural flood control measure is a barrier of earth (*levee*) or steel or concrete (*floodwall*) erected between the watercourse and the property to be protected. Levees need considerable room to fit between the river and the area to be protected. If space is a constraint, more expensive floodwalls are used.

Levees and floodwalls should be set back out of the floodway so they will not push floodwater onto other properties. Their design also should compensate for the flood storage that they will displace and for access through or over the barrier.

Current Practice in North Myrtle Beach

There are no levees or floodwalls along the streams or Intracoastal Waterway in North Myrtle Beach.

Recommendation
Since local floodplain overbank areas are very wide and development close to the shoreline, levee encroachments would remove considerable flood conveyance and storage area. Levees are not recommended for North Myrtle Beach.

6.35 Swale

A grassy swale consists of grass beds or grassy expanses at the side of the road where a concrete ditch or other hard structure might have been placed; it filters or treats stormwater in addition to conveying it to the drainage system. Grassy swales along the roadside, and/or natural vegetative beds in stormwater channels, aid in decreasing the velocity of stormwater flow. Velocity is a major cause of erosion, and in the case of floods, structural damage.

Advantages

These “green” pieces of infrastructure are generally more visually appealing than their “gray” counterparts.

Disadvantages

Swales and vegetated channel beds may require insect management techniques (preferably all-natural) and occasional aeration.

Recommendation

Where swales are feasible to convey stormwater, the sidewalks should slant slightly away from the streets and toward the grassy swales. Grassy strips and linings also provide a modest degree of absorption and sediment filtration. Additions of vegetation to the environment should be indigenous for ecological soundness and ease of maintenance.

6.36 Stormwater and Drainage

In order to improve the City's drainage system, City Council approved the creation of a stormwater utility fee that went into effect July 2000. The fee is paid on all developed property in the City limits. The fee is used to provide funding for stormwater and water quality improvements along the beachfront, such as inland drainage projects and the extension of beach outfalls. Projected as a fifteen-year program, the fee is expected to generate $1.4 million each year. The City completed a stormwater management plan in September 2007 as part of the Environmental Protection Agency's (EPA) Phase II stormwater regulations promulgated by SC Department of Health and Environmental Control (DHEC). The City received general permit coverage for its stormwater system in that same year. DDC Engineers, Inc., a private consulting firm hired by the City, completed the stormwater master plan update and mapping, which is part of the EPA's requirements.

The Stormwater Coordinator is the process of ensuring that stormwater runoff does not increase the dangers associated with flooding, and that water quality is not compromised by runoff. Stormwater runoff is the leading cause of pollution to groundwater and surface water. Considered non-point source pollution, stormwater runoff contributes large amounts of contaminants to bodies of water, especially from urban areas, which have a higher percentage of imperious surface area. Sediment impacts water bodies by reducing water clarity and water quality, it reduces the growth of aquatic vegetation, clogs fish gills, and reduces the spawning area and aquatic habitat. Sedimentation also changes drainage patterns.

Managing stormwater runoff and contributing to better in-shore beach water quality is a costly endeavor. To help off-set costs, in 2000, the Public Works Department launched a program to improve drainage throughout the City by extending drainage outfalls to the ocean, funded by the stormwater utility fee. The purpose was to extend outfalls 1,300 feet into the ocean instead of terminating on the beach as they do now. Outfalls at 39th Avenue South and 45th Avenue South were completed Spring 2004. An outfall at 6th Avenue South and 21st Avenue South was completed in 2006. Additional outfalls are being planned for the next 3 to 5 years for Main Street and 18th Avenue North. Constructing the outfalls has been costly. The outfalls at 6th and 21st Avenue South were $5 million dollars. The Main Street and 18th Avenue North outfalls are estimated to cost approximately $5 to $6 million dollars each.

The City is currently working on the following two stormwater projects:

- 18th Avenue North Outfall Project (scheduled for completion in 2023) and the
- ¾ Drainage Improvement Project (scheduled to begin in Summer of 2021).

Recommendations

1. Increase dimensions of drainage culverts in the most troublesome areas to improve stormwater removal in repetitively flooded areas. Wider culverts enhance the ability of the neighborhood stormwater system to convey accumulated surface waters.
2. Prioritize culverts for upgrade according to their level of potential flood loss reduction or the number of property owners affected, and err on the side of overestimation when building culverts under new streets.
3. Seek mitigation funding to complete the 18th Avenue North Outfall Project.
4. Seek mitigation funding for the ¾ Drainage Improvement Project.
5. Conduct a study of drainage problems in the Cherry Grove area.

   1,350 flood insurance claims have been paid for losses in the Cherry Grove area. These payments total $18,284,043 and are 50 percent of the flood claims paid within the City.

   There are 156 repetitive loss properties in this area. They represent 78 percent of the City's repetitive loss properties. These properties have had 365 flood insurance claims with payments totaling $5,684,480 for an average payment of $15,574 per claim and $36,207 per building.

   The proposed study should examine dredging the cannels as one possible solution to reduce the flooding problem.

6.37 Channel and Basin Maintenance

Clogged or broken drainage systems can seriously impair stormwater management efforts. Flood channels, storm sewers, retaining ponds and erosion basins can become blocked by overgrowth, debris, sedimentation, or components that fail with age.

Channel and detention basin maintenance is an ongoing program to clean out blockages caused by overgrowth or debris. These activities normally do not affect the shape of the channel or basin, but they do affect how well they can perform.

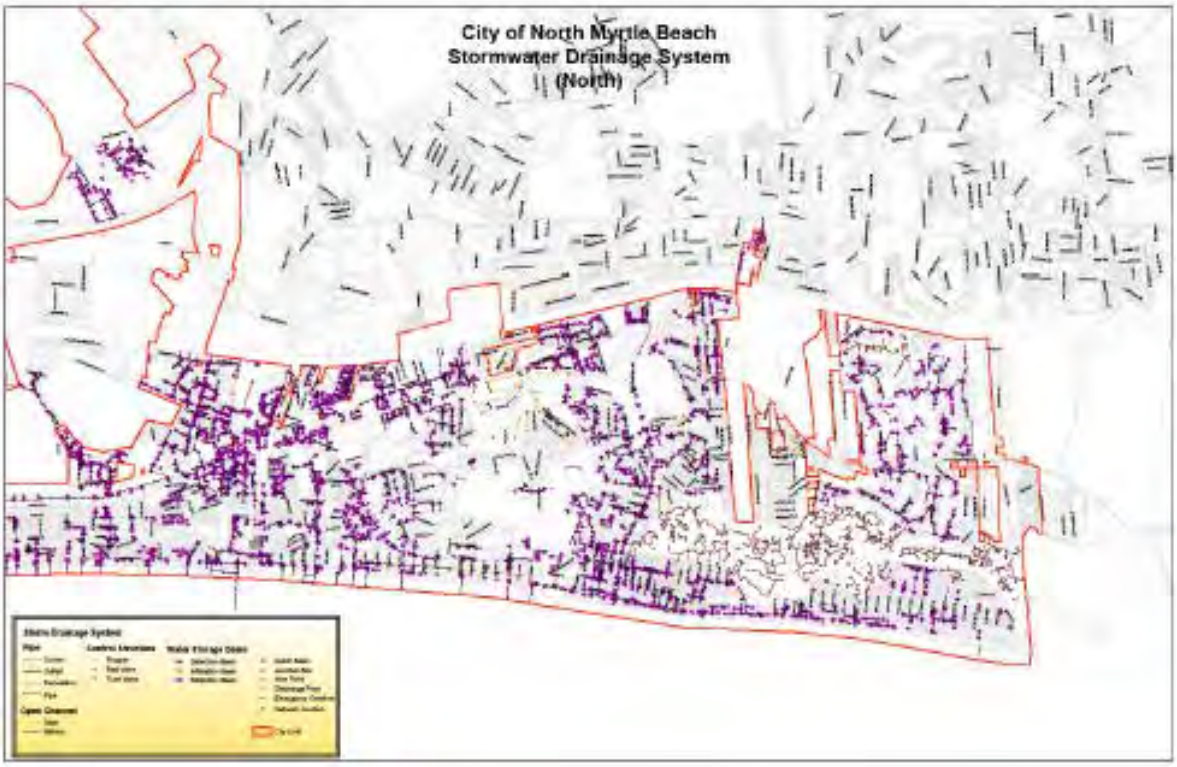
Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Individual actions can add up to big problems. Therefore, the North Myrtle Beach drainage system maintenance program includes regulations that prevent dumping in or altering watercourses or storage basins.

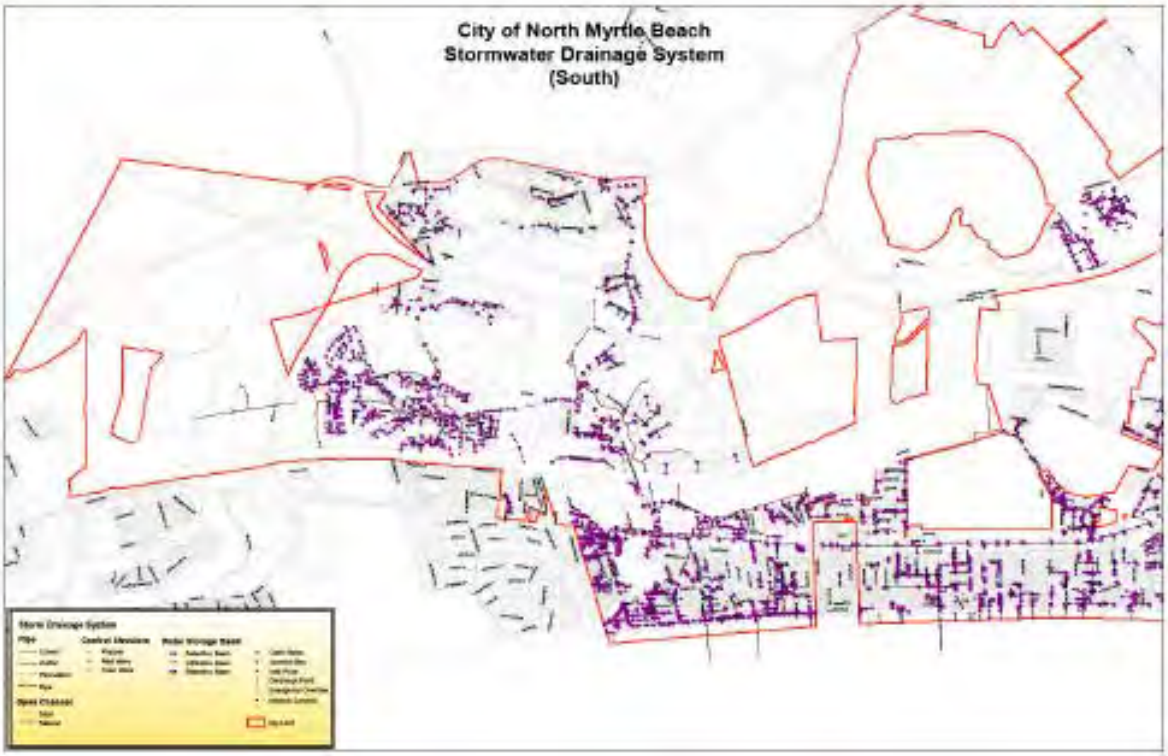
Recommendation

Drainage systems require perpetual maintenance. The City should continue its program for the replacement or improvement of culverts, mains, stormwater lines, sewer pipes and backup valves as part of its general program of maintenance and improvement to reduce flooding hazards.

Other Alternatives Considered (including No Action):

None. Dropping the city's maintenance program will lead to increased flood losses and make the area less attractive to residents and visitors.


City of North Myrtle Beach
Stormwater Drainage System
(North)


City of North Myrtle Beach
Stormwater Drainage System
(South)

6.38 Retention ponds

Retaining or retention ponds (used here interchangeably with detention ponds) are basins designed to catch surface runoff and prevent its flow directly into a stream or river.

Current Practice in North Myrtle Beach

North Myrtle Beach encourages the use of "Best Management Practices" to maximize the amount of rainfall that infiltrates into the soils and the use of on site storage facilities to reduce runoff rates and volumes, and minimize erosion and sedimentation. The City requires that stormwater must not leave a parcel at a higher rate after the parcel has been developed than it did before.

Retention and detention basins must be designed with sufficient hydraulic capacity for the 25 year, 24-hour storm. Primary drainage systems must meet the same hydraulic capacity.

Advantages

Retention ponds are a relatively inexpensive way to prevent localized flooding, provided that ample undeveloped land is available, and have the added advantage of not altering the character of the streams they protect. These ponds can act as groundwater recharge sites and reduce water pollution through soil filtering.

Recommendation

The City should continue to regulate stormwater runoff and require retention facilities as appropriate.

Emergency Services

People at risk from disasters, whether natural or human in origin, can take actions that save lives, reduce losses, speed response, and reduce human suffering when they receive accurate warnings in a timely manner. Warnings are becoming much more useful to society as lead-time and reliability are improved and as society devises ways to respond effectively. For example, computers are being programmed to respond to warnings automatically, shutting down or appropriately modifying transportation systems, lifelines, manufacturing processes, and such. Effective dissemination of warnings provides a way to reduce disaster losses that have been increasing as people move into areas at risk and as our infrastructure becomes more complex and more valuable.

Effective warnings should reach, in a timely fashion, every person at risk who needs and wants to be warned, no matter what they are doing or where they are located. Such broad distribution means utilizing not only government-owned systems such as NOAA Weather Radio and local sirens, but all privately owned systems such as radio, television, pagers, telephones, the Internet, and printed media.

Emergency management measures that protect people during and after disasters are described in local emergency operations plans and standard operating procedures. These plans should cover the following four areas:

6.39 Threat Recognition
6.40 Emergency Warning Dissemination
6.41 Response and Mitigation Operations
6.42 Post-disaster Recovery and Mitigation

6.39 Threat Recognition

Hazard analysis is the basis for both mitigation efforts and Emergency Operations Plans (EOPs). From an emergency operations planning perspective, hazard analysis helps a planning team decide what hazards merit special attention, what actions must be planned for, and what resources are likely to be needed.

The first step in responding to a disaster is knowing that one is coming. Scientists are developing more accurate and more numerous warnings as they deploy better sensors to measure key variables, employ better dynamic models, and expand their understanding of the causes of disasters. Warnings can now be made months in advance, in the case of El Niño, to seconds in advance of the arrival of earthquake waves at some distance from the earthquake. The new National Weather Service (NWS) Doppler radar systems are providing the capability to diagnose the potential for severe thunderstorms, tornadoes, and flood-producing rainfall. As a result, warnings are becoming predictive in nature rather than reactive.

Local plans should describe how natural hazard threats are identified. The plan should include information on each of the hazards identified for the community. Of particular interest are the hazard's **frequency** of occurrence (both historical and predicted or probable, as available), **magnitude** and **intensity**, **location** (if the hazard is associated with a facility or landscape feature) and **spatial extent** (either around the known location of the hazard or as an estimate for non- localized hazards like tornado), **duration**, **seasonal pattern** (based on month by month historical occurrence), **speed of onset**, and **availability of warning.**

6.40 Emergency Warning Dissemination

Local disaster warnings are issued in conjunction with the National Weather Service and can be administered in a number of ways, including sirens, radio, television, cable TV, mobile public-address systems, telephone trees, and even door-to-door contact. Posted signs can be used to identify risks at a particular site. Multiple or redundant warning systems are most effective, as they ensure that a message will be received even if one part of the warning system is not heard.

The plan should describe the warning systems in place in the jurisdiction and the responsibilities and procedures for using them. All components of the system should be identified and the provisions that have been made to implement warnings should be described.

6.41 Response and Mitigation Operations

Warnings are effective only if they are accurate and result in appropriate action. Appropriate response to warning is most likely to occur when people have been educated about the hazard and have developed a plan of action well before the warning.

Emergency Operations Plans (EOPs) developed using the functional approach consists of a Basic Plan, functional annexes, and hazard-specific appendices. These are supplemented by the SOPs and checklists necessary for implementation of the EOP. This is the approach used by the City of North Myrtle Beach.

The Basic Plan is an overview of the jurisdiction's emergency response organization and policies. It should:

- provide the legal authority for emergency operations,
- provide a risk assessment of potential hazards,

- include a vulnerability assessment describing the expected situation and needs following disasters of different magnitudes,
- assess the potential public service needs following disasters,
- describe the city's capability to respond to expected needs,
- summarize the situations addressed by the EOP,
- explain the general concept of operations,
- assigns responsibilities for emergency planning and operations,
- describe how people and property will be protected in emergencies and disasters,
- identify steps to address mitigation concerns during response activities.

6.42 Post-disaster Recovery and Mitigation

After a disaster, communities should undertake activities that can prepare people and property for the next one. They are implemented during recovery to keep people from immediately going "back to normal" (i.e., the same way they were before the disaster). These measures include:

- Regulating reconstruction to ensure that it meets all code requirements, including the NFIP's substantial damage regulations
- Public information to advise residents about mitigation measures they can incorporate into their reconstruction work
- Evaluating damaged public facilities to identify mitigation measures that can be included during repairs
- Acquiring substantially or repeatedly damaged properties from willing sellers
- Planning for long term mitigation activities
- Applying for post-disaster mitigation funds

Requiring permits, making inspections and enforcing the substantial damage regulations can be very difficult on local, understaffed offices after a disaster. If not done right, not only does a community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations to the National Flood Insurance Program (NFIP).

Post-disaster reconstruction plans

A hazard mitigation plan specifies actions a community will take to reduce its vulnerability to natural hazards or to minimize the impact of a hazard event. Post- disaster reconstruction plans outline the policies or planning instruments that community officials will rely on for post-disaster decision-making. The two are often linked because the post-disaster window is considered an opportune time to make a community more disaster resilient.

Post-disaster mitigation planning allows for redevelopment in a less hazard- prone manner. Reconstruction plans should be designed to be in concert with the long-range goals of the community (as measured by the comprehensive plan). In particular, they should outline the rules and priorities for any post-disaster acquisition of damaged properties. Two typical targets are buildings that have suffered damage amounting to a certain percentage of their value or properties that lie within the hazard area. The degree of damage that would qualify a building for public acquisition should be identified in the plan, as should any other criteria for prioritizing purchases.

A reconstruction plan should also outline a post-disaster permitting process that facilitates repairs but remains steadfast to the need to mitigate against future disasters. One element of the plan

should emphasize the need to obey the building code. One way to create time to assess the damage and plan for recovery is to institute a short-term building moratorium. Another is to do much of the planning in advance and create an overlay zone that is triggered by the hazard event.

Hazard mitigation and post-disaster plans allow for a substantial amount of decision-making to occur prior to a disaster event and aid in better decision- making after the event.

Moratorium

A moratorium is a short-term suspension of the right to develop, usually accomplished by not issuing permits.

Moratoria can play an important role following a disaster. They give officials time to assess the damage and set priorities for response, planning and mitigation efforts. They are often used to prevent property owners from repairing damaged structures before an acquisition program can go into effect. They can also allow officials to expand high-hazard designated areas to reflect the actual damages from a hazard event.

Since moratoria are frequently subject to legal and political challenges, the City must be prepared to show adequate justification for taking this action. With such justification, a moratorium is likely to withstand legal scrutiny.

The National Flood Insurance Program's Community Rating System (CRS) encourages comprehensive flood warning and response programs and recognizes them under Activity 610 (Flood Warning Program). This activity has five elements that provide credit for local flood warning and response planning:

1. **Flood Threat Recognition System (FTR).** The first element of a flood- warning program is the operation of a system that tells the community that a flood is on its way. This is termed a flood threat recognition system and is recognized as element FTR under this activity. The notice that a flood is coming can be provided by the National Weather Service, by a state or regional agency, by monitoring local rain and river gages, and/or in other ways. However, the community must have a system for receiving meaningful early notifications.

   In North Myrtle Beach watches and warnings for hurricanes, floods, tornadoes and other natural hazards are received from the National Weather Service at the Communications Center in the Department of Public Safety. These watches and warnings are passed on to the city manager, emergency management coordinator, and others as prescribed in the City's municipal incident management guide. The center operates 24/7.

   CRS gives local governments more FTR credit when the flood threat recognition system can forecast various levels of threat. The National Weather Service (NWS) provides watches and warnings for hurricanes, floods, severe thunderstorm, tornadoes and other natural hazards. NWS numerical models are used in the hazards analysis to identify the timing, severity, and sequence of wind and hurricane surge hazards that can be expected from hurricanes of various categories, tracks, and forward speeds striking the area. In the North Myrtle Beach area the Sea, Lake and Overland Surges from Hurricanes (SLOSH) model is used to map inundation areas. During the preparation of the analysis, additional areas expected to be inundated by freshwater flooding from

rainfall are added to the inundation maps.

2. **Emergency Warning Dissemination (EWD).** The next element is the dissemination of the flood warning to residents of the community. This element is termed emergency warning dissemination and is identified as the acronym EWD. Various methods can be used, such as sirens, telephone calls, or the Emergency Alert System. Up to 60 points of credit can be earned based on the dissemination methods used. Credit for this element is available only if the community has a creditable flood threat recognition system, an annual outreach project that covers flood warning and flood safety and reaches at least 90% of the target audience, and an adopted flood response plan.

   North Myrtle Beach citizens receive warnings through Emergency Alert System broadcast, GeoAlert telephone warning, and mobile siren and public address systems on emergency vehicles.

3. **Other Response Efforts (ORE).** If the community implements the first two elements (FTR and EWD), then it is eligible for up to 50 credit points for implementing activities to minimize flood damage under this third element, other response efforts (ORE). These include activities like sandbagging, coordinating evacuation, barricading hazardous area like flooded streets and bridges, and issuing status reports to the media.

   The City's municipal incident management guide assigns disaster management responsibilities. Standard Operating Procedures (SOPs) are used to describe how these responsibilities are to be carried out.

   Managing the hurricane or flood response is the responsibility of the City's Emergency Management Team. When a hurricane or flood is imminent, the Emergency Management Team is convened. North Myrtle Beach's City Manager, Mayor and several department heads participate on the Team.

   The Team determines what needs to be done and tasks municipal departments and local agencies with assignments or requests. There are written standard operating procedures on emergency actions that need to be followed for public safety concerns. Actions generally taken to prevent or reduce damage or injury include:

   - Directing evacuation
   - Sandbagging certain areas
   - Closing streets or bridges
   - Shutting off power to threatened areas
   - Releasing children from school
   - Opening evacuation shelters
   - Monitoring water levels

   The North Myrtle Beach plan also includes a recovery section that identifies appropriate measures to take and which agencies will be responsible for carrying them out. These include:

   - Patrolling evacuated areas to prevent looting
   - Providing safe drinking water
   - Vaccinating residents for tetanus and similar diseases

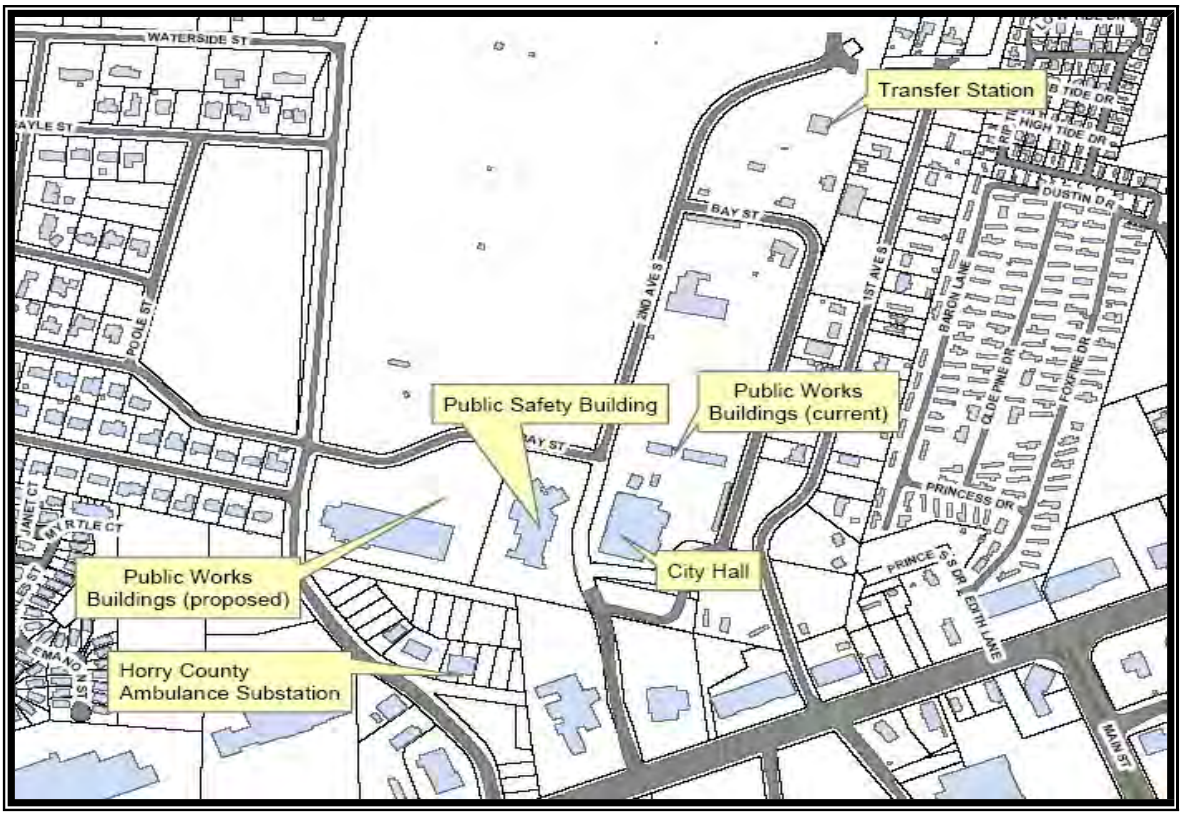
- Clearing streets
- Cleaning up debris and garbage
- Evaluating damaged buildings to determine if they can be reentered

Additional flood damage can be prevented if the city's response plan includes appropriate tasks, such as moving building contents above flood levels.

4. **Critical Facilities Planning (CFP).** If the community implements the first two elements, then it is also eligible for up to 50 credit points for implementing the fourth level of involvement: critical facilities planning, that is, coordination of the flood warning and response effort with critical facilities. A critical facility is a structure or a site that, if flooded, would result in severe consequences to public health and safety. Examples include hospitals, emergency operating centers, important bridges, and hazardous materials storage areas. Critical facilities also include structures that are needed to complete disaster response and recovery missions. These may include schools and key businesses. Providing these facilities with early warning and coordinating with their flood response plans is recognized under this element.

   The City, the County or a utility own most of the critical facilities identified in the City's emergency plan. One exception is the Alligator Farm.

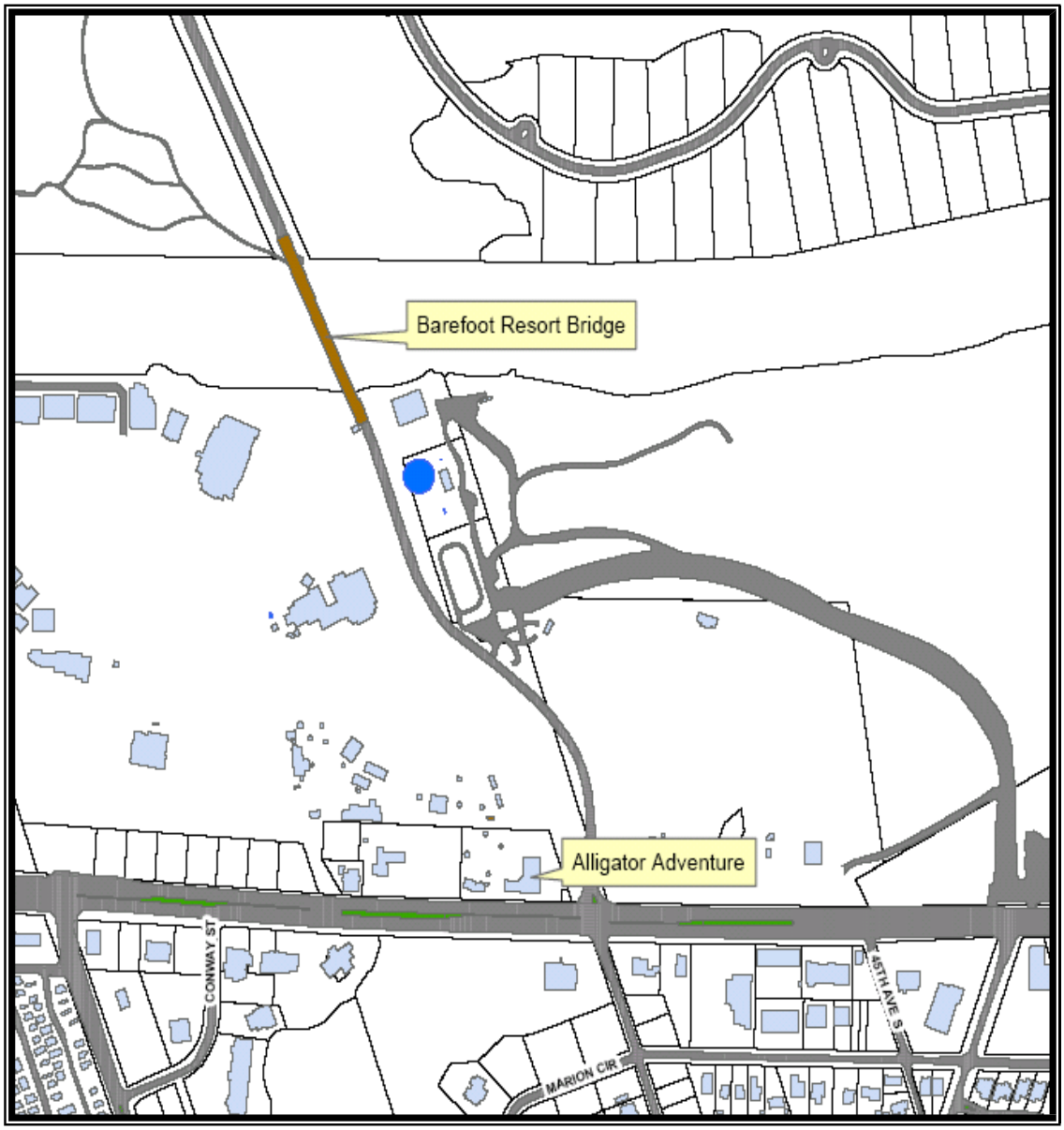
North Myrtle Beach Critical Facilities



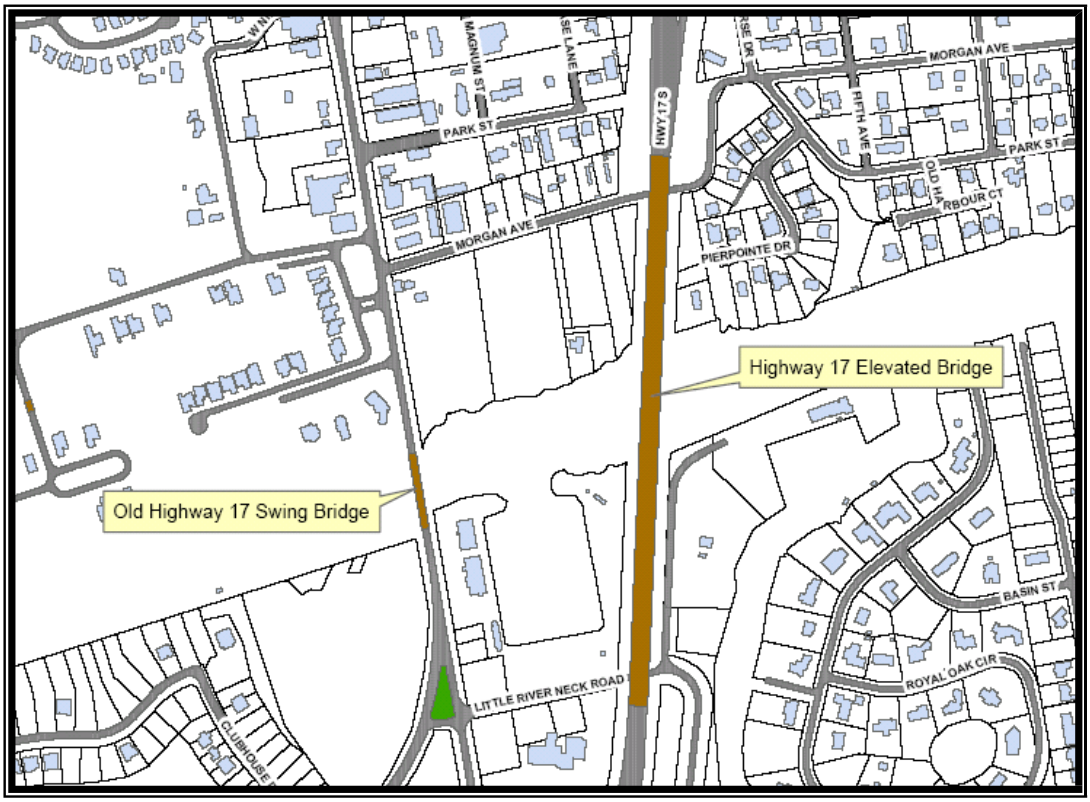
City Hall – includes the Emergency Operations Center and is designed to withstand a Category 5 Hurricane.

Public Works Building - includes offices for street maintenance and public utility staff.

Public Safety Building – has space for the Police Department, Fire Chief, and the main fire station. Other fire stations are located on Little River Neck Road, Sea Mountain Highway and 33 Avenue South.



Horry County Ambulance Substation – provides access to area hospitals during an emergency. There are no hospitals in North Myrtle Beach. The North Myrtle Beach Rescue Squad is collocated here with Horry County Fire and Rescue.



Transfer Station - is the central location for solid waste services.

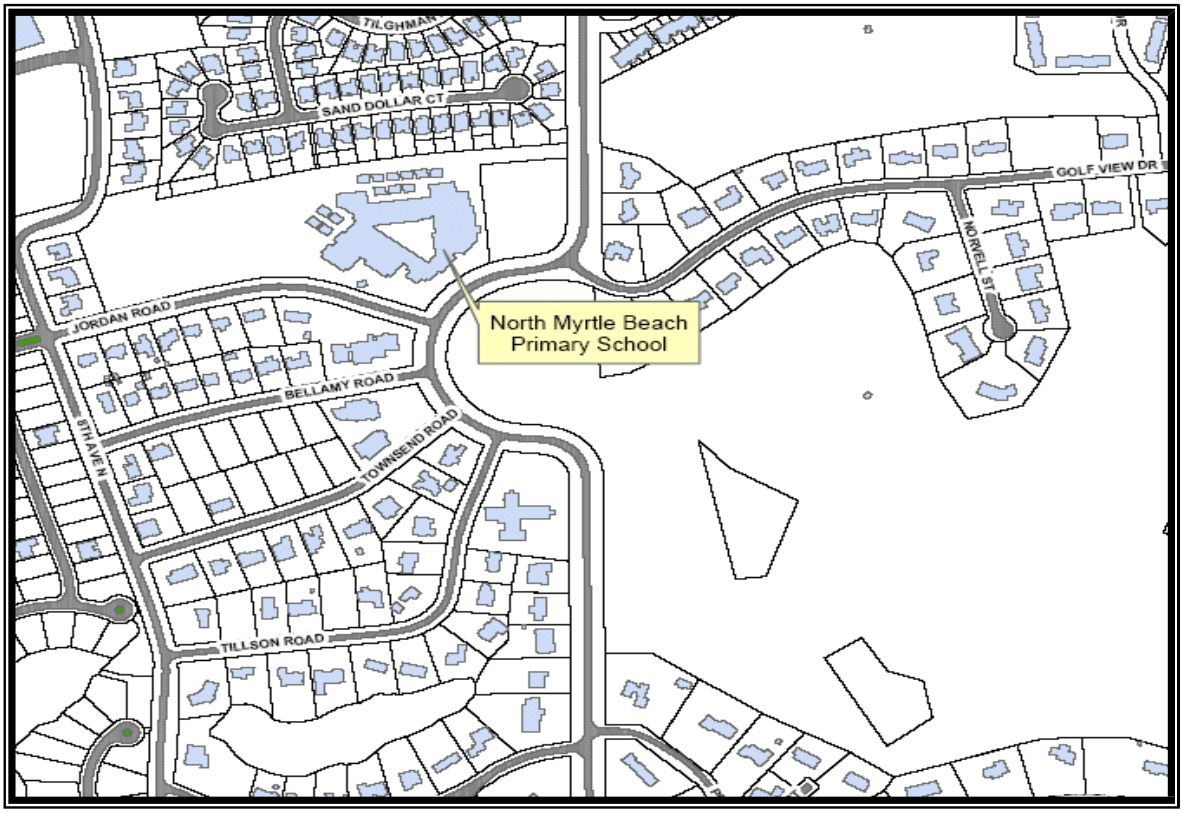
Barefoot Resort Bridge – provides access across the Intracoastal Waterway to Barefoot Resort. This is the quickest access to the area for emergency response vehicles.

Alligator Adventure – has alligators that must be relocated during hurricanes. The City provides advanced warning and Alligator Adventure has a response and evacuation plan.

Highway 17 Elevated Bridge – provides the major route for evacuation during hurricanes.

Old Highway 17 Swing Bridge – provides a secondary route for evacuation, but must be closed before the elevated bridge over Highway 17.

North Myrtle Beach Primary School – is the only public school building in the City limits. It is used as an emergency shelter. The school is located on 11th Avenue North. The North Myrtle Beach Elementary School, North Myrtle Beach Intermediate and Middle Schools and North Myrtle Beach High School are all located west of the waterway.



5. **StormReady community (SRC).** This element provides 25 credit points to a local government that has been designated by the National Weather Service as a StormReady community and has a flood threat recognition system able to forecast the arrival time and peak flow or elevations of floods. North Myrtle Beach has received the StormReady designation from the National Weather Service.

6. **TsunamiReady Community (TRC)**

The City of North Myrtle Beach continues to be a TsunamiReady Community by the National Weather Service. The City has also prepared a Tsunami Response Plan as an Annex to its Emergency Operations Plan. However, because of deficiencies in the Tsunami Response Plan the City cannot receive the 30 points of CRS credit.

As described in the Risk Assessment (Chapter 3) the Tsunami inundation area extends beyond the 300 feet (see the tsunami maps especially those for Cherry Grove) identified in the operations plan for evacuation. Additionally, the plan does not assign responsibilities or identify task and resources needed to complete an evacuation of the hazard area within the 4 hours of time available as estimated by NOAA.

The Tsunami Annex is a good start; however, it could be improved by:

- Evaluating the warning policies and procedures for evacuation zones.
- Describing how the warning will be disseminated to the public.
- Preparing pre-scripted warning messages.
- Identifying evacuation routes.
- IDENTIFYING WHO IS RESPONSIBLE FOR COMPLETING NECESSARY WARNING AND RESPONSE TASKS, AND IDENTIFING THE RESOURCES NEEDED, AVAILABLE AND THOSE THAT MUST BE REQUESTED.
- Identifying buildings that will be used for vertical evacuations.
- Identifying how critical facilities will be warned.
- Describing how the "all clear" message will be disseminated.

Recommendations

1. Public information programs should explain hurricane/flood watches and ot warnings and appropriate safety and protection steps to take after they are issued. The City should continue to provide this information each year through brochures mailed to all property owners.

2. The City should keep all records and handouts from post-disaster recovery and mitigation efforts to guide City activities during future disasters.

3. Since the 2010 Hazard Mitigation Plan the City has entered the SLOSH inundation areas for hurricanes into the Geographic Information System. They should be used to assist with disaster planning and evacuation.

4. The emergency operation plan should include a detailed vulnerability analysis for hurricanes, floods, tsunamis, wildfires and other hazards.

5. OPCON level triggers in the emergency plan should have operational definitions that permit easy recognition. Current OPCON level definitions should be reviewed.

6. The emergency operations center's alert list should be updated at least annually.

7. Standard Operating Procedures should be developed to describe how emergency warnings will be disseminated to the general public.

8. For each OPCON level the tasks that need to be implemented should be included in the plan. Standard Operating Procedures for each task should be developed. The SOPs should describe how the task will be carried out, who is responsible, what resources will be needed, and where and how those resources will be obtained.

9. Each department or agency SOP should include hazard mitigation measures to be implemented before and during a disaster or emergency situation.

10. Emergency operations and mitigation plans should be developed or updated for each critical facility. These plans should identify task to be implemented by the facilities, the amount of warning time needed to complete operational and mitigation tasks, and the resources necessary to complete their assigned missions.

11. At least one master copy of the latest emergency plan and the SOP for each Department, response agency and critical facility should be maintained in the emergency operations center.

12. A disaster management information system should be developed. The system should identify and track that status of disaster tasks assigned to departments and agencies. It should include a resource inventory and management component.

13. There should be an annual flood exercise of the emergency operations plan. This exercise should include a scenario that test current policies, procedures, and capabilities of departments and agencies with emergency response and recovery responsibilities.

14. The City should actively participate in the County's after-action report prepared following local disasters.

15. The City should prepare a Post-disaster Mitigation and Recovery Plan.

    a. This plan should describe how the city will provide temporary housing for residents, workers and businesses. The plan should examine current zoning and land use policies to ensure they accommodate temporary uses following disasters.

16. The City should encourage the State to enhance the evacuation capacity of the transportation system by constructing a four-lane highway to I-95 from the northeastern side of the City.

Chapter 7: Program for Public Information

North Myrtle Beach has had a long history of developing educational and outreach projects with input from partners and public opinion surveys. The Program for Public Information (PPI) assembles all of these activities and materials in a coordinated document. The PPI examines this past experience to determine the effectiveness of the current approaches, especially as they relate to natural hazards mitigation messages. The PPI looks at risk from natural hazards such as hurricanes, floods and wildfires; examines current approaches for coordination among city departments, public agencies, non-profits, and other potential public information partners; reviews how current information programs address the city's hazard mitigation goals; and, looks at how changes in the insurance industry and stakeholder priorities affect the city's current approach to hazard mitigation outreach.

The City's initial PPI was developed at the same time as the 2015 update of the City's Hazard Mitigation Plan. During the 2021 update of the Hazard Mitigation Plan, the PPI was reviewed and updated. The City's PPI Committee had one change to its membership. The PPI Committee reviewed the PPI needs assessment and key messages and determined that the PPI is still relevant and that goals and proposed projects should continue to be in place. The plan has been updated where needed to reflect updated information based on evaluations of projects.

7.1 PPI Committee

Committee members were tasked with identifying outreach goals, identifying those that should be targeted for outreach, and recommending what type of message should be delivered and how often.

The 2021 PPI Committee members are:

Dwayne Bates	The Bates Group, LLC. Designer, Construction Management
Russell Courtney	Russ Courtney and Associates, LLC, PLLC Land Surveying and Design
Wayne White	Property Supervisor, White Realty, Inc.
Wyman Wise	Wyman Wise State Farm, Insurance Agent
Delane Stevens	Building Official, City of North Myrtle Beach
John Hill, CFM	Assistant Building Official, Floodplain Manager, City of North Myrtle Beach
Dawn Snider	Senior Planner, Planning and Development Department, City of North Myrtle Beach
Patrick Dowling	Public Information Officer for the City of North Myrtle Beach

The planning process and risk considerations for the Program for Public Information and the Mitigation Plan are very similar; therefore, the Hazard Mitigation Committee was also tasked by City Council to prepare the PPI.

7.2 PPI Goals

In its previous Hazard Mitigation Plans, North Myrtle Beach has adopted a vision for a better-informed public that is educated about flood, hurricane and wildfire risks, and knows what they can do to decrease future damage from these hazards. Since much of the city is in the Special Flood Hazard Area mapped by the Federal Emergency Management Agency (FEMA) the city also wants to make sure its property owners and residents understand the value and benefits of flood, homeowners and wind insurance.

Supporting these vision statements three goals have been adopted.

1. To have residents adopt behaviors that improve hazard preparedness.
2. To decrease future damage from natural hazards.
3. To maintain a high level of insurance coverage.

Reducing future flood damage requires a partnership with the public, as an educated public is an important component for success. Households that have a plan in place for flood loss reduction, response and recovery will be more likely to maintain personal safety. Willing homeowners can make modifications to their homes and property that will improve flood resiliency. For homeowners to make those choices, they need access to clear, relevant facts - and in some cases, financial assistance – to take the necessary actions.

7.3 North Myrtle Beach Public Information Needs

North Myrtle Beach is a coastal community that has experienced hurricanes, flooding, and a major wildfire within its recent history. Thus, while the National Flood Insurance Program's Community Rating System was the catalyst for the development of the PPI, the city believes the PPI must address more than flooding and flood insurance. While CRS credit may not be available for some projects and messages, high winds from hurricanes and wildfire are also included in the PPI.

The city has almost 17,000 year around residents according to US Census data from 2019. Approximately 35 percent of the city is located within a Special Flood Hazard Area (SFHA). Over 4,600 homes and businesses are within the SFHA. While most of the SFHA buildings are elevated structures, the city does have older homes and businesses built prior to the FEMA FIRM Maps that are slab on grade structures and therefore more susceptible to flood damage.

At one of the Mitigation Committee public meetings those present were asked if they lived in Myrtle Beach during Hurricane Hazel in 1954. Only one person raised his hand. He was 4-years old at the time and only remembers what he has been told or read about the storm. Such is the case with most residents. They either didn't live in North Myrtle Beach during the city's major storms or they have forgotten the details about the suffering and destruction that occurred.

7.4 Housing Status

Housing Units and Occupancy			
Housing	**Number of Units**	**Percentage of Units**	**Percentage of Occupied**
Housing Units	28,203	100%	-
Occupied	7,558	26.8%	100%
Vacant	20,645	73.2%	-
Owner Occupied	5,766	17%	70%
Renter Occupied	1,645	7%	30%

Source: 2019 US Census estimates

The percentage of owner-occupied homes is below the State average (58.3%) and the National average of (58.5%). The number of rental homes is below the State average (25.1%) and the National average (29.3%).

The percentage of vacant homes is very high compared to both State and National averages; however, that should be interpreted to be second homes and rentals, and some vacancies.

The committee decided the best ways to reach the owners of "second homes" is through mailings like the monthly city publication "Currents". This monthly publication is mailed to all utility accounts and others who want to receive it.

Long-term renters should carry flood insurance on their contents. Many receive mail directly from the City such as the City's monthly publication. All renters will be encouraged to sign-up with the City to receive direct mailing from the City on flood hazards, flood insurance and other issues.

Only 17% of the city's single-family structures are occupied by permanent residents. As a tourist destination 24% of the housing units are second homes, 1% are individual rental units, 45% are held by property management companies and the remaining 15% are hotel units. Addressing the public information needs of this large (11 million Grand Strand visitors a year) can be a challenge. That is why the city engages residents and visitors through a variety of methods including radio, television, TWITTER, NIXILE, FACEBOOK, City TV, the city web page **www.nmb.us** and other methods.

7.5 Flood Hazards

The City of North Myrtle Beach is exposed to flooding from hurricanes, severe thunderstorms, tropical storms and storm surges from the Atlantic Ocean. Portions of the city flood from Hog Inlet and the Intracoastal Waterway. The city also receives stormwater from surrounding areas of the unincorporated parts of Horry County that abut the city. Heavy rainfalls allow for flooding

in low lying streets and property.

As with past public opinion surveys, the survey conducted for the PPI indicated that drainage issues are still a concern for property owners and residents. To address these concerns and meet the Environmental Protection Agency's (EPA) Phase II stormwater regulations the city completed a stormwater management plan in September 2007.

Outfalls at 39th Avenue South and 45th Avenue South were completed in the spring of 2004. Outfalls at 6th Avenue South and 21st Avenue South were completed in 2006.

Two major drainage projects were completed in 2015. One, a retention pond, is located off of Hillside Drive near 6th Avenue South. Aimed at reducing localized flooding and improving water quality, a detention pond will eliminate chronic flooding of Ocean Boulevard in that area.

The Main street ocean outfall was also completed in 2015. Removing existing storm water drain pipes from the beach and combining them into one large underground storm water pipe that discharges storm water into ocean water about 1,200 feet offshore significantly reduces bacteria levels in the swim zone, reduces inland flooding and reduces damage to the federal beach nourishment project.

Through the PPI the city will continue to monitor citizen concerns, provide information on drainage system improvements, identify flood reduction benefits, and inform property owners and residents about the things they can do to improve drainage system maintenance while improving water quality.

7.6 Repetitive Loss Properties

FEMA keeps a list of repetitive loss and severe repetitive loss properties for each jurisdiction in a national database. 226 buildings in North Myrtle Beach are included as repetitive loss properties in FEMA's database[1]. Several of those have been removed over the years because property owners have elevated or retrofitted the buildings so that they now meet minimum floodplain management construction standards.

Today, 195 buildings remain on the repetitive loss list. They are only 2% of the flood insurance policies. However; repetitive loss building claims have totaled $8,529,764 or 23% of the flood insurance claims paid in North Myrtle Beach. Outreach to those property owners continues to be important to ensure continued progress in reducing the threat to these buildings and improve the economic stability of the community.

[1] As part of the 2021 update of the plan, the City requested an updated repetitive loss list from FEMA; however, this data was not provided in time to be incorporated into the update. Therefore, older data was used for reference.

Repetitive Loss Buildings				
	AE, A1-30, AO, AH, A	**VE, V1-30, V**	**B, C, X**	**TOTAL**
RL Buildings (Total)	168	23	4	195
RL Buildings (Insured)	64	7	3	74
Percentage Insured	38%	30%	75%	38%

Source: FEMA NFIP Database

Staff contacts these property owners by letter on an annual basis; however, these efforts have met with limited success.

Repetitive Loss Building Claims				
	AE, A1-30, AO, AH, A	**VE, V1-30, V**	**B, C, X**	**TOTAL**
RL Payments (Total)	$6,029,753	$2,478,322	$84,689	$8,592,764
Building	$4,818,956	$2,394,983	$69,612	$7,283,551
Contents	$1,210,797	$83,339	$15,077	$1,309,213

Source: FEMA NFIP Database

Only 38% of the 195 repetitive loss buildings are insured for flood loss. This under insurance represents a threat to the rebuilding effort of the city following a major hurricane or flood. The committee has identified the owners of repetitive loss buildings as a special target audience.

While the 195 repetitive loss properties is significantly less than the 226 repetitive loss properties the city had a one time, there is still considerable work to be done to reduce the number of properties on the list. During the development of the initial PPI, a survey of repetitive loss property owners was conducted so the PPI Committee could determine how much these property owners understand about the flood hazard and their mitigation options.

Twenty-two percent (22%) of those responding to the questionnaire indicated the building included in the survey is their primary home. This is a slightly higher response than the primary home ownership percentage for the city.

The Hazard Mitigation Committee identified 48 repetitive loss areas. The boundaries for these areas were drawn to include properties with similar risk and large enough to protect the identity of property owners. Altogether the properties in the 48 areas total 785 properties. Maps of the 48 Repetitive loss Neighborhoods are included in Chapter 4, Repetitive Loss Area Analysis. The PPI Committee sent letters and a survey form to each property owner. 336 (43%) responses

were received.

While most of the property owners live elsewhere, over half (56%) were aware that their property had flooded at some point. Many are aware because they continue to get flooding during heavy rains, especially on a high tide.

Responses from the Property Owner Questionnaire		
Question	**Number of Responses**	**Percentage**
Total Respondents	336	43%
Those who KNOW their property has flooded in the past	189	56%
Those who KNOW of water in their lower enclosed area	69	37%
Those who KNOW of water in their first-floor area	42	22%
Those who have taken flood mitigation measures	213	63%
Removed enclosure	4	
Elevated electrical equipment	97	
Elevated AC/heat pump	174	
Installed flood vents	65	
Elevated house/building	69	
This is their primary residence	70	22%
Have a flood insurance policy	277	82%
Interested in pursuing mitigation measures	205	61%

The thing that was a surprise is the number of property owners who report having taken some mitigation action to reduce flood losses at their property. 213 or 63% of those responding to the questionnaire reported completing some flood mitigation action. Most reported elevating electrical or mechanical equipment servicing the building. However, 69 said they had elevated their home. Most of the homes reported as elevated are not on the FEMA repetitive loss list. Several continue to be at risk of flooding because enclosures have been constructed below the elevated building.

277 or 82% of the respondents said they have a current flood insurance police. A few indicated they did not renew their policy because of the increased premium cost. The PPI Committee recognizes this will probably be a growing trend. The committee decided to focus some of its activity on messages about the importance of financial protection that comes with carrying a flood insurance policy and wind coverage.

While 63% of the respondents to the survey indicated they have already taken measures to reduce the potential for flood loss at their property, 61% said they were interested in receiving additional information on flood loss reduction measures.

7.7 Buildings Insured for Flood Hazards

One of the purposes of the assessment is to look at flood insurance coverage to determine if there are areas that are under insured or need additional coverage because few property owners carry flood insurance.

Flood Insurance Policies by Flood Hazard Area				
Flood Zone	**Policies**	**Properties with Flood Insurance**	**$ of Closed Paid Loss**	**% of Total Value for Claims Paid**
X, B, C	2,307	1,953	$ 1,334,430	4%
AE	6,831	2,603	$24,493,384	66%
VE	953	182	$11,262,401	30%
TOTAL	10,091	4,738	$37,090,673	100%

NOTES: 1. Policy data is from NFIP CIS dated August 2015.
2. The column "Properties with flood insurance" is data on December 31, 2014.

Flood insurance is required as a condition of Federal aid or a mortgage or loan that is federally insured for a building located in a high hazard A or V Zone. Therefore, one would expect most policies to be in the AE and VE Zones.

The interesting statistic in the Table below is that there are a high number of policies in B, C, and X Zones where flood insurance is not required. While B, C and X zone policies account for23% of the flood insurance policies, only 4% of the NFIP claims paid have been in the X Zones. This may be because no hurricane has made a direct hit on North Myrtle Beach since 1968. With the September 2015 flood in South Carolina many are wishing they had renewed their flood coverage. This is a good lesson for those in the City that are considering whether or not to renew their policy because flood insurance premiums are increasing.

In the Table above the number of flood insurance policies exceed the number of properties in flood zones AE and VE because the policy numbers include Condo policies and other buildings with multiple policies. Therefore, it is impossible to tell from this data the percentage of buildings in each flood hazard zone that are covered by flood insurance. To make this determination a survey of lots and building in the SFHA is needed.

Flood Insurance Policies by Occupancy

Field surveys were conducted in November and December 2014 for the Hazard Mitigation Plan. The surveys were updated in August 2015 as part of the PPI survey. Based on a field survey and review of property records, there are 4,550 lots in the special flood hazard areas (SFHA). Of these, 77% percent are zoned for single family (1-4 unit), 15% are "other residential units, and the remainder are commercial. Not all of the lots have buildings, and several have buildings that are located outside of the SFHA. While the building is not mapped in the SFHA, they still have some level of flood risk and should be encouraged to carry a flood insurance policy.

Flood Insurance Policies by Occupancy			
Use Classification	**Policies in Force**	**Number of Lots in the SFHA**	**Number of Buildings in the X Zone**
Single Family	3,784	3,518	6,683
All Other Residential	6,146	692	1,005
Non-residential	180	340	593
TOTAL	10,110	4,550	8,281

Sources: FEMA NFIP Database February 28, 2015
Field Survey conducted November and December 2014. Updated August 2015. North Myrtle Beach Planning and Development Department, September 16, 2015.

After the field surveys flood insurance policy data was reviewed to determine if an active flood insurance policy was carried on the structure. The policy data was also reviewed to determine the level of flood insurance coverage on each building.

This data was prepared for each area of the City. The areas used for this identification are generally based on the boundaries of the original four jurisdictions that were consolidated in 1968 to make the City of North Myrtle Beach. The fifth area designated as HWY-17 includes the area north of the highway and the area along the Little River Neck Road. This area was given a separate designation because most of it was not included in the original four communities; it has more recent development, has fewer flood risks, and does not have any repetitive loss properties.

Buildings with Flood Insurance Coverage by Neighborhood Area				
NEIGHBORHOOD	**NUMBER OF BUILDINGS WITH FLOOD COVERAGE**	**AE ZONE**	**V ZONE**	**X ZONE**
WINDY HILL	417	154	56	207
CRESCENT BEACH	424	126	13	285
OCEAN DRIVE	1447	544	43	860
CHERRY GROVE	1649	1463	62	124
HWY 17 WEST	743	271	0	472
TOTAL	4680	2558	174	1948

Source: FEMA NFIP Database December 31, 2014 modified with local building survey data.

NOTE: An additional 5,430 flood insurance policies are held on 70 multi-unit structures such as condominiums, townhouses and apartment buildings.

As expected, the largest number of buildings in the SFHA are mapped as being in an AE Zone. What is surprising is the large number of in the X zone with flood insurance policies. X zone policies account for 42 % of the flood policies. The PPI committee is concerned that this percentage may decline as a result of recent legislation which put a higher fee on properties that are second homes or rental property. The PPI committee will continue to monitor this situation and may need to give special attention to these property owners.

Only 76% of the buildings in the buildings in the SFHA carry a flood insurance policy. This means a significant portion of the City's assets are not covered for loss due to a flood. This can have a significant impact on the City's recovery from a major flood or hurricane. Without insurance property owners and families could need substantial resources or loans to be able to rebuild or repair their homes. A high level of flood insurance coverage is good for both property owners and the City's economic strength. The PPI will encourage the purchase of flood insurance.

Buildings in the SFHA with Flood Insurance Coverage by Neighborhood Area			
Neighborhood	**SFHA Buildings (AE and VE)**	**# of SFHA Buildings SFHA Buildings with Flood Coverage**	**% of Buildings Covered by Flood Insurance**
Windy Hill	333	210	63%
Crescent Beach	157	139	89%
Ocean Drive	709	587	83%
Cherry Grove	2,080	1,525	73%
HWY 17 West	327	271	83%
TOTAL	3,606	2,732	76%

Source: FEMA NFIP Database December 31, 2014 modified with local building survey data.

Likewise, the data in the following Table is of significant concern. 65% of the City's building value is located in AE or VE zones. Much of that value is not insured and a significant portion of the buildings that are insured, are underinsured. The problems with not being "insured to value" need to be addressed by the City's Program for Public Information.

The Public Information Program should provide relevant information annually to residents and property owners. Since most property owners live in other states or elsewhere in South Carolina, unique methods must be considered in order to get information out. In addition to the distribution of printed material the City has found social media to be effective methods for distributing messages. The City Public Information Officer reports that the City has over 13,500 TWITTER followers and that some stories posted on FACEBOOK will get as many as 50,000 hits.

BUILDING VALUE BY FLOOD ZONE				
Building By Type	**V-Zone**	**AE-Zone**	**X-Zone**	**City Total**
Single-Family	76,680,900	398,661,500	830,814,700	1,306,157,100
Duplex	8,663,800	22,696,500	23,382,900	54,743,200
Hotel/Motel	3,075,100	12,245,600	13,206,200	28,526,900
Mobile Home	0	2,557,100	10,868,600	13,425,700
Multi-Family/Townhouse	1,308,581,000	1,037,468,800	515,029,500	2,861,079,300
RV/Campground	0	122,500	7,106,800	7,229,300
Public, Social, Cultural	2,000	7,083,000	17,313,500	24,398,500
Commercial/Amusement	441,900	50,757,900	153,216,400	204,416,200
Open Space	0	4,675,900	6,088,200	10,764,100
Other Land Use	25,200	1,706,000	6,313,900	8,045,100
Total	**1,397,469,900**	**1,537,974,800**	**1,583,340,700**	**4,518,785,400**

Source: North Myrtle Beach Planning and Development Department

Building Constructed Before the NFIP

Buyers and owners of Pre-FIRM (built before Flood Insurance Rate Maps were effective) structures are often unaware of what they can and can't do when they are ready to improve their property. They express feelings of being "blindsided" by the information, which can lead to some very difficult discussions at the permitting counter. Many are not aware that they must comply with special construction regulations to ensure that new buildings and substantial improvements to existing buildings meet flood protection standards and that any project they do to their property does not increase flooding for their neighbors.

Many of the repetitive loss properties on the FEMA list were constructed before the City was mapped for flood hazards. The CRS Program requires participating communities to complete an analysis of repetitive loss areas and contact repetitive loss property owners on an annual basis, identifying options for long-term mitigation. Whenever possible, staff from the City works with homeowners to reduce future flood damage to these properties using long-term methods, such as a home elevation. Some other examples of acceptable long-term mitigation actions are the removal of enclosures below an elevated structure, demolition rebuild, or an acquisition and demolition by the City.

Pre- and Post- FIRM Policies in Force			
Flood Zone	**Pre-FIRM Flood Policies**	**Post-FIRM Flood Policies**	**Total Flood Policies**
A01-30 & AE Zones	1,619	5,212	6,831
V01-30 & VE Zones	457	496	953
B, C & X Zone	394	1,913	2,307
Total	2,470	7,621	10,091

Source: FEMA NFIP Database December 31, 2014

Multi-Family Buildings that are Under Insured

Before 2000, the trend was toward smaller hotels and multi-family resorts with fewer than 100 units. Since then, the trend has been toward large-scale resorts, each with over 500 units. Unless there are private flood insurance policies we didn't find, many condominium buildings appear to be under insured for flood losses.

Hotels and Multi-Family Buildings		
Policy	**Policies in Force**	**Premium**
Condo	5,926	$2,229,288
Non Condo	4,165	$3,758,450

Source: FEMA NFIP Database December 31, 2014

The Cost of Flood Insurance

Data on the average cost of flood insurance will assist the City help property owners understand the cost of insurance. It will help describe the benefits of mitigation as implementation of BW-12 and HFIAA progress.

Pre-FIRM Policies			
Zone	**Policies in Force**	**Premium**	**Av. Premium**
A01-30 & AE Zones	1,613	$1,652,473	$ 1,024
A Zones	6	$13,982	$ 2,330
V01-30 & VE Zones	457	$571,706	$ 1,251
B, C & X Zone	394	$155,816	$ 395
Standard	136	$47,945	$ 353
Preferred	258	$107,871	$ 418
Total	2,470	$2,393,977	$ 969

Source: FEMA NFIP Database December 31, 2014

Post-FIRM Policies			
Zone	**Policies in Force**	**Premium**	**Av. Premium**
A01-30 & AE Zones	5,211	$1,695,104	$ 325
A Zones	1	$2,231	$ 2,231
V01-30 & VE Zones	496	$976,847	$ 1,969
B, C & X Zone	1,913	$919,579	$ 481
Standard	368	$287,001	$ 780
Preferred	1,545	$632,578	$ 409
Total	7,621	$3,593,761	$ 472

Source: FEMA NFIP Database December 31, 2014

The Advantage of Flood Insurance

Since flood insurance covers damage from flooding not covered by other types of policies, the reimbursement for flood damage claims provides homeowners a means of recovering – to rebuild or replace damaged items. Federal disaster aid for flood relief is a loan that must be paid back, which will have a longer-term impact on the recipient's budget.

The advantage of having a flood insurance policy is seen in the table in below: ALMOST 2,000 claims have been paid for OVER $37,000,000. Committee members agreed that flood insurance provides important benefits for the community at large - by helping speed recovery, maintain property values and support public health and safety – and it would be a worthwhile activity to publicize the availability of flood insurance.

This effort should be directed to all property owners. The Hurricane SLOSH maps for Category 3, 4, and 5 events are a dramatic testimony to the risk a property owner could face. The maps (see Chapter 3, Risk Assessment) show the potential for land well beyond the SFHA to be inundated with flood waters even in a Category 3 Hurricane.

Flood Insurance Claims Paid				
	Insurance in Force	**Number of Closed Paid Losses**	**$ of Closed Paid Losses**	**Av Claim Payment**
Condo	$1,416,491,100	187	$10,136,406.12	$54,205
Non Condo	$1,184,033,000	1,740	$27,063,408.55	$15,554
TOTAL	$2,600,524,100	1,927	$37,199,814.67	$19,305

Source: FEMA NFIP Database December 31, 2014

Insurance Coverage by Building Occupancy

Using the FEMA summary data table for building occupancy, the amount of coverage (insurance in force) was divided by the number of policies in force to determine the average amount of coverage by category. The resulting table is shown below with the new, locally determined “average coverage” column added.

The average coverage for buildings seems high (above the $250,000 max coverage for a residential building); however, most buildings have multiple owners with each carrying a flood insurance policy.

Average Flood Coverage by Building Use			
	Policies in Force	**Insurance in Force**	**Average Coverage**
Single Family	3,784	$1,059,511,100	$279,987
2-4 Family	511	$136,757,800	$267,627
All Other Residential	5,635	$1,332,993,000	$236,555
Non Residential	180	$69,604,600	$386,692
Total	10,110	$2,589,866,500	$257,059

Flood coverage for multi-family structures is a different matter. The building value for the City's multi-family buildings located in flood hazard areas in is over $2.5 billion; however, based on available records the flood building coverage is only $1.4 billion. The continued survival of these hotels, condominium and apartment buildings is essential for the economic health of North Myrtle Beach if it is to remain a tourist destination. It is important for these buildings to be adequately covered with insurance for natural hazards.

This matter should continue to be studied by the Hazard Mitigation Committee so that an accurate picture of the insurance coverage situation can be determined.

Minus Rated Policies

Properties that are "minus rated" are not eligible for the CRS discount. The "minus rating" could be caused by a number of reasons, including:

1. The lowest floor is one foot or more below the base flood elevation (presumably based on data in Elevation Certificates).
2. Heat pumps and air condition units are on platforms that are more than a foot lower than the base flood elevation.
3. Foundation flood openings are higher than 12" above grade, or flood openings don't add up to 1 sq. in. of net open area for every sq. ft. of the enclosure.
4. An enclosure has been added below an elevated building and the enclosure doesn't meet the construction or use standards in the flood insurance program regulations.

Minus Rated Policies	
Total Number of Minus Rated Policies:	345
6+ feet below base flood elevation	197
1 to 5 feet below base flood elevation	148

Source: FEMA NFIP Database December 31, 2014

The high number of minus rated buildings indicates an opportunity for conducting outreach to educate property owners about insurance rating, mitigation measure options, the importance of carrying flood insurance, and the importance of having a current elevation certificate. The city will be conducting voluntary site visits to help property owners understand their risk and mitigation options. The PPI committee will develop a brochure to assist the staff explain this information and homeowner options.

Population by Ethnicity

Population by Ethnicity		
Ethnic Group	**Population**	**Percentage**
Non-Hispanic or Latino	12,881	94%
Hispanic or Latino	871	6%
Total	13,752	100%

Source: 2010 US Census

A summary of the public information needs, conditions and information to be addressed by the Program for Public Information:

- ✓ Floods and other hazards such as hurricanes and wildfire should be addressed by the PPI.
- ✓ Many older homes in the SFHA have slab foundations.
- ✓ Most residents and property owners were not in NMB nor did they own property in NMB during the last major storm.
- ✓ The City is a great vacation destination and the PPI needs to address the public information needs for safety information before and during storms.
- ✓ Most property owners live elsewhere and are best reached with social media and printed information sent through the mail.
- ✓ Many repetitive loss property owners know their property has flooded in the past and have taken some action to reduce future flood losses.
- ✓ Only 76% of the buildings in the SFHA are covered with a flood insurance policy.
- ✓ Buildings in the City have a value of $4.5 billion and carry $2.5 billion in flood insurance coverage. This represents 56% of the building value.
- ✓ It appears that most insured single-family buildings carry an adequate level of coverage.
- ✓ A survey conducted for the hazard mitigation plan indicated property owners prefer to receive written material to learn about flood insurance and mitigation measures.
- ✓ As part of its PPI efforts the City should send brochures to all property owners. This has the benefit of covering several topics including a reminder to those who are already-insured that it is important to keep their flood policies in force.
- ✓ Those who respond to mitigation surveys are more likely to have taken some mitigation action, carry flood insurance and want more information about additional flood loss reduction measures.
- ✓ Using social media boost interest in the hazard mitigation plan, natural hazards, mitigation measures and the purchase of flood insurance.

7.8 Target Audiences

The committee believes that if floodplain residents have access to the facts on the flood hazard and how to minimize impacts, they will be more equipped to take actions that will, over the long run, reduce costs and better maintain safety and the economic value of their homes.

An informed citizenry that is knowledgeable about the flood risks, what they can do to decrease future flood damages and the benefits of flood insurance will be better prepared to face the next major hurricane.

After consideration of the community assessment results, the committee agreed on seven target audiences that would benefit most from public information outreach.

Target audience #1- Property owners located in the SFHA (Zone AE, Coastal A and VE):
Property owners in these areas are vulnerable to flood hazards due to the proximity of the ocean. Understanding the flood zone their properties are located in and the need to have flood insurance is a key to protecting their financial investment and the tax base for the city. For those property owners that live in the city year-round, the committee wanted to make sure the members of this group have an evacuation plan, and understand the dangers of standing water. Remodeling of homes is a constant activity in the city. It is important that the requirements for permits be addressed by outreach projects.

Target audience #2 – Repetitive loss property owners:
The majority of repetitive loss structures were built before the FIRMs were adopted. Whenever possible, staff from the city works with homeowners to reduce future flood damage to these properties using long-term methods, such as a home elevation. The city sends a letter to repetitive loss property owners each year. While progress is being made in reducing the number of repetitive loss properties, the committee members agreed that additional efforts through the PPI might yield better results.

Target audience #3 - Properties located just outside the SFHA (X shaded zones).
The committee chose to target these areas to increase awareness that flood insurance is available even if you're not within a Special Flood Hazard Area (SFHA). They wanted the property owners to be aware of their flood zone and need for flood insurance. Water quality was also a concern of the committee in this area.

Target audience #4- Short term renters located in the SFHA (Zone AE, Coastal AE & VE):
The committee wanted to be assured the short term renters who are not familiar with the town could be ready if a flood should happen. Also, the committee wanted to educate them on water quality.

Target audience #5 – Real estate, lending and insurance companies:
These companies are a key to conveying information about flood hazards and the need for flood insurance. The committee wants to make sure the agencies have all the information they need to promote flood insurance and inform potential property owners of the dangers of flooding.

Since flood insurance covers damage from flooding not covered by other types of policies, the

reimbursement for flood damage claims provides homeowners a means of recovering – to rebuild or replace damaged items. Federal disaster aid for flood relief is a loan that must be paid back, which will have a longer term impact on the recipient's budget.

Target audience #6 – The community at large:
Yearly mail-outs regarding the need for flood insurance are also mailed to all property owners within the city limits. The Committee concluded that the community at large should also be considered a target audience, since flooding can occur anywhere for a variety of reasons. Flooding can occur due to an undersized culvert or blocked drain, and also in areas not shown on flood maps. Citizens may travel through flooded areas and not know the proper safety precautions, or they may consider purchasing or moving to a flood prone property.

Target audience #7 – Prospective Buyers.
Committee members agreed that people interested in purchasing properties inside flood hazard zones need to have accurate information about the flood risk up front, so they can incorporate it into their decision-making process. Purchasers with federally-backed mortgages are required to purchase flood insurance, so the flood hazard designation of a property will be known at that time, but by that time, buyers may feel it is too late for them to change course. Flood insurance is not required for homes purchased with cash.

Aware of floodplain area homeowners who were surprised to learn that stricter development regulations applied on their property. Committee agreed that if a PPI project or projects increased the ease of obtaining this information, potential buyers may be more informed in the future and better prepared to make a decision they will be happy with.

7.9 Existing Public Information Efforts

Knowing what other public information is reaching the city's residents is a key part of developing a Program for Public Information. The program is designed to build community resilience to flooding by influencing residents to adopt behaviors to improve flood hazard preparedness and decrease future flood damage.

The Table below contains initiatives that are in place that support the goal and CRS messages. The list was composed through city staff research and PPI Committee members.

Existing Public Information Efforts (EPIE)			
Organization	**Project**	**Subject Matter**	**Frequency**
City of North Myrtle Beach – Public Information Officer	**CURRENT** (Monthly News Publication)	Various flood and hazard related topics	Monthly
	FACEBOOK		
	TWITTER		
	CITY TV – Channel 15 on TWC - WPDE		
	NIXLE		
	WEBSITE www.NMB.us		
City of North Myrtle Beach – Building Inspection Division	Handouts and Brochures		Year-round
	Flood Map Inquiry Service	Flood Hazard Areas, flood insurance and flood protection	Year-round
	Elevation Certificates	Certificates for properties within the city.	Year-round
	Flood Brochure mailed to all citizens	9 flood topics	Annually
	Flood mitigation materials placed in the Library		Annually
	Staff Site visits		Year-round as requested

Existing Public Information Efforts (EPIE)			
Organization	**Project**	**Subject Matter**	**Frequency**
City of North Myrtle Beach – Public Safety and City Public Information Officer	Public Messages for flood response preparations and recovery		
City of North Myrtle Beach – Recreation Department	Beach Sweep	Remove trash and debris from the beach	September
Insurance Agencies	Handouts on flood insurance	Flood Insurance Purchase and mitigation measures	As needed
Horry County Emergency Management	"Know Your Zone"	Hurricane Preparation Tips, Evacuation Routes and Tips, Shelter Information	Year-round
Coastal South Carolina Chapter of the Red Cross			

7.10 Key Messages

The group selected ten key messages that need to be disseminated to the audiences. The first six are the same as the six priority messages for the CRS. The six priority topics of the revised CRS program are essentially best management practices (BMPs) for households – actions that can be taken by homeowners or renters to avoid or reduce flood damage. The city believes that if floodplain residents have access to the facts on the flood hazard and how to minimize

impacts, they will be more equipped to take actions that will, over the long run, reduce costs and better maintain safety and the economic value of their homes.

Messages 7-12 were added by the committee based on a consideration of community characteristics and demographics.

1. Know your flood hazard
2. Insure your property for your flood hazard, everyone can buy flood insurance
3. Protect people from the flood hazard
4. Protect your property from the hazard
5. Build responsibly
6. Protect natural floodplain functions
7. Have your evacuation route planned in advance, choose a rendezvous point.
8. Get permits before you build.
9. Tips for hurricane season.

10. Sources of financial assistance for property protection.
11. Know your flood risk in X zone properties.
12. So what should I know when buying coastal property?

The overall strategy is to make information more readily available to the target audiences in a manner that will encourage each audience to adopt behaviors to improve preparedness and decrease future flood damage.

7.11 New Proposed Projects

New proposed projects, developed through discussions at the committee meetings, are highlighted below as well as continued projects that the committee feels should be publicized more:

- The CRS Coordinator would hold at least two meetings annually to let property owners know what measures can be taken to reduce their damages.
- A letter, signed by the Mayor will be sent all property owners within the city yearly encouraging all property owners to purchase flood insurance. The letter will explain the importance of having flood insurance and remind property owners that most homeowner's insurance policies do not cover flood.
- The city will partner with Horry County Emergency Management "Phone Tree" to make residents aware of approaching storms and where shelters are located.
- City staff would hold a neighborhood meeting in one or more repetitive loss areas with large numbers of affected properties to let homeowners know what measures can be taken to reduce their damage, and to attract homeowners willing to participate in FEMA grant-assisted home elevation project.
- A Real Estate representative would work within his professional community to offer a continuing education opportunity for realtors that would communicate the impacts of buying a house in a floodplain or wildfire area and encourage them to better prepare the homeowner.
- The City will publicize the National Flood Insurance Program's (NFIP) Flood Smart website, www.floodsmart.gov, which is a collection of information to help people decide if flood insurance is right for them. The website illustrates how different levels of flood water can damage a home, and estimates the costs of restoring to original condition.
- The City will work with multi-family rental unit owners to provide information on hurricane and flood hazards, evacuation notices and routes, and safety information to renters.

7.12 Flood Response Preparations

In addition to projects that are implemented every year, the PPI Committee recommends projects that will be implemented during and after a flood. These projects are drafted and made ready for reproduction and dissemination after a flood warning. Projects such as those listed below will be developed:

Project Name	Description	Outcome	Assignment	Procedure
FRP # 1. Letter to flooded property owners.	Letters will be sent to flooded areas describing flood safety and clean up issues, ways to protect their property, the availability of flood insurance, and permitting requirements.	Increased awareness of flood safety and clean up issues. Reduction in future flood insurance claims. Increase in flood insurance coverage. Fewer permit violations.	Chief Building Official, Emergency Management Coordinator and the City Public Information Officer.	Letters will be sent following a flood event. Addresses will be determined using the GIS database and maps showing the extent of flooding.
FRP # 2. Door Hangers	Door hangers listing permitting requirements.	Increase in floodplain permits and a reduction in the number of "Stop Work Orders".	Building Inspectors	Door hangers distributed after a flood while assessment is underway.
FRP # 3. Press Releases	Press releases will include information on permit requirements, safety measures and flood insurance.	Increase in permits requested, increased flood coverage and fewer injuries during recovery.	City Public Information Officer	PIO will send press releases to the media outlets.
FRP # 4. Website	Post flood and recovery information on all priority topics.	Increased awareness related to the topics especially safety, permits and flood insurance.	Chief Building Official, Emergency Management Coordinator and the City Public Information Officer.	Staff will submit story ideas and information to the PIO who will develop the messages for the web.

Project Name	Description	Outcome	Assignment	Procedure
FRP # 5. Handouts	Handouts will be developed on the following topics: How to choose a contractor; permitting; recovery center locations; ICC, financial assistance availability.	Increased awareness on the topics.	Chief Building Official, Emergency Management Coordinator and the City Public Information Officer.	Handouts will be distributed by the development and recovery staff, placed in the Library for pick up, placed in government offices.

7.13 Annual Evaluation

The PPI Committee will meet at least twice a year, to evaluate the Plan and incorporate any needed revisions. The evaluation will cover:

- A review of the projects that were completed
- Progress towards the desired outcomes
- Recommendations regarding projects not completed
- Changes in the target audiences

Staff will draft an update as changes are made by the committee. The revisions will be submitted to City Council for review and as part of the City's annual recertification package to the Community Rating System.

7.14 Adoption

This document will not be in effect until it is approved by the North Myrtle Beach City Council.

Council approval date: _____

Definitions

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the NFIP are protected to the same degree against flooding.

Base Flood Elevation: The computed elevation to which floodwater is anticipated to rise during the base flood. Base Flood Elevations (BFEs) are shown on Flood Insurance Rate Maps (FIRMs) and on the flood profiles.

Flood Insurance Rate Map (FIRM): An official map of a community, on which FEMA has delineated both the SFHA's and the risk premium zones applicable to the community. Most FIRM's include detailed floodplain mapping for some or all of a community's floodplains.

Repetitive Loss property. FEMA defines a Repetitive Loss property as any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978.

Severe Repetitive Loss property. FEMA defines a Severe Repetitive Loss property as a residential property that is covered under an NFIP flood insurance policy and (a) has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

Special Flood Hazard Area, (SFHA): The base floodplain delineated on a FIRM. The SFHA is mapped as a Zone AE or Zone VE. The SFHA may or may not encompass all of a community's flood problems.

PROGRAM FOR PUBLIC INFORMATION
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Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
1. Property Owners Located in the SFHA	Topic # 1: Know your flood hazard	Increase the number of inquiries asking about the flood hazard designation of property.	(OP#1) Prepare and distribute a brochure or other document describing local flood hazard designations and what they mean. Describe the building regulations. Make available on the web site and in the building division.	Chief Building Official	Finish Brochure First quarter 2016 ---------- Activity Year round	
	Topic # 2. Everyone in the City can buy flood insurance.	Increase the number of flood insurance policies in the SFHA.	(OP#2) Prepare and distribute a brochure on flood insurance. Illustrate the insurance benefits of freeboard and free of obstruction.	Chief Building Official	Finish Brochure Second quarter 2016 ---------- Activity Year round	Insurance Agents
	Topic # 3. Protect People from the flood hazard - Follow safety precautions	Public health maintained during and after the storm	(OP#3) Prepare for use during disasters Public Service Announcements describing safety measures.	City Public Information Officer	Finish Brochure Second quarter 2016 ---------- Distribute during a disaster.	

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Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
1. Property Owners Located in the SFHA	Topic # 4. Protect your property from the flood hazard.	Increase the permits for retrofitting measures.	(OP# 4) Prepare and distribute a brochure on retrofit measures. Place on the web site, in the Library and in the Building Division.	Chief Building Official	Finish Brochure Second quarter 2016 ---------- Activity Year round	
	Topic # 5. Build responsibly.	Increase the number of permits for new construction that build to higher standards.	(OP#5) Prepare a brochure that describes and tells the benefits of freeboard, free of obstruction, flood resistant materials, flood openings, etc. Place on the web site, in the Library and in the Building Division.	Chief Building Official	Finish Brochure Second quarter 2016 ---------- Activity Year round	
	Topic # 6. Protect natural floodplain functions.	Water quality maintained.	(OP#6) Prepare an article for the City Publication *Currents* that describes the benefits of the preserve and open space areas of the City and the importance of maintaining waterways, ditches and cannels free of debris and trash.	City Public Information Officer	Third quarter 2016	

PROGRAM FOR PUBLIC INFORMATION
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Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
1. Property Owners Located in the SFHA	Topic # 7. Plan your evacuation.	All visitors and 80% of residents evacuate when ordered	(OP#7) prepare an article for the City publication *Currents* on evacuation planning, routes to take, things to pack, and safety tips.	City Public Information Officer and Emergency Management Coordinator	Second quarter 2016	
	Topic # 8. Get permits before you build, repair or renovate your property.	Fewer Stop Work Orders for Violations	(OP#8) Prepare an article for the City publication Currents on the required building permits.	City Public Information Officer and Chief Building Official	First quarter 2016	
	Topic # 9. Tips for hurricane season.	Fewer Injuries and no loss from wind or water borne debris.	Hurricane Preparation Tips	Emergency Management Coordinator	Second quarter 2016	Horry County Emergency Services
	Topic # 10. Sources of financial assistance for property protection measures.	More building permits to retrofit building to protect them from flooding,	(OP#10) Prepare and distribute a brochure following disasters, include an article in the City publication *Currents* , place in the Building Division.	Chief Building Official and City Public Information Officer	Finish Brochure Third quarter 2016 ---------- Activity Year round	

PROGRAM FOR PUBLIC INFORMATION
OUTREACH PROJECTS

Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
2. Repetitive Loss Property Owners	Topic # 2. Everyone in the City can buy flood insurance.	Increase the number of flood insurance policies above the current 38% coverage.	OP# 2, 5, and 8 will cover this information.	Chief Building Official and City Public Information Officer	Second quarter 2016	
	Topic # 4. Protect your property from the flood hazard.	Reduce the number of repetitive loss properties	OP# 4 mailed as part of a brochure with additional topics.	Chief Building Official and City Public Information Officer	Second quarter 2016	
	Topic # 8. Get permits before you build, repair or renovate your property.	Fewer Stop Work Orders for Violations	OP# 8 mailed as part of a brochure with additional topics.	Chief Building Official and City Public Information Officer	Second quarter 2016	
	Topic # 10. Sources of financial assistance for property protection measures.	More building permits to retrofit building to protect them from flooding,	(OP # 10) will cover this activity.	Chief Building Official and City Public Information Officer	Finish Brochure Third quarter 2016 ---------- Activity Year round	

PROGRAM FOR PUBLIC INFORMATION
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Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
3. Property Owners Located in the X zone.	Topic # 11. Know your flood risk.	The policy count for properties in this category have been dropping. The purpose of this activity is to maintain or grow the number of flood policies for properties located in the X zone.	(OP # 11) will address the flood risk beyond the SFHA from Category 3 and higher hurricanes.	Chief Building Official and City Public Information Officer	Second quarter 2016	Insurance Agents
	Topic # 2. Everyone in the City can buy flood insurance.	Increase the number of flood insurance policies in the X zone.	OP # 2 and 11 will cover this activity.	Chief Building Official and City Public Information Officer	Third quarter 2016	
	Topic # 3. Protect People from the flood hazard - Follow safety precautions	Public health maintained during and after the storm	OP # 3 will cover this activity.	City Public Information Officer	Second quarter 2016	

PROGRAM FOR PUBLIC INFORMATION
OUTREACH PROJECTS

Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
3. Property Owners Located in the X zone.	Topic # 4. Protect your property from the flood hazard.	Increase the permits for retrofitting measures and see more new construction permits in the X zone include higher construction design standards.	(OP # 12) will be a brochure that encourages higher construction standards in the X zone.	Chief Building Official and City Public Information Officer	Finish Brochure Third quarter 2016 ---------- Activity Year round	
	Topic # 8. Get permits before you build, repair or renovate your property.	Fewer Stop Work Orders for Violations	OP # 8 will address this activity.	Chief Building Official and City Public Information Officer	Second quarter 2016	
4. Short-term renters	Topic # 3. Protect People from the flood hazard - Follow safety precautions	Public health maintained during and after the storm	(OP # 13). Prepare and distribute a brochure to rental agencies. The brochure will focus on helping short-term renters understand flood risk, safety measures and evacuation procedures should it be necessary to order an evacuation.	City Public Information Officer and Emergency Management Coordinator	Finish Brochure Second quarter 2016 ---------- Activity Year round	Rental Agencies

PROGRAM FOR PUBLIC INFORMATION
OUTREACH PROJECTS

Target Audience	Message	Outcome	Project(s) Proposed to Support the Message	Assignment	Proposed Schedule	Stakeholder
5. Real Estate, lending and insurance companies	Topic # 2. Everyone in the City can buy flood insurance.	Increase the number of flood insurance policies in the SFHA and the X zone.	(OP # 14) will be a brochure developed in cooperation with Real Estate , lending and Insurance Companies.	Chief Building Official and City Public Information Officer	Finish Brochure Second quarter 2016 ---------- Activity Year round	Real Estate, lending and insurance companies
6. The Community at Large	Topics 1 - 11	Better construction, improved flood insurance coverage, protected population, and protection for the environment.	(OP # 15) will be a brochure mailed to the entire community.	Chief Building Official and City Public Information Officer	Third quarter 2016	
7. Prospective Buyers	Topic # 12. So what should I know when buying coastal property.	Buyers who are aware of flood insurance, coastal construction standards, and the value of natural resources in the coastal setting.	(OP # 16) will be a brochure available to those interested in purchasing coastal property.		Third quarter 2016	

Chapter 8: Mitigation Action Plan

A fundamental premise of the mitigation plan is that current dollars invested in mitigation will significantly reduce the demand for future dollars by reducing the amount needed for emergency recovery, repair and reconstruction following a disaster. Mitigation also calls for conservation of natural and ecologically sensitive areas (such as wetlands, floodplains, dunes), which enables the environment to absorb some of the impact of hazard events. Additionally, mitigation can be integrated into the day-to-day regulatory framework of the City through implementation of policies, ordinances and programs that promote mitigation and mitigation techniques. In this manner, mitigation programs can help the City attain a level of *sustainability*, ensure long- term economic vitality and promote the environmental health for the community as a whole.

Hazard mitigation requires that we build, rebuild and plan for today's development while considering the impact of natural hazards yet to come on inhabitants in the years ahead.

The Hazard Mitigation Committee developed recommendations to be implemented by a number of City Departments. The recommendations are in the form of action items listed in the table on the following pages. Each action item is related to the hazards, goals and mitigation activities identified in Chapters 3-7.

The Hazard Mitigation Action Plan Table that follows identified the primary hazards addressed by each mitigation activity. A priority is also assigned to each activity. Several factors were considered when assigning a priority to an activity including:

- The value of the property loss reduction benefit likely to be achieved by the activity.
- The potential economic recovery benefit.
- The cost of implementing the activity.
- The level of public support.

For each action item a lead Department or staff position has been identified. Each action item also has a deadline listed. Deadlines are either "ongoing" (for programs that should continue) or a date for the action to be completed.

For each action item general categories of expenditure have been identified along with potential sources of funding. Additionally, an indication of completion, progress, deferment, or no change since the previous plan is provided for each action. If the action is new, that is noted as well.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Plan Monitoring, Evaluation and Update							
Complete 5-year review and update of the Hazard Mitigation Plan	City Council Adopt Mitigation Planning Committee	All	High	May 2021 and again in 2026	Staff time and contractor $65,000	General Fund and HMGP grant	The plan will be completed before expiration of the previous plan in May 2021. Once the new plan is approved by FEMA it will be in place for 5 years.
Monitor Mitigation Plan Actions and Report Progress Annually	Mitigation Planning Committee City Departments	All	High	Sept. 1 annually June 1 annually	Staff time, annually Staff time	General Fund General Fund	Monitoring the mitigation actions is part of the Plan Maintenance section (Section 9). This action will be deleted from future updates.
Adopt a Resolution to Continue the Mitigation Planning Committee – for CRS credit, a new resolution has to be passed before each update of the plan.	City Council	All	High	Oct. 2015	Staff time	General Fund	This action has been completed and shall be completed for each subsequent plan update.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Prevention Measures							
Continue to Support Enforcement of Coastal Setback Regulations	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Maintain an Inventory of the Beach Profile and Erosion Data	City Engineer	Coastal Erosion Hurricanes and Tropical Storms	High	Ongoing	Staff time and contract services	Accommodations Tax	Ongoing – this is part of the day-to-day duties of the City Engineer. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Update the City's Beachfront Management Plan	Planning Department	Coastal Erosion Hurricanes and Tropical Storms	High	Starting work in 2021	Staff time, consultant, and printing	General Fund	The City will begin work on the Beachfront Management Plan in 2021.
Provide adequate staffing and training, complete building plan reviews, and ensure administrative and enforcement procedures meet the requirements for the City to maintain its 3/3 Classification under the Building Code Effectiveness Grading Schedule. (Former Objective 1.5)	City Council City Manager	All	Very High	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the City. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Continue to enforce the International Building Codes	Building Division	All	High	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Draft Coastal AE-Zone Report and Regulations	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	Set date after flood maps are released by FEMA	Staff time and consultant $6,000	Permit Fees and General Fund	This is no longer an action that the City is actively seeking to implement. It will be reconsidered during future plan updates.
Hold Hearing and Consider Adoption of Coastal AE-Zone Regulations	City Council	Coastal Erosion Hurricanes and Tropical Storms	High	Set date after flood maps are released by FEMA	Staff time and consultant $2,000	Permit Fees and General Fund	This is no longer an action that the City is actively seeking to implement. It will be reconsidered during future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Draft Non-conversion Agreement Report and Ordinance	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	Set date after flood maps are released by FEMA	Staff time and consultant $2,500	Permit Fees and General Fund	Action completed. The City requires new homeowners to sign a letter that requires acknowledgement of non-conversion. This action will be marked as complete and removed from future plan updates.
Hold Hearing and Consider Adoption of Non-conversion Agreement Ordinance	City Council	Coastal Erosion Hurricanes and Tropical Storms	High	Set date after flood maps are released by FEMA	Staff time and consultant $1,500	Permit Fees and General Fund	Action completed. The City requires new homeowners to sign a letter that requires acknowledgement of non-conversion. This action will be marked as complete and removed from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Draft Freeboard Regulations	Building Division	Flooding Hurricanes and Tropical Storms	High	Set date after flood maps are released by FEMA	Staff time	Permit Fees and General Fund	This action has been completed. The City requires one foot of freeboard on new development in the Special Flood Hazard Area. This action will be removed from future plan updates.
Hold Hearing and Consider Adoption of Freeboard Regulations	City Council	Flooding Hurricanes and Tropical Storms	High	Set date after flood maps are released by FEMA	Staff time	Permit Fees and General Fund	This action has been completed. The City requires one foot of freeboard on new development in the Special Flood Hazard Area. This action will be removed from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Maintain Flood Maps and Data	Building Division	Flooding Hurricanes and Tropical Storms	High	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Draft Critical Facility Regulations	Building Division	Flooding Hurricanes and Tropical Storms	Moderate	January 2017	Staff time	Permit Fees and General Fund	This is no longer an action that the City is actively seeking to implement. It will be reconsidered during future plan updates.
Hold Hearing and Consider Adoption of Critical Facility Regulations.	City Council	Flooding Hurricanes and Tropical Storms	Moderate	2023	Staff time	Permit Fees and General Fund	This is no longer an action that the City is actively seeking to implement. It will be reconsidered during future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Draft Wildfire Mitigation Plan	Fire Chief	Wildfire	Moderate	2023	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Ensure that all new construction is completed using wind-resistant design techniques that will limit damage caused by high winds and reduce the amount of wind-borne debris (Former Objective 1.3)	Building Division	Hurricanes and Tropical Storms	Moderate	Ongoing	Staff time	Permit Fees and General Fund	Ongoing – enforcing the Building Code is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Maximize the use of available hazard mitigation grant programs to protect the City's most vulnerable populations and structures (Former Objective 2.1)	Building Department	All	High	Ongoing	Staff time	Permit fees and General Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Develop a system for recording flood damages as a result of inadequate drainage (Former Objective 2.5)	Public Works	Flooding	High	Ongoing	Staff time	Stormwater Fees and General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Increase the City's NFIP/CRS Class Rating to a Class 5 by the year 2024 through enhanced floodplain management activities (Former Objective 3.4)	City Engineer	Flooding Hurricanes and Coastal Hazards	High	Ongoing	Staff time	Permit fees and General Fund	Ongoing. The City is actively working to improve it's CRS rating.
Enhance the City's capability to conduct hazard risk assessments, demonstrate funding needs, and track mitigation activities throughout the City. (Former Objective 5.3)	Information Services Planning Department Building Department	All Hazards	High	Ongoing	Staff Time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Property Protection							
Maintain the City's Class 3 ISO Fire Insurance Rating.	City Council Fire Chief	Wildfire Hurricanes Earthquakes	High	Ongoing	Staff time, training facilities, equipment and water distribution maintenance	General Fund	Ongoing – this activity is part of the day-to-day duties of City staff. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Develop a Mitigation Administrative Plan for the Use of Hazard Mitigation Grant Funds	Finance Building Department	All	Moderate	Ongoing	Staff time	General Fund and Mitigation Grant	Ongoing. This action will be implemented as funding and staff availability allow.
Continue to Upgrade Hazard Resistance of Traffic Control Equipment	City Council and City Engineer	Hurricane Earthquake Severe Winter Storms	Moderate	Ongoing	Equipment Purchases	Mitigation Grants and Street Improvement Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Maintain the City's Class 2 Fire Insurance Rating through adequate staffing, training, equipment maintenance, facility distribution, and water supply (Former Objective 1.6)	City Council Fire Chief	Wildfire Hurricanes Earthquakes	High	Ongoing	Staff Time	General Fund	Ongoing – this activity is part of the day-to-day duties of City staff. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Continue to bury power and communication utility lines.	City Engineer and Utility Companies	Hurricane Earthquake Severe Winter Storms	Moderate	Ongoing	Equipment purchase, construction material and staff time	Utility Fees	Ongoing. The City continues to require buried powerlines in PUDs and works with other developers on a case-by -case basis to bury lines in other situations.
Purchase Additional Emergency Generators for Critical Facilities	City Engineer and Finance	All	High	Ongoing	Generator purchases and installations	General Fund and Mitigation Grants	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Encourage "Safe Room" Construction in Schools, Day Care Centers, Rest Homes, and other locations.	Building Division	Tornado	Low	Ongoing	Staff time and printing	Permit Fees	Ongoing. This action will be implemented as funding and staff availability allow.
Conduct a Study on the Benefits of Adding a Repetitive Loss Provision to the Flood Ordinance	Building Division	Flooding Hurricanes	Moderate	Ongoing	Staff time and consultant	Permit Fees and General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Encourage the Use of Seismic Retrofit Options	Building Division	Earthquake	Low	Ongoing	Staff time and printing	Permit Fees	Ongoing. This action will be implemented as funding and staff availability allow.
Protect buildings in the coastal AE-Zone from damage due to wave action on the foundation and enclosures (Former Objective 1.2)	Building Department	Flooding Hurricanes and Coastal Hazards	High	Ongoing	Staff time	Permit Fees and General Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Ensure the beach management setback regulations are applied to all new construction and redevelopment projects (Former Objective 1.9)	Public Works Planning Zoning	Flooding Hurricane and Coastal Hazards	High	Ongoing	Staff Time	General Fund	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Increase the number of City residents that maintain an active NFIP flood insurance policy by 5% by the year 2025 (currently 12,739 policies in force) (Former Objective 3.3)	Building Department	Flooding Hurricane and Coastal Hazards	High	Ongoing	Staff Time	General Fund	Ongoing. The City actively promotes the need for flood insurance and continues to work toward achieving this goal.
Reduce flood losses to buildings with enclosures. (Former Objective 1.1)	Building Department	Flooding	High	Ongoing	Staff Time	Permit Fees and General Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Natural Resource Protection							
Ensure Erosion and Sedimentation Permits are Obtained	Building Division Public Works	Flooding Hurricanes	Moderate	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Continue to Enforce Stream Dumping Regulations	Public Works	Flooding Hurricanes	Moderate	Ongoing	Staff time	General Fund	Ongoing – this is part of the day-to-day duties of the Public Works Department. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Continue to enforce setback regulations from the shorelines, streams channels and their banks.	Building Division	Coastal Erosion Hurricanes and Tropical Storms	High	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Encourage property owners to participate in the NRCS Wetlands Restoration Program	Planning Department	Flooding	Low	Ongoing	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Evaluate Construction of a Walking Trail that Incorporates Natural Areas.	Parks and Recreation Planning Department	Flooding	Low	Ongoing effort	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Ensure maintenance of the beach nourishment project in accordance with the City's agreement with the USACE (Former Objective 1.7)	Public Works	Coastal Erosion	High	Ongoing effort	Staff Time	General Fund	Ongoing – this is part of the day-to-day duties of the Public Works Department. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Preserve the natural and beneficial functions of the city's floodplain, wetlands, beaches and dunes through continued support of natural resource protection policies and by discouraging growth in environmentally sensitive areas (Former Objective 4.1)	Planning Department	Coastal Erosion Flooding Hurricane and Coastal Hazards	Low	Ongoing	Staff Time	General Fund	Ongoing – this is part of the day-to-day duties of the Planning Department. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Structural Projects							
Continue to Maintain the City's Drainage System	Public Works	Flooding	High	Ongoing	Staff time and equipment maintenance	General Fund	Ongoing – this is part of the day-to-day duties of the Public Works Department. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Complete the Beach Renourishment Maintenance Project	Public Works	Coastal Erosion Hurricanes and Tropical Storms	Very High	2019	Construction and staff time	CORPS and City Beach Renourishment Fund	Completed. The most recent Beach Renourishment Maintenance Project was completed in 2019.
Continue to Enforce the City's Stormwater Regulations	Public Works	Flooding	High	Ongoing	Staff time	Stormwater Fund	Ongoing – this is part of the day-to-day duties of the Public Works Department. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Complete Hillside Drainage Improvements	Public Works	Flooding	High	Completed	Construction and staff time	Stormwater Fund and Mitigation Grants	This drainage improvement project has been completed.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Complete the Main Street Drainage Improvements	Public Works	Flooding	High	Completed	Construction and staff time	Stormwater Fund and Mitigation Grants	This drainage improvement project has been completed.
Complete the 18th Avenue North Outfall Project	Public Works	Flooding	High	2023	Construction and staff time	Stormwater Fund	New action for the 2021 Plan Update
¾ Drainage Improvement Project	Public Works	Flooding	High	Start Summer 2021	Construction and staff time	Stormwater Fund	New action for the 2021 Plan Update
Document damage from inadequate drainage and develop a capital improvements program to eliminate problem sites.	Public Works	Flooding	High	Ongoing	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Ensure new and substantially improved buildings meet the applicable earthquake provision of the building code (Former Objective 1.4)	Building Department	Earthquake	Low	Ongoing	Staff Time	Permit Fees	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Reduce property damage from stormwater runoff (Former Objective 1.8)	Public Works Building Department	Flooding	High	Ongoing Effort	Staff Time	Stormwater Fees	Ongoing. This action will be implemented as funding and staff availability allow.
Decrease the number of FEMA-identified "repetitive loss properties" located in North Myrtle Beach by 20% by the year 2026 (Former Objective 2.2)	Building Department	Flooding Hurricane and Coastal Hazards	Moderate	Ongoing Efforts	Staff Time	General Fund	The City is actively working to reduce the number of repetitive loss properties in the City.
Ensure that all vital/critical facilities are protected from the effects of natural hazards to the maximum extent possible (Former Objective 2.3)	Public Works	All	Moderate	Ongoing	Equipment Purchases	Mitigation Grants and Street Improvement Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Develop a schedule for placing existing above ground utilities underground where feasible, particularly along evacuation routes, major arteries, and highly congested areas (Former Objective 2.6)	Public Works and City Council	All	High	Ongoing	Equipment purchase, construction material and staff time	Utility Fees	Ongoing. This action will be implemented as funding and staff availability allow.
Emergency Services							
Update Building Division SOP for Disaster Recovery Inspection Policies and Include ICC Provisions	Building Division	All	Moderate	2025	Staff time and printing	Permit Fees	Ongoing. This action will be implemented as funding and staff availability allow.
Adopt an updated Emergency Operations Plan that Includes Hazard Mitigation Actions and Identifies Resources Needed to Accomplish Response and Mitigation Tasks	Emergency Management Coordinator City Council and City Manager	All	High	2021	Staff time and printing	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Conduct an Annual Exercise of the Emergency Operations Plan	City Manager Fire Chief	All	High	Ongoing – Annually before Hurricane Season	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Complete tasks needed to maintain designation as a StormReady and TsunamiReady Community.	Fire Chief	All	Low	Complete annual meetings and training.	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Ensure that current emergency services are adequate to protect public health and safety (Former Objective 2.4)	All Departments	All	High	Ongoing	Staff Time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Continue to develop and streamline damage assessment following any natural disaster	Building Department Support Services	All	High	Ongoing	Staff Time	General Fund and Permit Fees	New Action for 2021 update

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Public Information							
Provide Flood Map and Erosion Information to the Public	Building Division	Flooding Coastal Erosion	High	Ongoing	Staff time	Permit Fees	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Send Mitigation Brochures to the Public	Building Division	Flooding	High	Annually	Staff time and printing	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Prepare News Releases on Property Protection Measures and Progress made in Implementing the Mitigation Plan	Public Information Officer	All	Moderate	Quarterly	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Update the Public Outreach Strategy	Public Information Officer Building Department Planning Department	All	Moderate	Ongoing	Staff time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Update Public Information Materials to Include Methods to Protect Buildings from High Winds, Shaking and Wildfire.	Building Division	Flooding Hurricanes Wildfire Earthquake	Moderate	Evaluate every year	Staff time and printing	General Fund	Ongoing. This action will be implemented as funding and staff availability allow.
Continue to provide mitigation materials in the library.	Building Division	Flooding	Low	Update Annually	Staff time and printing	General Fund	Ongoing – this is part of the day-to-day duties of the Building Division. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Continue to provide mitigation materials, flood information on the City's website	Building Division Planning Department Public Information Officer	Flooding Hurricane	Moderate	Update Annually	Staff Time	General Fund	New action for 2021 update
Continue to require the 100-year flood contour to be shown on the final subdivision plat.	Planning Department	Flooding Hurricanes	High	Ongoing	Staff time	General Fund	Ongoing – this is part of the day-to-day duties of the Planning Department. As such, this is not a mitigation action that the City seeks to implement, but rather a capability of the City that demonstrates mitigation capacity. The action will be deleted from future plan updates.
Increase the level of knowledge and awareness for the City's residents on the hazards that routinely threaten the area. (Former Objective 3.1)	Building Division Building Department	All	Moderate	Ongoing	Staff Time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow

Action Item	Responsible Office	Hazards Addressed	Priority	Deadlines	Budget	Funding Sources	2021 Implementation Status
Educate property owners on the affordable, individual mitigation and preparedness measures that can be taken before the next hazard event (Former Objective 3.2)	Building Division	All	Moderate	Ongoing	Staff Time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow
Work on providing Elevation Certification on the City's Flood Website	Building Department Planning Department	Flooding	Moderate	Ongoing	Staff Time	General Fund	New action for the 2021 update
Working with other organizations, develop educational materials to educate residents about hazard resistant construction techniques and actions they can take to protect existing buildings from hazard-related damages (Former Objective 5.1)	Building Division	All	High	Ongoing	Staff Time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow
Support demonstration projects where residents may learn how to protect buildings from hazards (Former Objective 5.2)	Building Division	All	Moderate	Ongoing	Staff Time	General Fund	Ongoing. This action will be implemented as funding and staff availability allow

Section 9: Plan Maintenance

No plan, however perfect in concept, will be perfect in execution. Revisions to the hazard mitigation plan are necessary to correct flaws that are discovered in the plan, document changes in hazard risk and vulnerability and to capture progress made in advancing the City's mitigation strategy. Additionally, FEMA requires that hazard mitigation plans be updated and re-adopted every five years. There are always some contingencies that cannot be foreseen, or events which cannot be predicted. Revision incorporates those changes necessary to better fit the plan to real-life situations. Periodic revision of mitigation plans will also help to ensure that local mitigation efforts include the latest and most effective mitigation techniques. Periodic revision of the mitigation plan will also keep it in compliance with state and local statutes and regulations.

Keeping the plan current will be a shared responsibility among elected officials, City staff and the Hazard Mitigation Committee. The responsibilities of the Hazard Mitigation Committee are described in Chapter 2.

9.1 Integration with Other Planning Mechanisms

Since the adoption of the previous plan in 2015 and since each prior version of the plan, the City has worked to integrate the hazard mitigation plan into other planning mechanisms where applicable/feasible. Examples of how this integration has occurred have been documented in the Implementation Status discussion provided for each of the mitigation actions found in Section 8. Specific examples of how integration has occurred include:

- Integrating the mitigation plan into reviews and updates of the floodplain management ordinance
- Integrating the mitigation plan into reviews and updates of City's emergency operations plan
- Integrating the mitigation plan into review and updates of building codes
- Integrating the mitigation plan into the capital improvements plan through identification of mitigation actions that require local funding.

Opportunities to further integrate the requirements of this Plan into other local planning mechanisms shall continue to be identified through future meetings of the Mitigation Planning Committee, and the annual review process described herein. Although it is recognized that there are many possible benefits to integrating components of this Plan into other local planning mechanisms, the development and maintenance of this stand-alone Hazard Mitigation Plan is deemed by the City's Mitigation Planning Committee to be the most effective and appropriate method to implement local hazard mitigation actions at this time.

9.2 Monitoring and Evaluation of Mitigation Actions

Monitoring and evaluation of mitigation actions involve the ongoing processes of compiling information on the outcomes that result from implementation of the hazard mitigation strategies contained in the plan. In other words, monitoring and evaluation measure how successfully the City is implementing each mitigation strategy.

Monitoring and evaluation also provide the City with an opportunity to make necessary

revisions as local conditions change. Changes in development, technology or the capability of the City to implement mitigation actions may necessitate changes to the plan itself.

The primary issue that monitoring and evaluation should address is whether the City's vulnerability has decreased as a result of the plan. Where vulnerability has decreased, the City should determine why and consider implementing successful mitigation measures in other locations.

If vulnerability has increased, or remained constant, the City should identify whether additional measures might be more successful, or whether revisions should be made to existing measures.

Other issues that should be assessed include:

- The adequacy of the City's resources to implement the mitigation strategies.
- Any redundancy among strategies that can be eliminated to free-up resources.
- Whether adequate funding is available.
- Any technical, legal or coordination problems associated with implementation.
- Whether mitigation actions are being implemented according to schedule.

The plan evaluation effort for North Myrtle Beach will be led by the Mitigation Planning Committee, which has been requested by the City Council to prepare and present an annual evaluation report on the *Mitigation Plan* by August 15 of each year. The report will cover the following points:

- A review of the original plan.
- A review of any floods, hurricanes or other disasters that occurred during the previous calendar year.
- A review of the action items in the original plan, including how much was accomplished during the previous year.
- A discussion of why any action items were not completed or why implementation is behind schedule.
- Recommendations for new projects or revised action items. The following table will help the committee and the City as they track and evaluate mitigation actions identified in the Hazard Mitigation Plan.

Five (5) Year Plan Review

The Plan will be thoroughly reviewed by the Mitigation Planning Committee every five years to determine whether there have been any significant changes in the City that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure to hazards, an increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect the necessary content of the Plan.

The plan review provides City officials with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the

opportunity to address mitigation actions that may not have been successfully implemented as assigned. City staff will reconvene the Mitigation Planning Committee which will conduct the five-year review.

During the five-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals address current and expected conditions?
- 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 City departments participate in the plan implementation process as assigned?

Following the five-year review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and plan amendment process outlined herein. Upon completion of the review and update/amendment process, the City of North Myrtle Beach Hazard Mitigation Plan will be submitted to the State Hazard Mitigation Officer at the South Carolina Emergency Management Division (SCEMD) for final review and approval in coordination with the Federal Emergency Management Agency (FEMA).

Disaster Declaration

Following a disaster declaration, the City will revise the Hazard Mitigation Plan as necessary to reflect lessons learned, or to address specific issues and circumstances arising from the event. It will be the responsibility City staff to coordinate the reconvening of the Mitigation Planning Committee and ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

Reporting Procedures

The results of the five-year review will be summarized by the Mitigation Planning Committee in a report that will include an evaluation of the effectiveness of the Plan and any required or recommended changes or amendments. The report will also include an evaluation of implementation progress for each of the proposed mitigation actions, identifying reasons for delays or obstacles to their completion along with recommended strategies to overcome them.

Plan Amendment Process

Upon the initiation of the amendment process, City staff will forward information on the proposed change(s) to all interested parties including, but not limited to, all directly affected City departments, residents, and businesses. Information will also be forwarded to the South Carolina Emergency Management Division. This information will be disseminated in order to seek input on the proposed amendment(s) for no less than a 45-day review and comment period.

At the end of the 45-day review and comment period, the proposed amendment(s) and all

comments will be forwarded to the Mitigation Planning Committee for final consideration. The Planning Committee will review the proposed amendment along with the comments received from other parties, and if acceptable, the committee will submit a recommendation for the approval and adoption of changes to the Plan.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered by the Mitigation Planning Committee:

- There are errors, inaccuracies or omissions made in the identification of issues or needs in the Plan,
- New issues or needs have been identified which are not adequately addressed in the Plan, and
- There has been a change in information, data, or assumptions from those on which the Plan is based.

Upon receiving the recommendation from the Mitigation Planning Committee and prior to adoption of the Plan, the City will hold a public hearing, if deemed necessary. City Council will review the recommendation from the Mitigation Planning Committee (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the City Council will take one of the following actions:

- Adopt the proposed amendments as presented
- Adopt the proposed amendments with modifications
- Refer the amendments request back to the Mitigation Planning Committee for further revision, or
- Defer the amendment request back to the Mitigation Planning Committee for further consideration and/or additional hearings.

9.3 Continued Public Involvement

Public participation is an integral component to the mitigation planning process and will continue to be essential as this Plan evolves over time. Significant changes or amendments to the Plan shall require a public hearing prior to any adoption procedures.

Other efforts to involve the public in the maintenance, evaluation and revision process will be made as necessary. These efforts may include:

- Advertising meetings of the City's Hazard Mitigation Planning Committee in local newspapers, public bulletin boards and/or City office buildings
- Designating willing and voluntary citizens and private sector representatives as official members of the Hazard Mitigation Planning Committee
- Utilizing local media to update the public on any maintenance and/or periodic review activities taking place
- Utilizing the City's website to advertise any maintenance and/or periodic review activities taking place, and
- Keeping copies of the Plan in public libraries.

9.4 Evaluation of Previous Monitoring, Evaluation and Update Process

Over the past five years, the City has been implementing, monitoring and evaluating the mitigation action plan. Progress made in implementing actions has been documented in Section 8: Mitigation Action Plan where each action contains a narrative about the implementation status of the action as of 2021. That said, the City did waiver slightly from the monitoring and evaluation process defined in the original version of the plan, but still made significant process in implementing their mitigation action plans. During the 2021 update of this plan, the Hazard Mitigation Planning Committee determined that the procedures for the upcoming five-year monitoring and evaluation process will be revised as defined above, and will be re-evaluated during the next plan update process.

The five-year comprehensive update process began as early as 2018 when the City made the decision to set aside funding for the Hazard Mitigation Plan update. To facilitate this effort, the City hired ESP Associates. Representatives from ESP Associates first reached out to City staff in January 2020 to initiate the plan update process. More details about the plan update process are provided in Section 2, Planning Process.

For the next update of this plan, the City's Planning Department will continue take the lead on organizing and initiating the 5-year update of the plan.